



# **Introduction to SNOMED Clinical Terms**

## **And Its Use With HL7**

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## About me:

- **Kaiser Permanente, Department of Internal Medicine, National Clinical Information Systems**
- **HL7 Board of Directors; Co-chair Structured Documents committee; Co-editor HL7 Clinical Document Architecture**
- **SNOMED Editorial Board**



## OUTLINE

- SNOMED Overview
- Using SNOMED in HL7
- SNOMED Interesting Topics



## OUTLINE

- **SNOMED Overview**
  - ◆ **Why SNOMED?**
  - ◆ High-level overview
- Using SNOMED in HL7
- SNOMED Interesting Topics



## Why was SNOMED CT developed?

- Users identified critical needs unmet
- Existing terminologies inadequate
  - ◆ lack of content coverage at the desired level of generality / specificity
  - ◆ lack of single consistent meaning for concepts & their relationships
  - ◆ no formal concept representation principles



## What is the need?

- Automation of systems that deal with health information requires clinical data that:
  - ◆ is **recorded** at the appropriate level of detail
    - not forced to be either too general or too specific
  - ◆ is **consistent** over time and across boundaries
  - ◆ can be **transmitted** without loss of meaning
  - ◆ can be **aggregated** at more general levels, and along multiple different perspectives
  - ◆ can be **interpreted** by automated systems



## Which key features drove US and UK decisions?

- **Content coverage** – unsurpassed
- **Backwards compatibility** – with widely used coding systems
- **Adaptability**
  - ◆ Spans different clinical disciplines and specialties
  - ◆ Usable with different levels of technical sophistication
- **Usable and useful**
  - ◆ User-driven development and enhancement
  - ◆ Appropriate interface properties
- **Reliable comparable pre- & post-coordination**
  - ◆ Effective reference terminology features
- **Localizable**
  - ◆ Subsets and extensions
  - ◆ Languages and dialects
- **Comparable**
  - ◆ Mapping tables to statistical classifications
- **Implementable**
  - ◆ Proven implementation guidance



## OUTLINE

- **SNOMED Overview**
  - ◆ Why SNOMED?
  - ◆ **High-level overview**
    - **SNOMED CT Hierarchies**
    - **SNOMED CT Conceptual Model**
- Using SNOMED in HL7
- SNOMED Interesting Topics

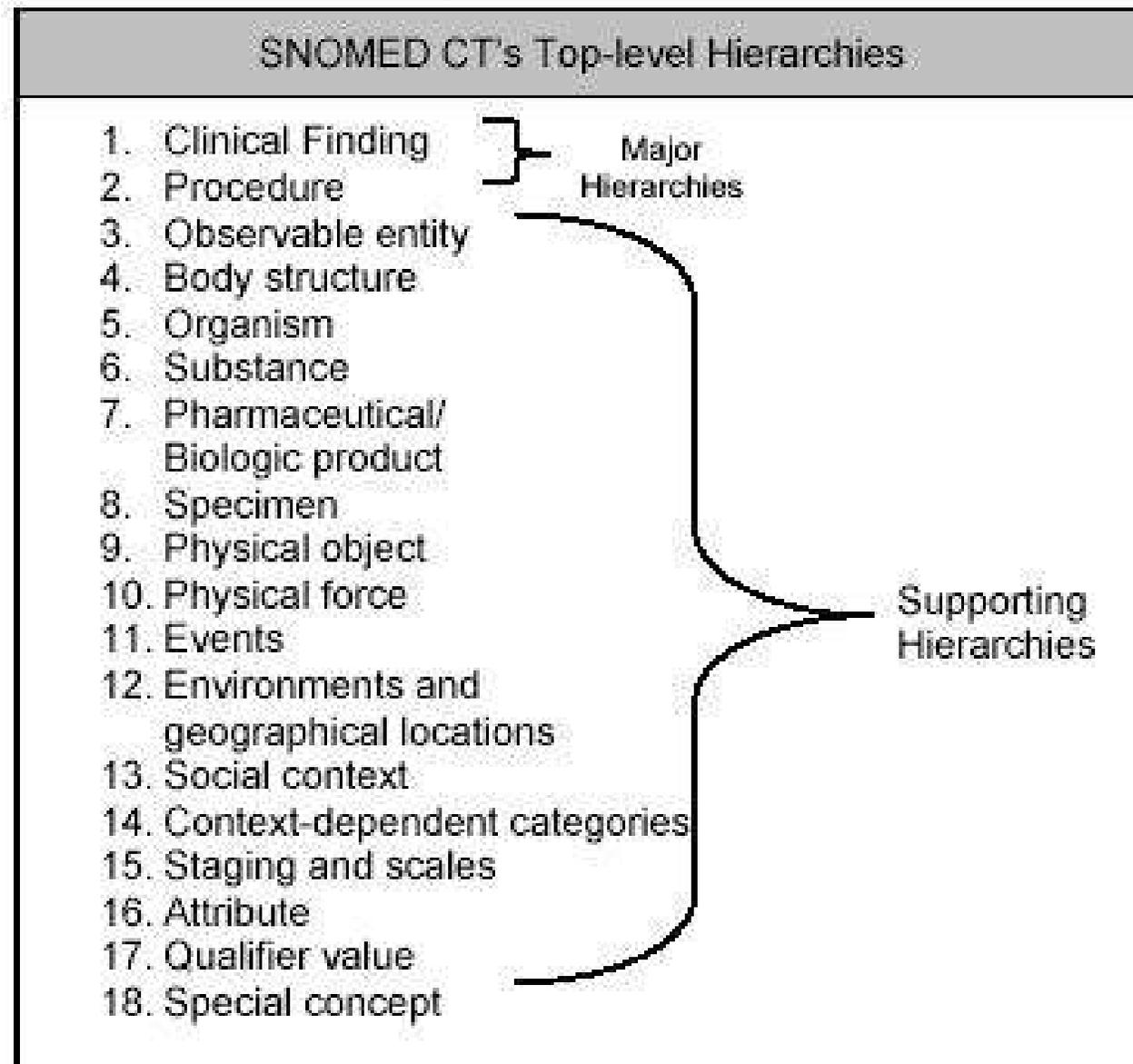


## What does SNOMED CT contain?

- 325,000 concepts
- 800,000 terms in English
  - ◆ 350,000 Spanish
  - ◆ 150,000 (rising) German
- 1,200,000 relationships



# Types of Concepts in SNOMED CT



## Clinical Findings

- The Clinical finding hierarchy contains Findings and Disorders.
- Concepts in this hierarchy represent the result of a clinical observation, assessment or judgment.
- These concepts are cross-mapped to ICD9CM codes.
- Examples:
  - ◆ Appendicitis
  - ◆ Pain
  - ◆ Dizziness
  - ◆ Normal deep tendon reflexes
  - ◆ Decreased serum sodium
  - ◆ Gold poisoning
  - ◆ Prolonged PR interval (ECG)



## Procedures

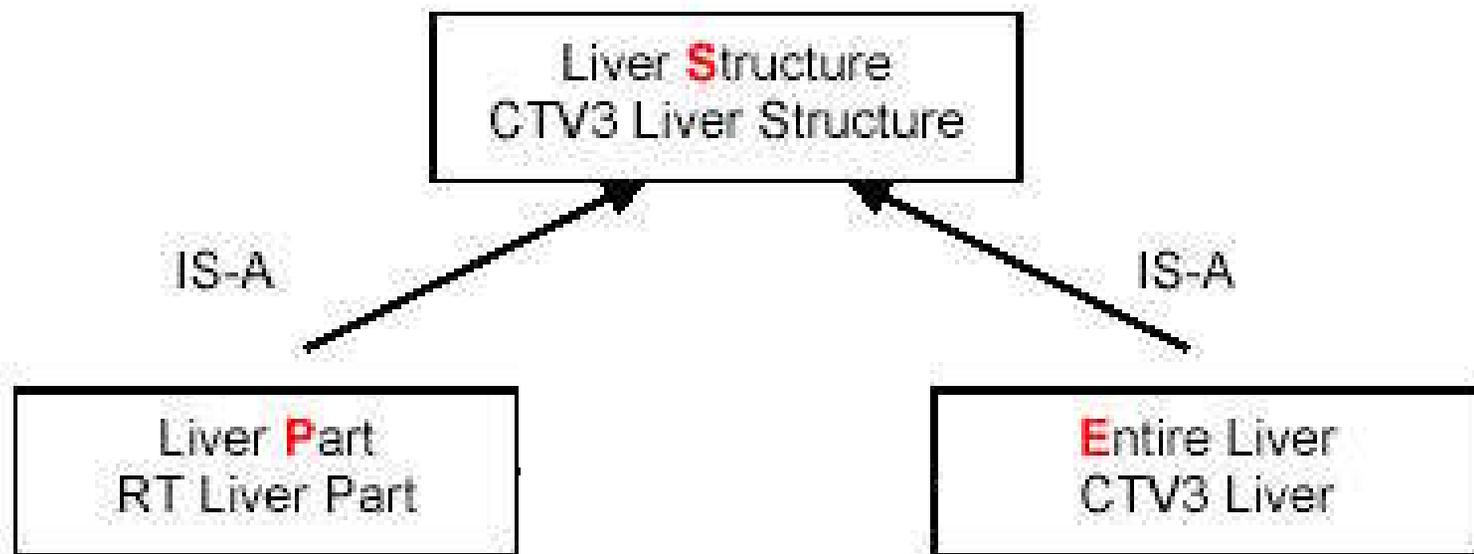
- Procedures are concepts that represent the purposeful activities performed in the provision of health care. This hierarchy includes a broad variety of activities, such as invasive procedures (*Excision of intracranial artery*), administration of medicines (*Pertussis vaccination*), imaging procedures (*Radiography of chest*), education procedures (*Instruction in use of cane*), and administrative procedures (*Medical records transfer*).
- Examples:
  - ◆ Patient registration
  - ◆ Physical examination
  - ◆ Change of dressing
  - ◆ Fitting of splint
  - ◆ Intravenous steroid injection
  - ◆ Epistaxis control with cautery
  - ◆ Appendectomy
  - ◆ Percutaneous transluminal coronary angioplasty
  - ◆ HIV counseling

## Observable entities

- Generally, concepts in this hierarchy can be thought of as representing a question or procedure which, when combined with a result, constitute a finding. For instance, *Left ventricular enddiastolic pressure (observable entity)* could be interpreted as the question “What is the left ventricular end diastolic pressure?” or “What is the measured left ventricular end-diastolic pressure?” However, when *Left ventricular end-diastolic pressure (observable entity)* is given a value it represents a finding. For example, *Increased left ventricular end-diastolic pressure* would be a finding because it is qualified by the value *Increased*
- Examples:
  - ◆ Head circumference
  - ◆ Contents of ear canal
  - ◆ Ability to hear whisper
  - ◆ PR interval
  - ◆ Heart rate
  - ◆ Blood pressure
  - ◆ Temperature
  - ◆ Synovial fluid viscosity

## Body structures

- Includes normal as well as abnormal body structures (morphologic abnormalities).
- The SNOMED CT anatomy hierarchy differentiates an “entire” topographic concept from a “part of” a topographic concept.



## Organisms

- Organism concepts represent organisms of etiologic significance in human and animal diseases. They are important for public health reporting of the causes of notifiable conditions and for use in evidence-based infectious disease protocols in clinical decision support systems.
- They include: Bacteria, fungi, viruses, parasites, prions, animals, plants



## Substances

- The substance hierarchy can be used for recording active chemical constituents of drug products, food and chemical allergens, adverse reactions, toxicity or poisoning information, and physicians and nursing orders.
- Concepts from this hierarchy represent general “substances” and chemical constituents of products in SNOMED CT. In addition, concepts from this hierarchy are linked to disorder and procedure hierarchies through the “causative agent”, “direct substance” and “component” attributes, respectively.
- Examples:
  - ◆ Insulin (substance)
  - ◆ Methane (substance)
  - ◆ Chromatin (substance)
  - ◆ Acetaminophen (substance)

## Pharmaceutical / biologic products

- The pharmaceutical/biologic product hierarchy is separate from the Substance hierarchy. These products represent a root hierarchy in order to clearly distinguish drug products (products) from the chemical constituents (substances) of drug products.
- Generic clinical drugs (name, strength, dose form) are maintained within SNOMED
- UK-specific manufacturing and proprietary brand names are maintained in a UK-specific extension
- There is also a US-specific extension, based on FDA databases, currently maintained by SNOMED



## Specimens

- The Specimen hierarchy contains concepts representing entities that are obtained for examination or analysis, usually from a patient.
- Specimen concepts are defined in terms of the normal or abnormal body structure from which they are obtained, the procedure used to collect the specimen, the source from which it was collected, and the substance of which it is comprised.
- Examples:
  - ◆ Nail specimen
  - ◆ Pus specimen
  - ◆ Clean catch urine



## Physical objects

- Concepts in this hierarchy include natural and man-made objects. Concepts in this hierarchy are of medical interest especially in injuries.
- Examples:
  - ◆ Vehicle
  - ◆ Prosthesis
  - ◆ Artificial organs
  - ◆ Biomedical device
  - ◆ Robot



## Physical forces

- This hierarchy includes *Motion, Friction, Gravity, Electricity, Magnetism, Sound, Radiation, Thermal forces (heat and cold), Humidity, Air pressure*, and other categories mainly directed at categorizing mechanisms of injury.
- Examples:
  - ◆ Fire
  - ◆ Gravity



## Events

- *Events are concepts that represent occurrences that result in injury (accidents, falls, etc.), and exclude procedures and interventions.*
- Examples:
  - ◆ Flood
  - ◆ Motor vehicle accident



## Environments and geographical locations

- This hierarchy includes types of environments as well as named locations, such as countries, states, and regions.
- Examples:
  - ◆ Cameroon
  - ◆ California
  - ◆ Taipei, Taiwan
  - ◆ Treatment room
  - ◆ Cancer hospital



## Social contexts

- This hierarchy contains social conditions and circumstances significant to healthcare. Content includes: family status, economic status, ethnic and religious heritage, life style, and occupations
- Examples:
  - ◆ *Economic status (social concept)*
  - ◆ *African American (ethnic group)*
  - ◆ *Clerical supervisor (occupation)*
  - ◆ *Caregiver (person)*
  - ◆ *Judaism (religion/philosophy)*
  - ◆ *Criminal lifestyle (life style)*

## Context-dependent categories

- At times, in order to represent information in a patient medical record completely, it is necessary to attach additional information to a concept. When this information fundamentally changes the concept meaning, it is known as context. This hierarchy contains concepts that carry context embedded within in them.
- Examples:
  - ◆ Family history of myocardial infarction
  - ◆ No family history of stroke
  - ◆ Nasal discharge absent



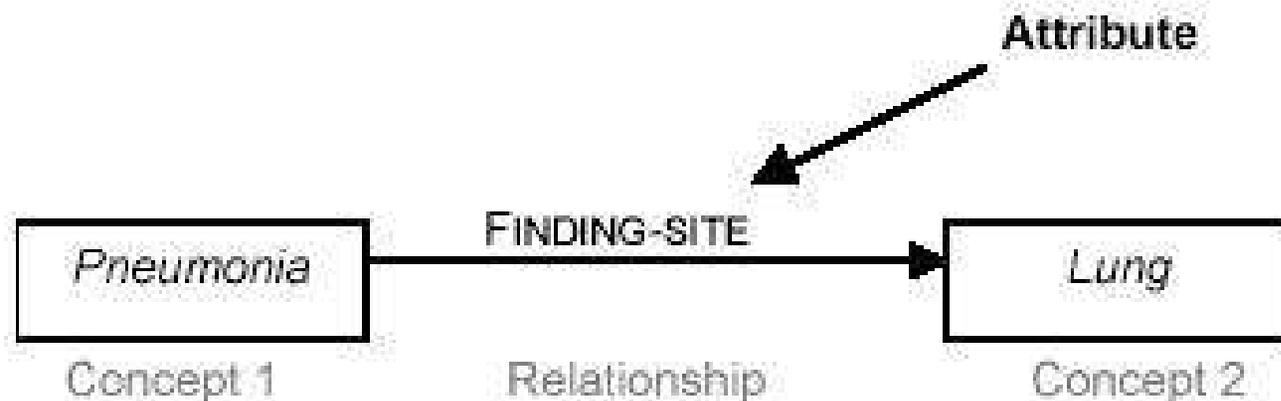
## Staging and scales

- In general, this hierarchy contains concepts naming assessment scales and tumor staging systems.
- The sub-hierarchy *Assessment scales (assessment scale)* contains concepts such as *Glasgow coma scale (assessment scale)* and *Stanford Binet intelligence scale (assessment scale)*.
- The sub-hierarchy *Tumor staging (tumor staging)* contains such concepts as *FIGO staging system of gynecological malignancy (tumor staging)* and *Dukes staging system (tumor staging)*.

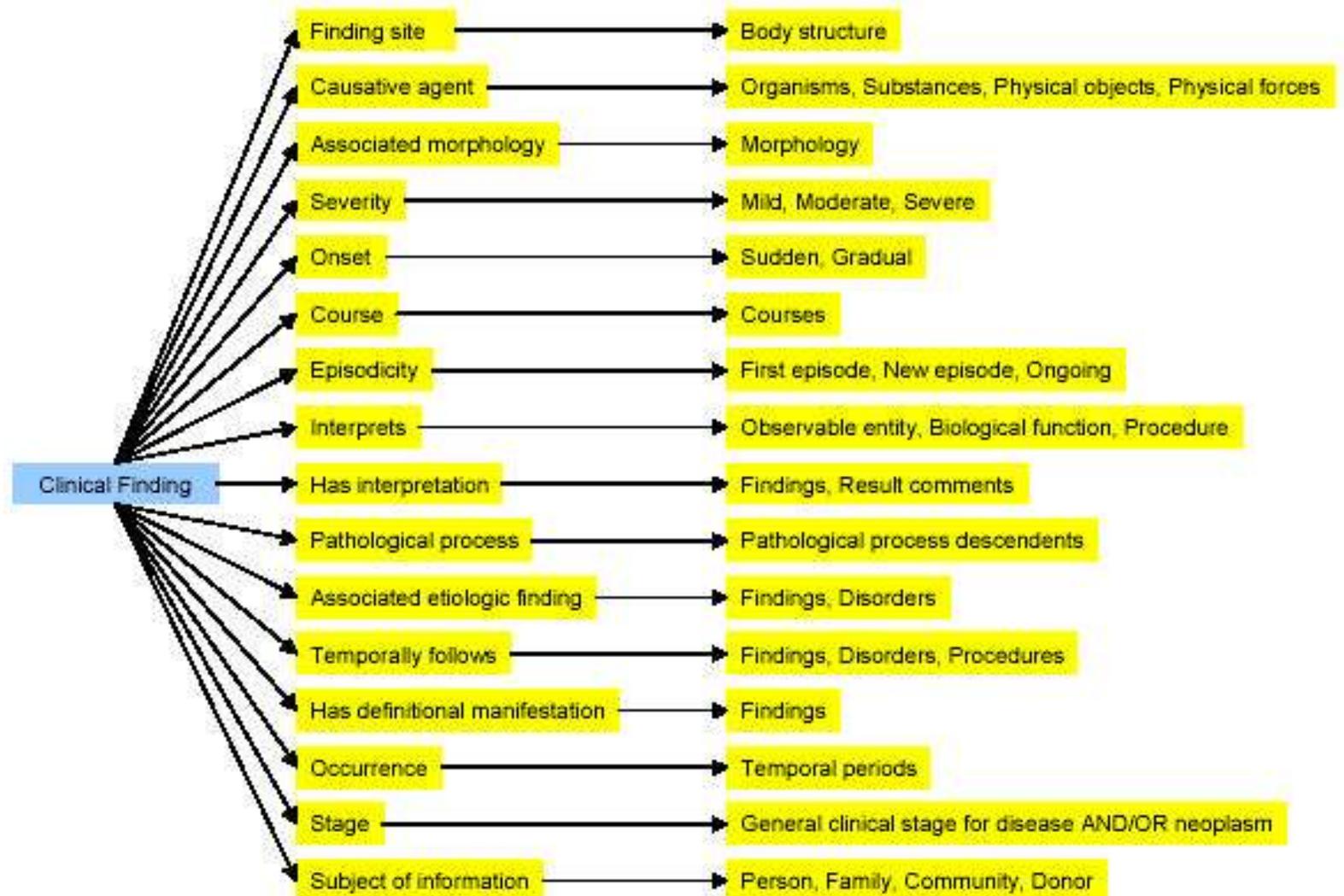


## Attributes

- *Attributes* are concepts that are used to relate two different SNOMED CT concepts. These attribute relationships are usually definitional characteristics of concepts. They can also be used to add qualifying (non-defining) relationships to concepts. Attributes are also known as “roles,” and attribute relationships are also known as “role relationships.”

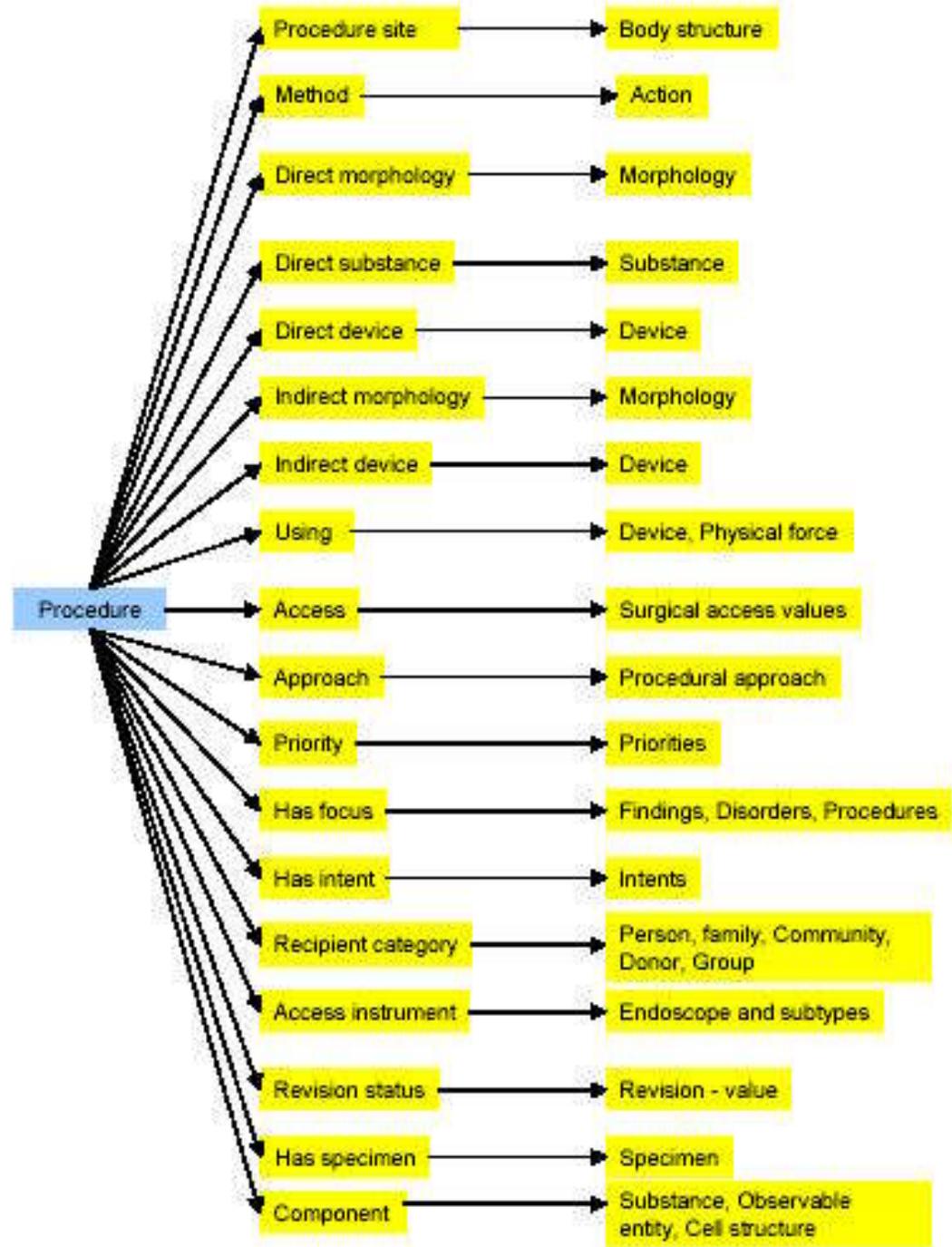


# Clinical Finding attributes

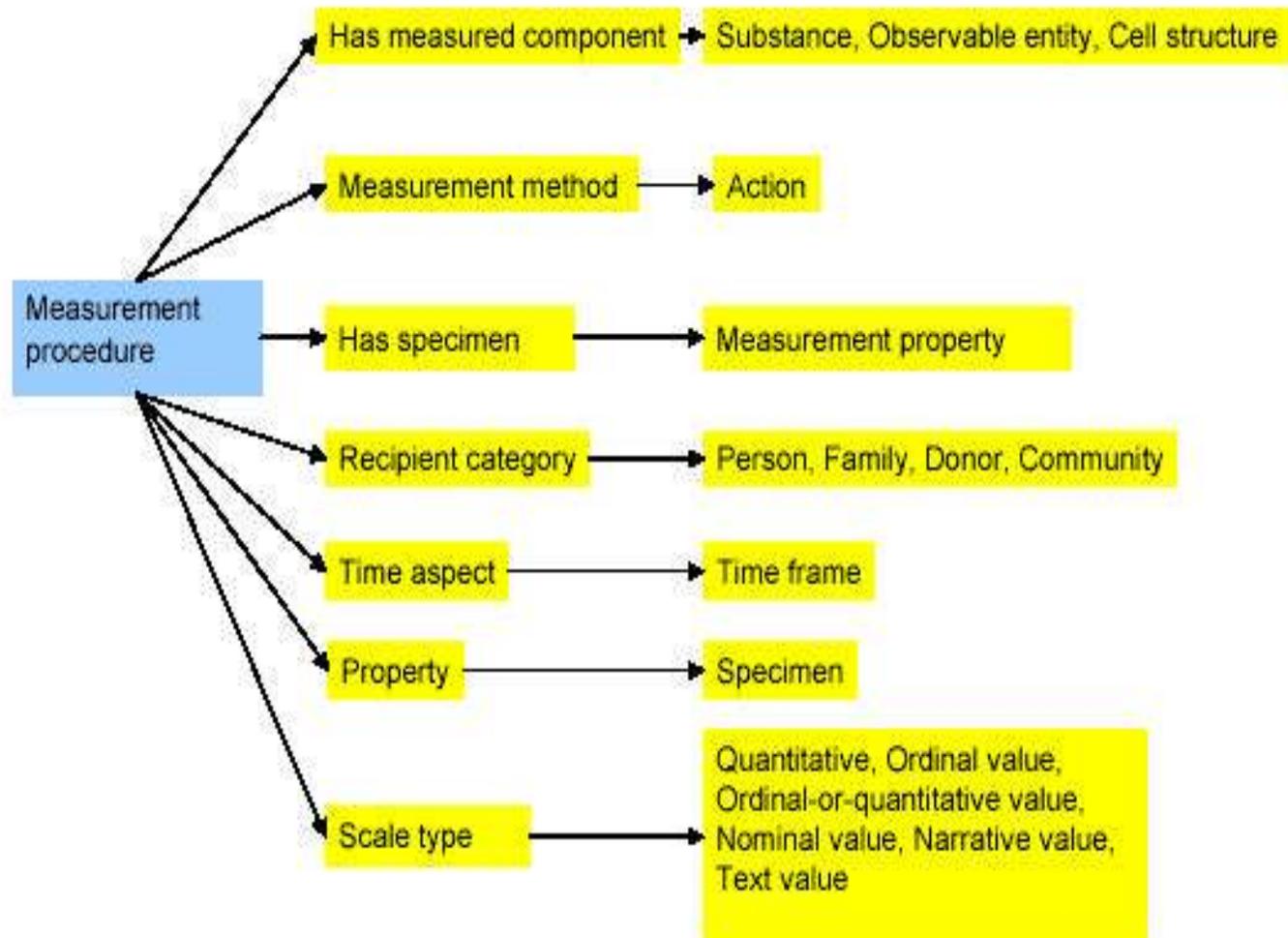




# Procedure attributes



# Measurement Procedure attributes



# Pharmaceutical / biologic product attributes



## Qualifier values

- The *Qualifier value* hierarchy contains values for SNOMED CT attributes. The values of most attributes come from other hierarchies. For example, the attribute *Finding-site* can have the value *Lung structure*. This value concept is from the *Body structure* hierarchy. In other cases, values that are not contained elsewhere in SNOMED CT are needed for attributes. These concepts are contained in the *Qualifier value* hierarchy.
- Examples:
  - ◆ Bilateral
  - ◆ Open
  - ◆ Reduced
  - ◆ Removal action



## Special concepts

- The Special concept hierarchy has three sub hierarchies containing concepts which have been set aside from the logical hierarchy of semantic subtypes. These are:
  - ◆ Inactive concept – The supertype ancestor of all Inactive Concepts.
  - ◆ Navigation concept – The supertype parent of all Navigation Concepts.
  - ◆ Namespace concept – The supertype parent of all Namespace Concepts.



## SNOMED CT Concepts are modeled using

- Hierarchies
  - ◆ Each “child” must be a subtype of its “parent”
  - ◆ A concept may have multiple parents
- Defining relationships
  - ◆ Using attributes, concepts may be linked to each other
  - ◆ Only relationships that are *necessarily true* are included
    - *Appendicitis : site = appendix* ✓ OK  
All appendicitis has location in the appendix.
    - *SLE : manifestation = anemia* ✗ no  
Only some people with SLE have anemia.

## The Principles behind SNOMED CT structure

- SNOMED is concept based
  - ◆ Each concept represents a unit of meaning
  - ◆ Each concept has one or more human language terms that can be used to describe the concept
  - ◆ Every concept has inter-relationships with other concepts that provide logical computer readable definitions. These include hierarchical relationships and clinical attributes.



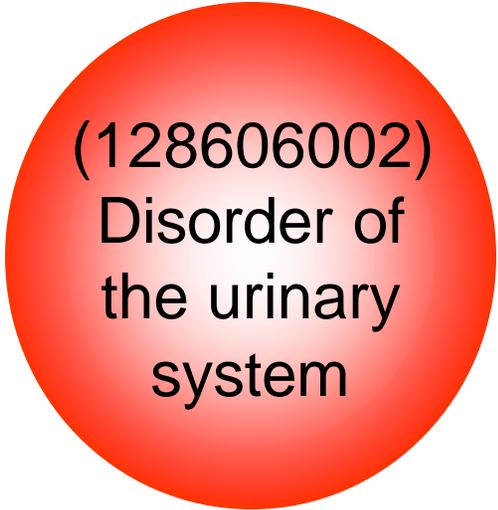
## The Principles behind the SNOMED CT Structure

- Hierarchical relationships



(90708001)  
Kidney disease

Is a



(128606002)  
Disorder of  
the urinary  
system



## Relationships Allow Multiple Hierarchies

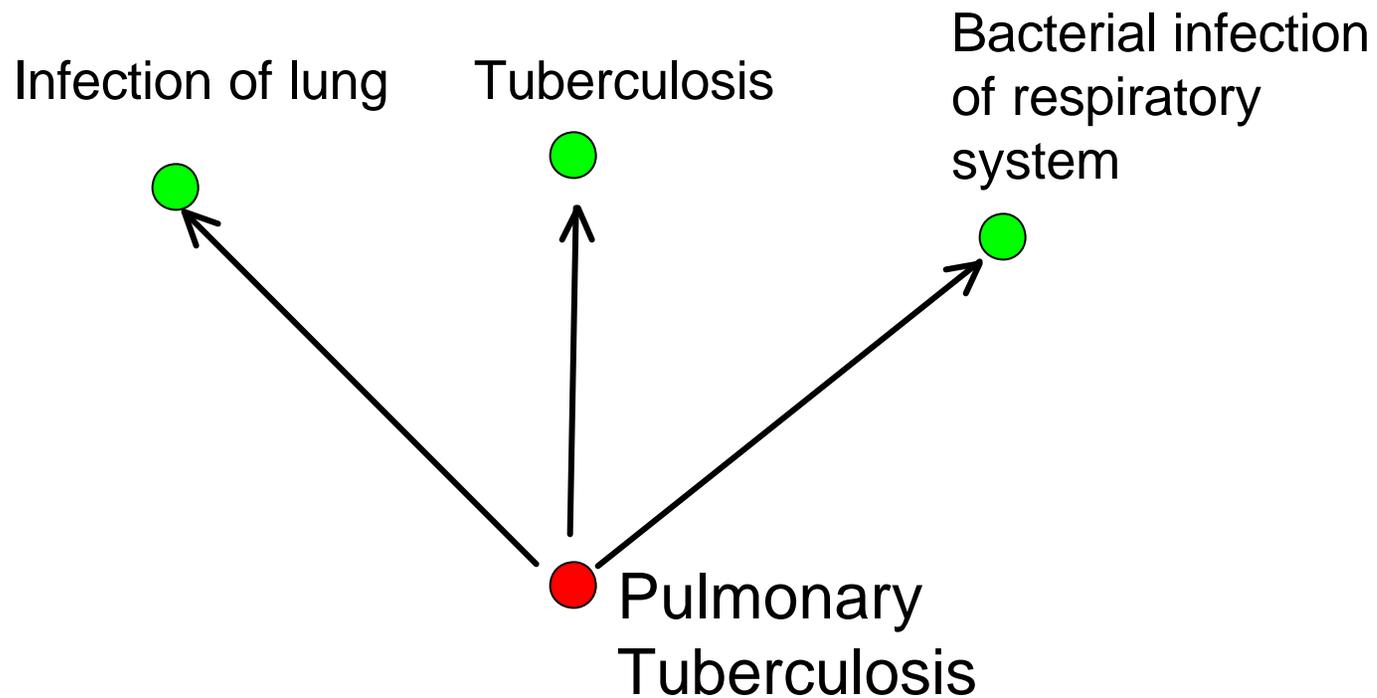
- A terminology that represents hierarchical relationships through identifiers can only have a single hierarchy. E.g. consider “lung diseases” in ICD-9-CM. They are scattered:

ICD-9-CM Code	ICD Description
011	Pulmonary tuberculosis
160	Malignant Neoplasm of the trachea, bronchus and lung
162.3	Malignant neoplasm of the upper lobe bronchus or lung
480	Other bacterial pneumonia
482.3	Pneumonia due to streptococcus



## Multiple Hierarchies

- SNOMED CT represents hierarchies in a relationships table, allowing multiple consistent views of the data

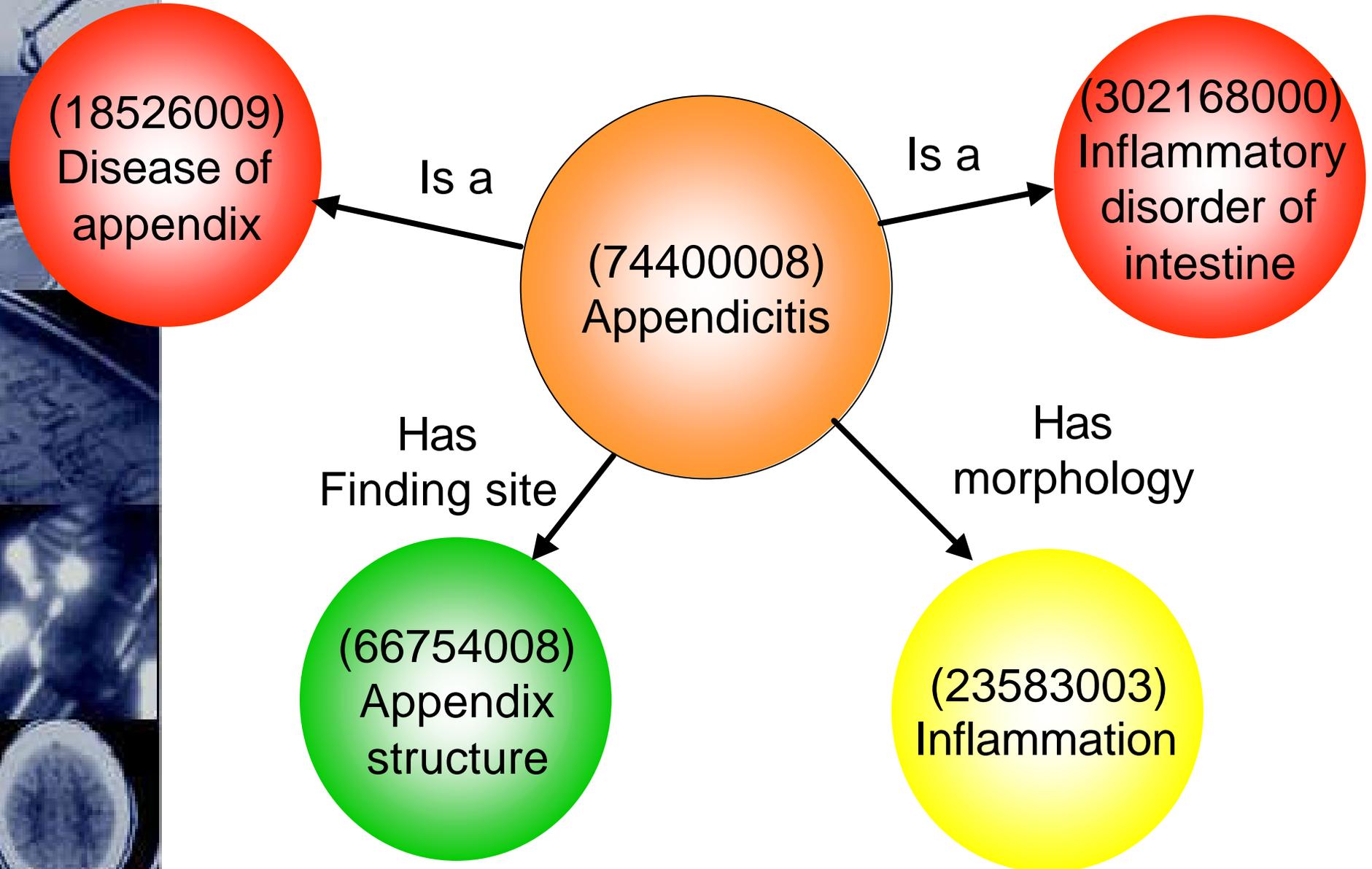


## Semantic Relationships

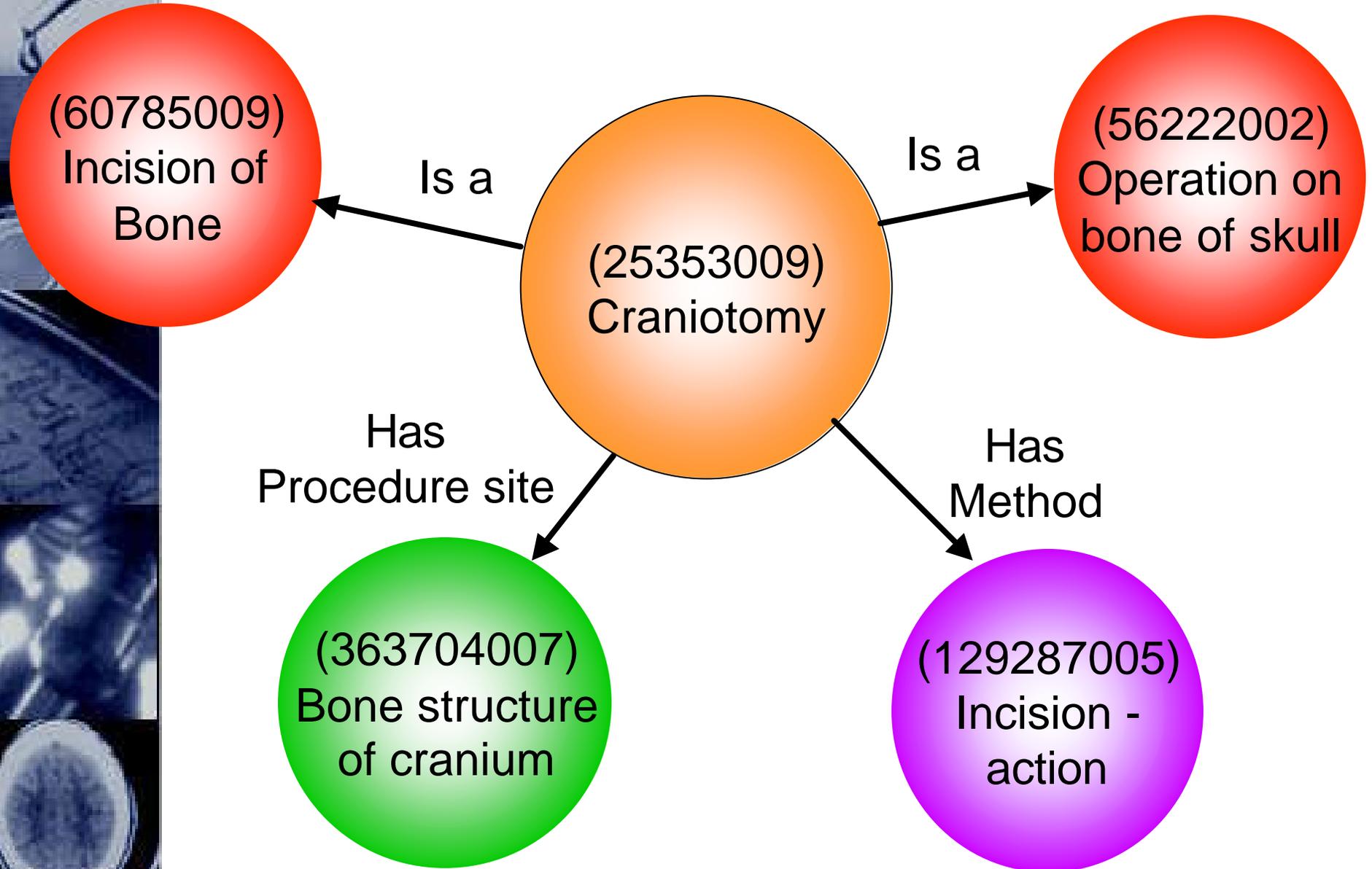
- SNOMED CT contains relationships that link concepts to form logical computer readable definitions.
- Logical definitions allow data to be recorded in a flexible way, whilst retaining the ability to analyze it in a consistent fashion.



# Semantic Definition



# Semantic Definition



## OUTLINE

- SNOMED Overview
- **Using SNOMED in HL7**
  - ◆ Overview
  - ◆ Terminology Model :: Information Model interface
- SNOMED Interesting Topics



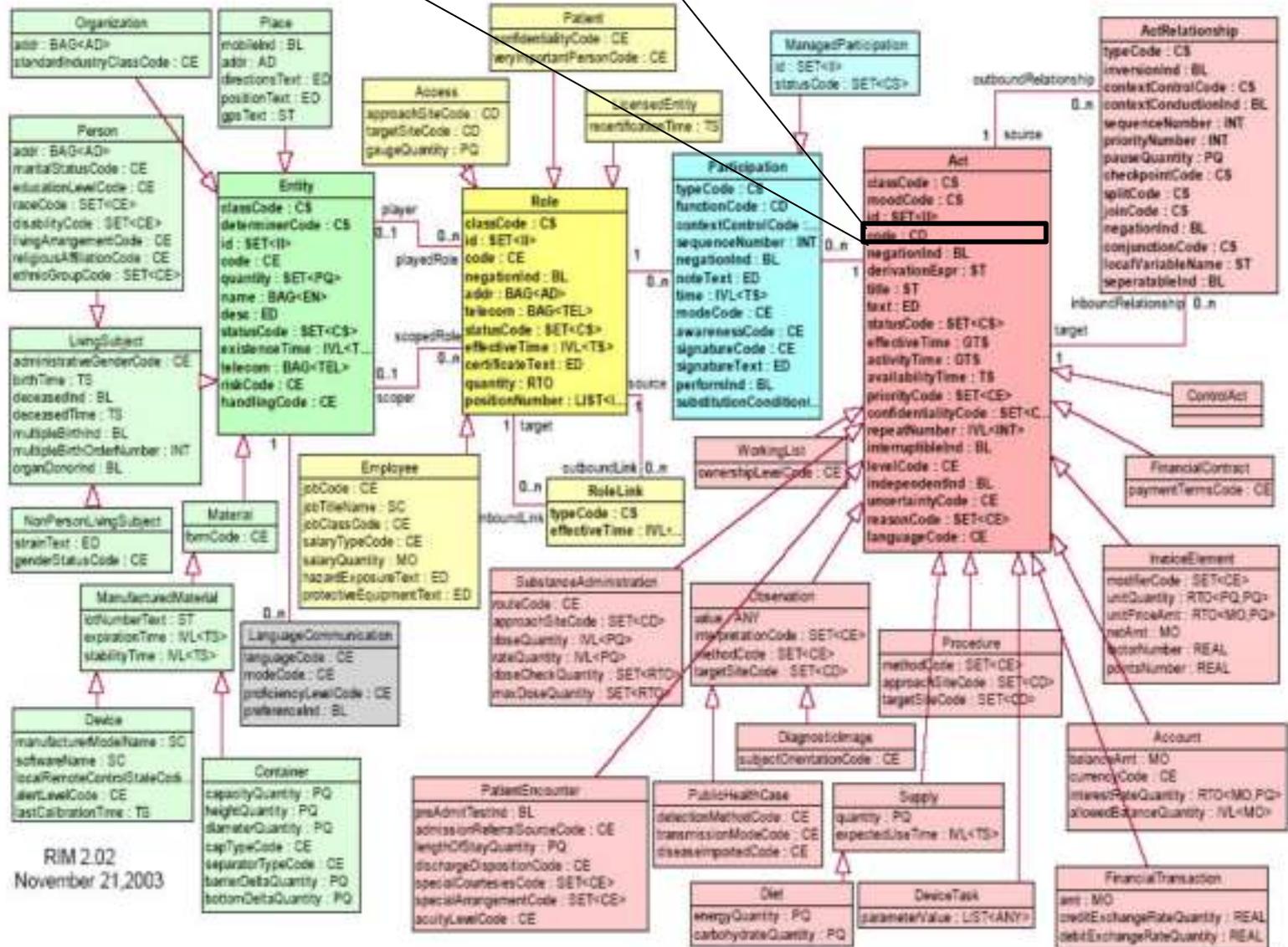
## Using SNOMED within the HL7 V3 Framework

- HL7 Reference Information Model defines classes, attributes, associations, and data types.
- Data types CE (Coded with equivalents) and CD (Concept descriptor) can carry terminology concepts (SNOMED, ICD9, etc).
- Each RIM attribute specifies its data type .
- When a coded RIM attribute is used in a particular V3 specification, it also declares the “vocabulary domain” of allowable concepts that can be used.
- A vocabulary domain can be constrained to a particular realm and coding scheme, creating a “value set.”
- A value set can be a SNOMED CT subset, appropriately specified to the particular realm of use. (In other words, the exact SNOMED CT subset for a particular field in a particular message/document can differ between countries, although both subsets must be a constraint on the RIM-level vocabulary domain).

# HL7 Reference Information Model



Act.code : CD



RIM 2.02  
November 21, 2003

## HL7 V3 CE (Coded with Equivalents) data type

Name	Type	Description
code	ST	The plain code symbol defined by the code system. For example, "784.0" is the code symbol of the ICD-9 code "784.0" for headache.
codeSystem	UID	Specifies the code system that defines the code.
codeSystemName	ST	The common name of the coding system.
codeSystemVersion	ST	If applicable, a version descriptor defined specifically for the given code system.
displayName	ST	A name or title for the code, under which the sending system shows the code value to its users.
originalText	ED	The text or phrase used as the basis for the coding.
translation	SET<CD>	A set of other concept descriptors that translate this concept descriptor into other code systems.

## HL7 V3 CE (Coded with Equivalents) data type

```
<Observation>
  <code code="14657009"
    codeSystem="2.16.840.1.113883.6.96"
    codeSystemName="SNOMED CT"
    displayName="Established diagnosis"/>
  <effectiveTime/>
  <value xsi:type="CE" code="40275004"
    codeSystem="2.16.840.1.113883.6.96"
    codeSystemName="SNOMED CT"
    displayName="Contact dermatitis">
    <translation code="6929"
      codeSystem="2.16.840.1.113883.6.2"
      codeSystemName="ICD9CM"
      displayName="DERMATITIS NOS"/>
  </value>
</Observation>
```

## HL7 V3 CD (Concept Descriptor) data type

Name	Type	Description
code	ST	The plain code symbol defined by the code system. For example, "784.0" is the code symbol of the ICD-9 code "784.0" for headache.
codeSystem	UID	Specifies the code system that defines the code.
codeSystemName	ST	The common name of the coding system.
codeSystemVersion	ST	If applicable, a version descriptor defined specifically for the given code system.
displayName	ST	A name or title for the code, under which the sending system shows the code value to its users.
originalText	ED	The text or phrase used as the basis for the coding.
translation	SET<CD>	A set of other concept descriptors that translate this concept descriptor into other code systems.
qualifier	LIST<CR>	Specifies additional codes that increase the specificity of the the primary code.

## HL7 V3 CD (Concept Descriptor) data type

```
<Procedure>
  <id/>
  <effectiveTime/>
  <code xsi:type="CD" code="30549001"
    codeSystem="2.16.840.1.113883.6.96"
    codeSystemName="SNOMED CT"
    displayName="Suture removal">
    <qualifier>
      <name code="363704007"
        displayName="procedure site"/>
      <value code="66480008"
        displayName="left forearm"/>
    </qualifier>
  </code>
</Procedure>
```

## Possible SNOMED CT value sets for RIM Procedure Class

- Procedure.code : CD  
    <= Descendant of Procedure (SCTID 71388002)
- Procedure.approachSiteCode : SET<CD>  
    <= Descendant of Procedural approach (SCTID 103379005)
- Procedure.targetSiteCode : SET<CD>  
    <= Descendant of Body structure (SCTID 123037004)
- Procedure.methodCode : SET<CE>  
    <= Descendant of Action (SCTID 129264002)

## Sample HL7 V3 instance containing SNOMED CT concepts

```
<Procedure>
  <id/>
  <effectiveTime/>
  <code code="30549001"
    codeSystem="2.16.840.1.113883.6.96"
    codeSystemName="SNOMED CT"
    displayName="Suture removal" />
  <targetSiteCode code="66480008"
    codeSystem="2.16.840.1.113883.6.96"
    codeSystemName="SNOMED CT"
    displayName="Left forearm" />
</Procedure>
```

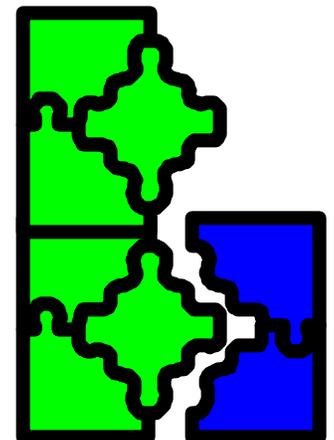
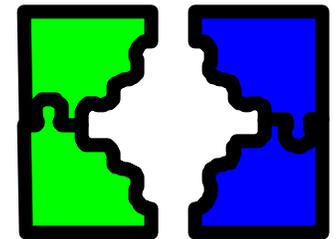
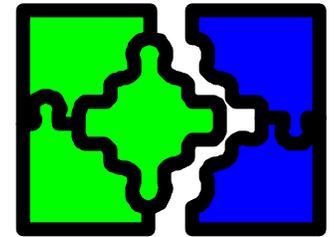
## OUTLINE

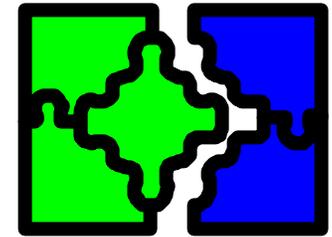
- SNOMED Overview
- **Using SNOMED in HL7**
  - ◆ Overview
  - ◆ **Terminology Model :: Information Model interface**
- SNOMED Interesting Topics



## Terminology Model :: Information Model Interface

- When the pieces fit perfectly.
- When the pieces don't fit at all.
- When the pieces fit in more than one way.

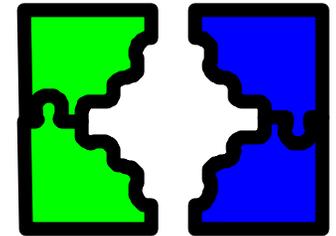




## When the pieces fit perfectly

- In some cases, there is one clear and universally agreeable representation.

```
<Procedure>
  <id/>
  <effectiveTime/>
  <code code="30549001"
    codeSystem="2.16.840.1.113883.6.96"
    codeSystemName="SNOMED CT"
    displayName="Suture removal"/>
</Procedure>
```



## When the pieces don't fit at all

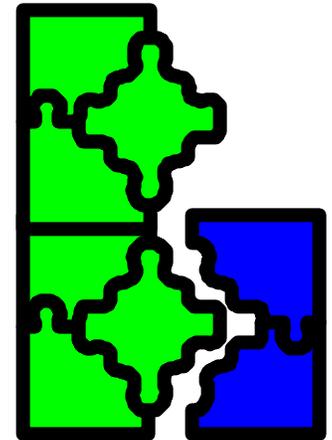
- In some cases, there may be no standard representation for the desired semantics.
- RIM and/or SNOMED enhancements may be needed.
- There's always free text...

```
<SubstanceAdministration>
  <text>Prednisone 20 mg every other day, alternating
with 18 mg every other day.</text>
  <consumable>
    <manufacturedProduct>
      <manufacturedLabeledDrug>
        <code code="116602009"
          codeSystem="2.16.840.1.113883.6.96"
          codeSystemName="SNOMED CT"
          displayName="Prednisone" />
      </manufacturedLabeledDrug>
    </manufacturedProduct>
  </consumable>
</SubstanceAdministration>
```



## When the pieces fit in more than one way

- In many cases, there is are multiple potential representations.

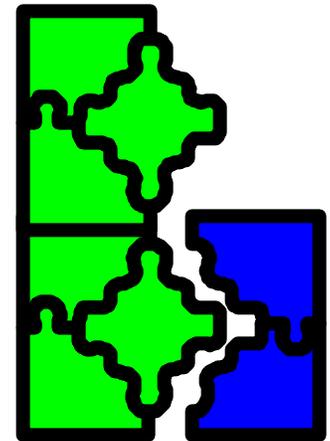


```
<Procedure>
  <id/>
  <code code="30549001"
    codeSystem="2.16.840.1.113883.6.96"
    codeSystemName="SNOMED CT"
    displayName="Suture removal" />
  <targetSiteCode code="66480008"
    codeSystem="2.16.840.1.113883.6.96"
    codeSystemName="SNOMED CT"
    displayName="Left forearm" />
</Procedure>
```



## When the pieces fit in more than one way

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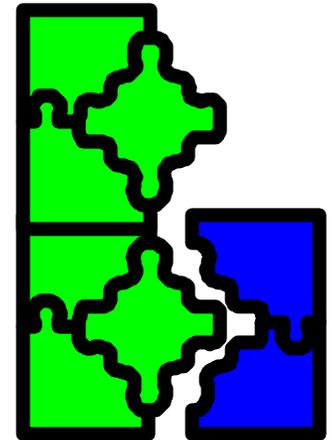


```
<Procedure>
  <id/>
  <code code="30549001"
    codeSystem="2.16.840.1.113883.6.96"
    codeSystemName="SNOMED CT"
    displayName="Suture removal">
    <qualifier>
      <name code="363704007"
        displayName="procedure site"/>
      <value code="66480008"
        displayName="left forearm"/>
    </qualifier>
  </code>
  <targetSiteCode/>
</Procedure>
```



## When the pieces fit in more than one way

- Local implementation guides to further constrain the HL7 standard.
- HL7 Templates
- Techniques for retrieving pre- and various post-coordinated representations (see upcoming section “[Retrieval of pre- and post-coordinated concepts](#)”).



## SNOMED::HL7 Collaboration

- An ongoing objective of CDA is to achieve greater and greater “semantic interoperability”, which might be defined as the ability of two applications to share data, with no prior negotiations, such that decision support within each application continues to function reliably when processed against the received data.
- While the framework provided by the RIM and by CDA are a critical component of semantic interoperability, they are not sufficient, particularly given the lack of global terminology solution, and the fact that each terminology overlaps with the RIM in different ways.



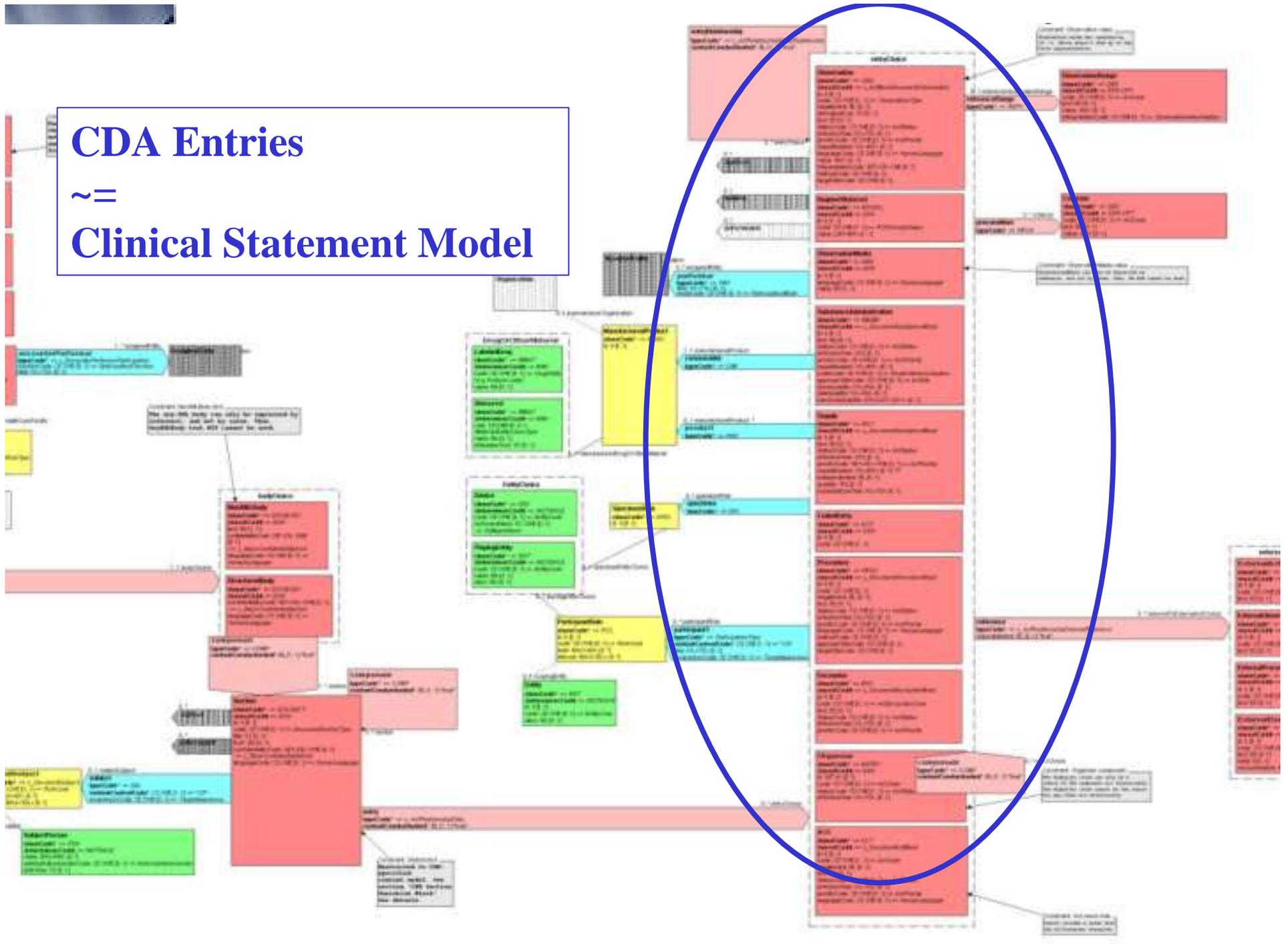
## SNOMED::HL7 Collaboration (cont)

- **HL7 Clinical Statement Model**
  - ◆ A collaborative project between several committees to define the representation of clinical observations and acts.
  - ◆ Used as the basis of the CDA Entry model.
  - ◆ The end result is that clinical observations are represented in the same way across various V3 specifications.
- **SNOMED CT and the HL7 Clinical Statement Model**
  - ◆ Preliminary work has begun to define an optimal use of SNOMED CT in the HL7 Clinical Statement Model.
  - ◆ It is anticipated that this will ultimately be balloted as an HL7 Informative Document, and distributed by the College of American Pathologists as part of their SNOMED CT implementation guidance. Topics will address:
    - SNOMED CT value sets.
    - Use of the HL7 Concept Descriptor data type for post-coordination of SNOMED CT concepts.
    - Aggregation of pre- vs. post-coordinated representations.

# CDA Entries

≈

# Clinical Statement Model



## SNOMED::HL7 Collaboration (cont)

- See [“HL7ClinicalStatement SNOMED LOINC Examples.xls”](#) for examples.



## OUTLINE

- SNOMED Overview
- Using SNOMED in HL7
- **SNOMED Interesting Topics**
  - ◆ **SNOMED description logic**
  - ◆ Retrieval of pre- and post-coordinated concepts
  - ◆ Cross mapping
  - ◆ Localization



## SNOMED CT is a “knowledge-base”

- Concepts have logic-based definitions.
- A “classifier” organizes the concepts into a poly-hierarchy, based on their definitions.
- The act of “classifying” helps identify synonymous concepts and helps determine where a concept will sit in the hierarchy.
- Logic-based definitions allow a computer to compare various representations and determine whether or not they mean the same thing. For example, when querying for all patients that have had a “pituitary operation”, SNOMED CT enables you to retrieve records such as:
  - ◆ “hypophysectomy”
  - ◆ “brain excision” + “pituitary gland”.
  - ◆ “partial excision of pituitary gland by transfrontal approach”
  - ◆ “brain incision” + “pituitary posterior lobe”



## Description Logic – an outline

- Define each concept by
  - ◆ Adding “stated” defining relationships to other concepts
  - ◆ Indicating if the concept is “fully defined” or “primitive”
- Apply an automatic classifier to
  - ◆ “Infer” other relationships between concepts
- Review the results of classification
  - ◆ The result is a logically consistent set of definitions
  - ◆ It may not be correct due to errors in stated definitions
  - ◆ Correct the errors
- Repeat the process
  - ◆ Add additional defining relationships to improve specificity
  - ◆ Repeat the classification process

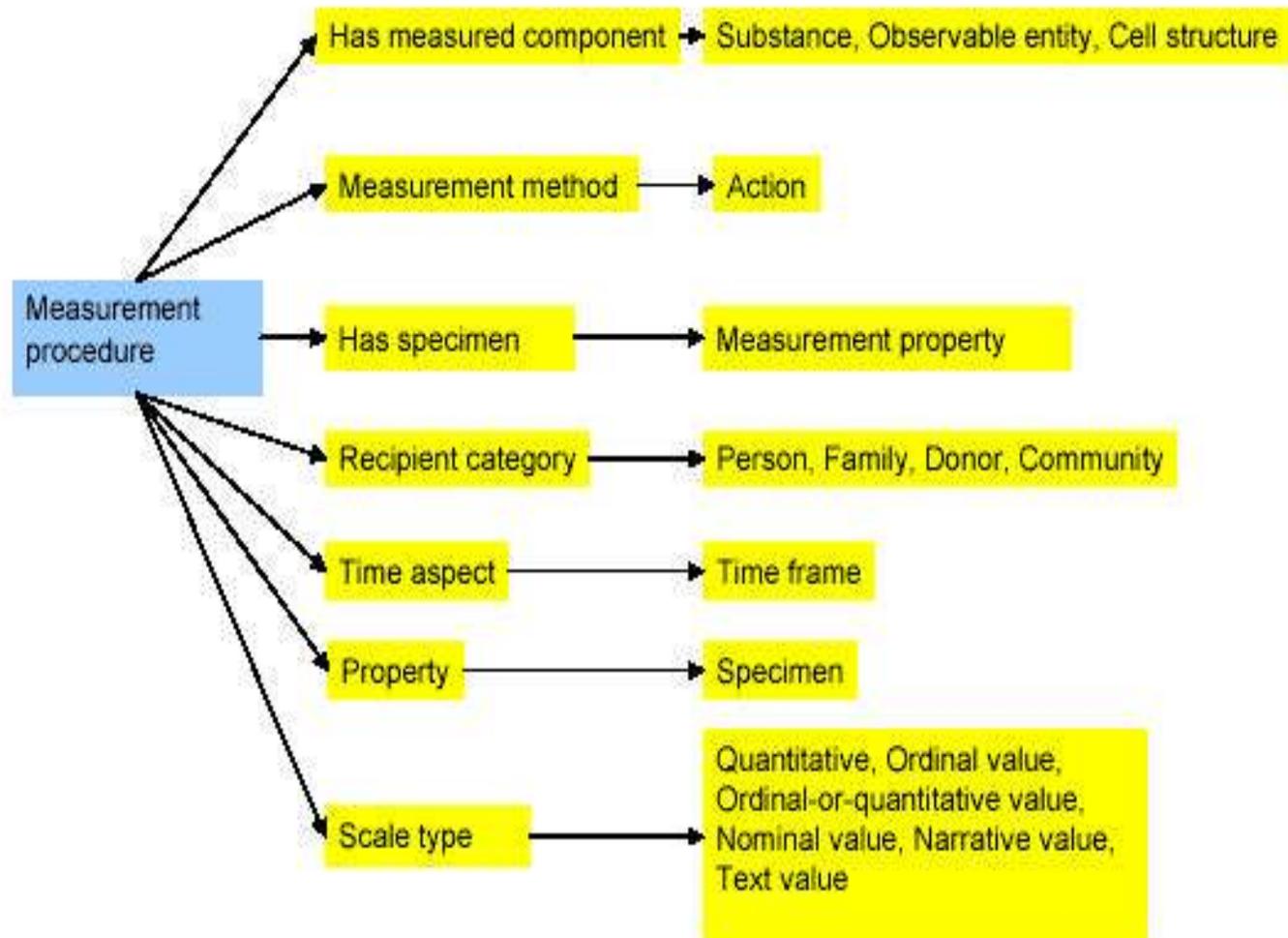


## Defining relationships & attributes

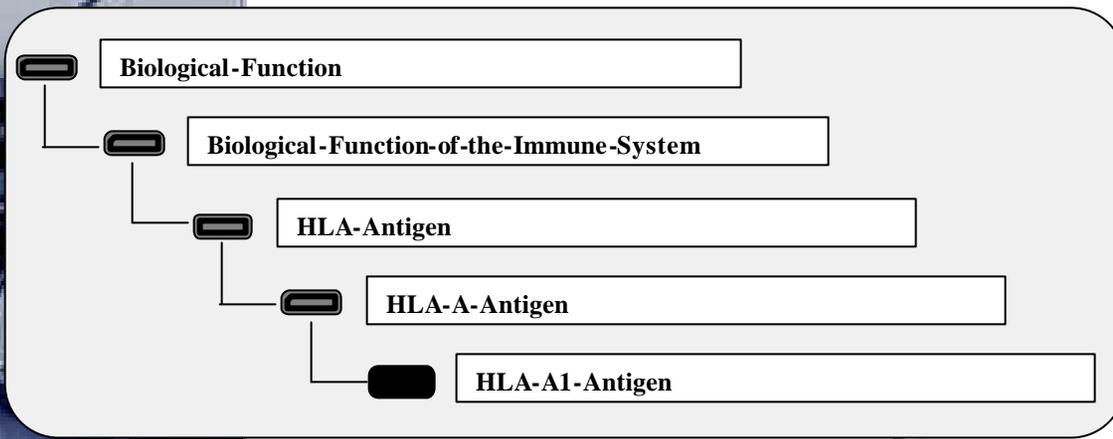
- Concepts used as RelationshipTypes for defining relationships are known as “attributes”
- Specific sets of attributes apply to
  - ◆ Findings & diseases
  - ◆ Procedures
  - ◆ Body structures



# Measurement Procedure attributes



# Description logic classification

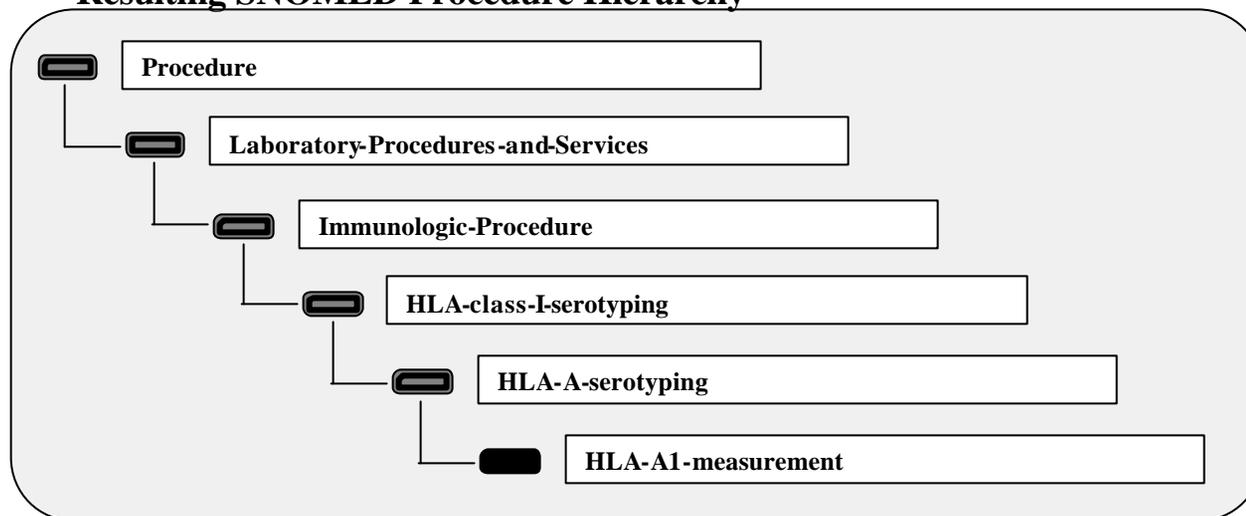


(defconcept HLA-class-I-serotyping  
(IsA Immunologic-Procedure  
(HAS-MEASURED-COMPONENT HLA-Antigen)))

(defconcept HLA-A-serotyping  
(IsA Immunologic-Procedure  
(HAS-MEASURED-COMPONENT HLA-A-Antigen)))

(defconcept HLA-A1-measurement  
(IsA Immunologic-Procedure  
(HAS-MEASURED-COMPONENT HLA-A1-Antigen)))

## Resulting SNOMED Procedure Hierarchy





# Description logic classification



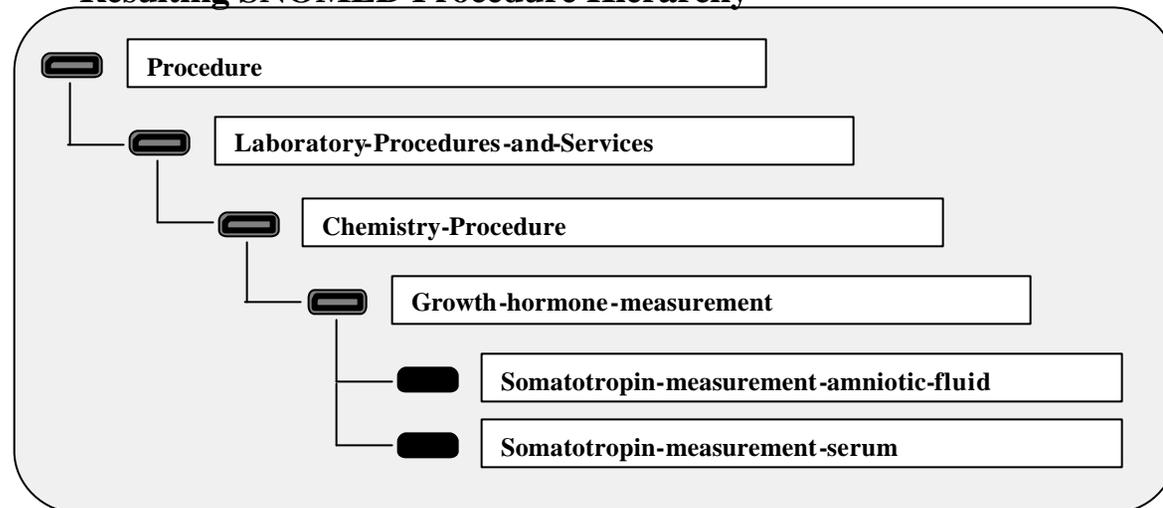
(defconcept Growth-hormone-measurement  
(IsA Chemistry-Procedure  
(HAS-MEASURED-COMPONENT Human-growth-hormone)))

(defconcept Somatotropin-measurement-amniotic-fluid  
(IsA Chemistry-Procedure  
(HAS-MEASURED-COMPONENT Human-growth-hormone)  
(HAS-SPECIMEN Amniotic-fluid)  
(SCALE-TYPE Quantitative)))

(defconcept Somatotropin-measurement-serum  
(IsA Chemistry-Procedure  
(HAS-MEASURED-COMPONENT Human-growth-hormone)  
(HAS-SPECIMEN Serum)  
(SCALE-TYPE Quantitative)))



## Resulting SNOMED Procedure Hierarchy



## Fully Defined and Primitive

- A concept is “fully defined” if its definition includes all necessary and sufficient characteristics.
- Red car (fully defined)
  - Is a = car
  - Colour = red
- Red family car (primitive)
  - Is a = car
  - Colour = red
- Red diesel family car (fully defined)
  - Is a = Red family car
  - Has engine type = diesel
- A description logic classifier can infer that “Red family car” is a kind of “Red car”, since “Red family car” has all the characteristics that define a “Red car”.



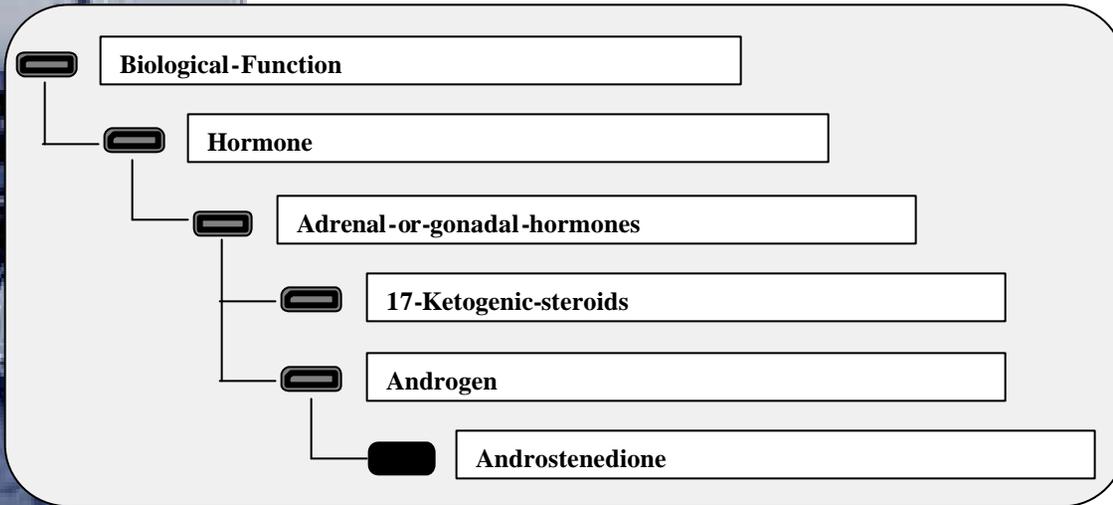
## Value of Description Logic

- Ensures technical consistency
  - ◆ Highlights anomalies rather than hiding them
- Allows human resources to concentrate on
  - ◆ Designing appropriate defining relationships
  - ◆ Accuracy of individual definitions
- Allows computation of equivalence and subsumption between
  - ◆ Pre-coordinated representations
    - Single ConceptId
  - ◆ Post-coordination representations
    - ConceptId plus qualifying ConceptIds



# •Description logic mis-classification

Error in Function hierarchy is mirrored in the auto-classified Procedure hierarchy

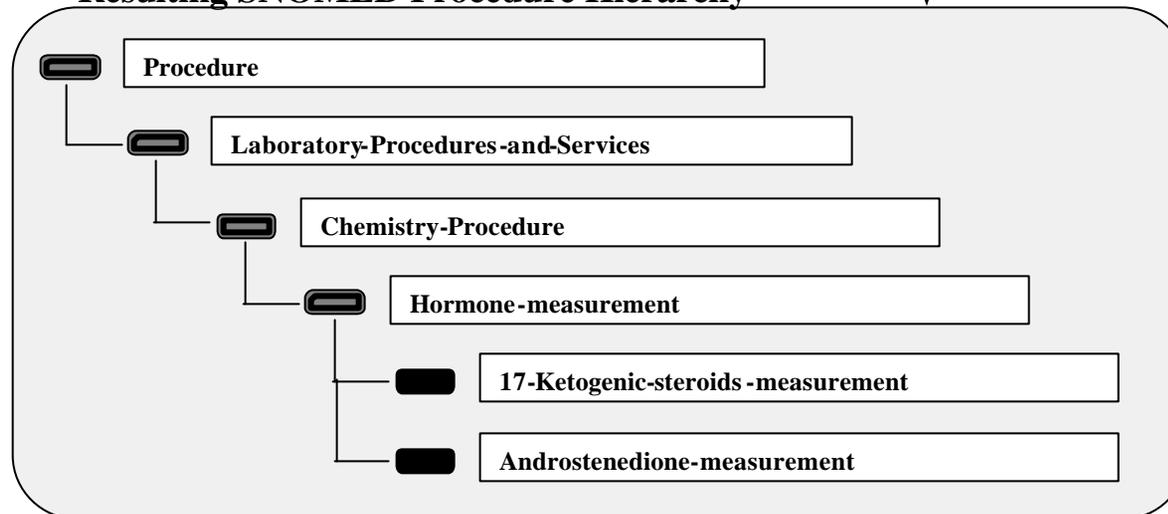


(defconcept Hormone-measurement  
(IsA Chemistry-Procedure  
(HAS-MEASURED-COMPONENT Hormone)))

(defconcept 17-ketogenic-steroids -measurement  
(IsA Chemistry-Procedure  
(HAS-MEASURED-COMPONENT 17-Ketogenic-steroids)))

(defconcept Androstenedione-measurement  
(IsA Chemistry-Procedure  
(HAS-MEASURED-COMPONENT Androstenedione)))

## Resulting SNOMED Procedure Hierarchy



## OUTLINE

- SNOMED Overview
- Using SNOMED in HL7
- **SNOMED Interesting Topics**
  - ◆ SNOMED description logic
  - ◆ **Retrieval of pre- and post-coordinated concepts**
  - ◆ Cross mapping
  - ◆ Localization



## Retrieval of pre- and post-coordinated concepts

- SNOMED CT allows concepts to be made more specific by post-coordinated expressions
  - ◆ Example: “Hysterectomy” + “Site = Entire uterus”
- SNOMED CT concepts can be post-coordinated in a variety of ways:
  - ◆ HL7 Concept Descriptor data type
  - ◆ Supplying values in other fields of the information model
- To aggregate various pre- and post-coordinated expressions:
  - ◆ Transform pre-and post-coordinated concept expressions into a canonical form
  - ◆ Transform queries into the same canonical form.
  - ◆ The normalized instances can then be directly compared to the query.



Find patients that have had a  
 “Pituitary excision”, a “Pituitary operation”

#	Procedure.ed	Procedure. approach_site_cd	Procedure. target_site_cd
1	Partial excision of pituitary gland by transfrontal approach		
2	Hypophysectomy	Transfrontal approach	
3	Excision	Transfrontal approach	Pituitary gland structure
4	Brain excision	Transfrontal approach	Pituitary posterior lobe
5	Brain incision		Pituitary gland structure



## Convert instances into a canonical form

Instance	Mapped into SNOMED CT	Converted into Long Canonical Form
1	IsA Partial excision of pituitary gland by transfrontal approach	IsA Partial hypophysectomy APPROACH Transfrontal approach METHOD Excision action PROCEDURE-SITE Pituitary gland structure
2	IsA Hypophysectomy APPROACH Transfrontal approach	IsA Procedure APPROACH Transfrontal approach METHOD Excision action PROCEDURE-SITE Pituitary gland structure
3	IsA Excision APPROACH Transfrontal approach PROCEDURE-SITE Pituitary gland structure	IsA Procedure APPROACH Transfrontal approach METHOD Excision action PROCEDURE-SITE Pituitary gland structure
4	IsA Brain excision APPROACH Transfrontal approach PROCEDURE-SITE Pituitary posterior lobe	IsA Procedure APPROACH Transfrontal approach METHOD Excision action PROCEDURE-SITE Pituitary posterior lobe
5	IsA Brain incision PROCEDURE-SITE Pituitary gland structure	IsA Procedure METHOD Incision action PROCEDURE-SITE Pituitary gland structure



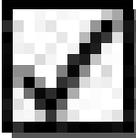
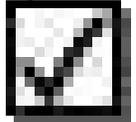
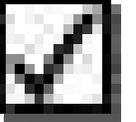
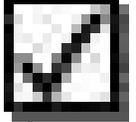
## Convert queries into a canonical form

- Concepts that aggregate under "**excision of the pituitary gland**" would be those procedures matching ALL the following criteria:
  - ◆ At least one supertype is a kind of Procedure.
  - ◆ At least one METHOD is a kind of Excision action.
  - ◆ At least one PROCEDURE-SITE is a kind of Pituitary structure.

Query	Converted into Long Canonical Form
Excision of the pituitary gland	IsA Procedure METHOD Excision action PROCEDURE-SITE Pituitary structure
Operation on the pituitary gland	IsA Procedure METHOD Surgical action PROCEDURE-SITE Pituitary structure



## Excision of pituitary?

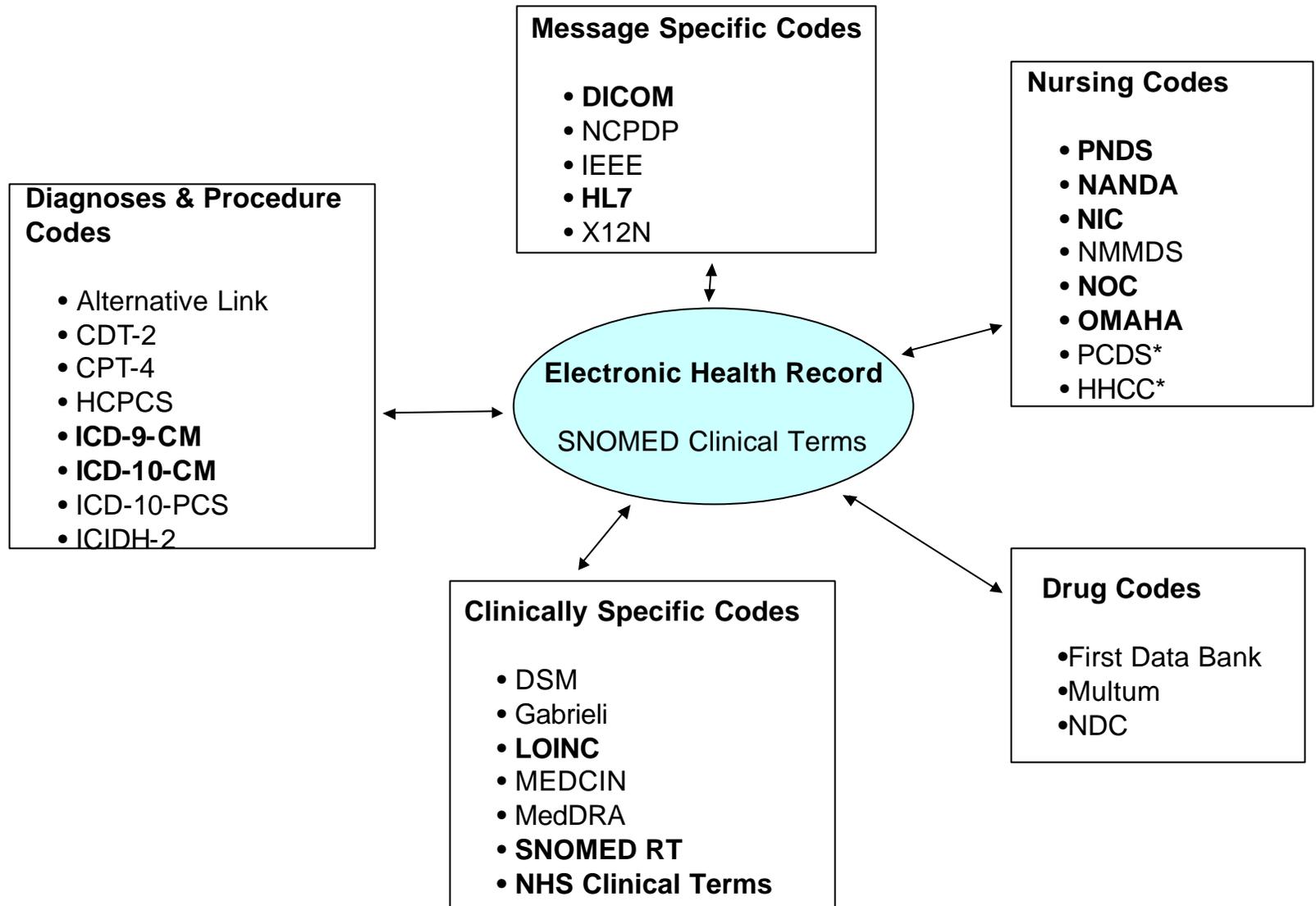
Instance	Mapped into SNOMED CT	Converted into Long Canonical Form
1 	IsA Partial excision of pituitary gland by transfrontal approach	IsA Partial hypophysectomy APPROACH Transfrontal approach METHOD Excision action PROCEDURE-SITE Pituitary gland structure
2 	IsA Hypophysectomy APPROACH Transfrontal approach	IsA Procedure APPROACH Transfrontal approach METHOD Excision action PROCEDURE-SITE Pituitary gland structure
3 	IsA Excision APPROACH Transfrontal approach PROCEDURE-SITE Pituitary gland structure	IsA Procedure APPROACH Transfrontal approach METHOD Excision action PROCEDURE-SITE Pituitary gland structure
4 	IsA Brain excision APPROACH Transfrontal approach PROCEDURE-SITE Pituitary posterior lobe	IsA Procedure APPROACH Transfrontal approach METHOD Excision action PROCEDURE-SITE Pituitary posterior lobe
5	IsA Brain incision PROCEDURE-SITE Pituitary gland structure	IsA Procedure METHOD Incision action PROCEDURE-SITE Pituitary gland structure

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  - ◆ Localization



# SNOMED CT Integration and Cross-Mapping



## Cross Mapping requirements

- SNOMED Clinical Terms is a clinical terminology
- Health statistics are reported using
  - ◆ Classifications (e.g. ICD9CM)
  - ◆ Groupers (e.g. DRGs)
  - ◆ Administrative or financial codings (e.g. OCPS4)
- Mapping is necessary to minimise re-entry of data
- Mapping is not trivial
  - ◆ Different uses = different levels of detail & QA
  - ◆ A major consideration when building HL7 interfaces to legacy applications that use locally defined codes



## Cross Map Structure

- Cross Map Sets
  - ◆ Identifies a target scheme for which a cross map is available.
  
- Cross Maps
  - ◆ Contains the complete set of cross maps for a Cross Map Set. Each SNOMED code in the set is mapped to a Cross Map Target.
  
- Cross Map Targets
  - ◆ Represents the code(s) in the target coding scheme for each Cross Map.



## Cross Map Structure

- Example: Gait Abnormality (SCTID 22325002), Cerebellar Gait (SCTID 69021004), Diabetic Retinopathy (SCTID 4855003)

- ◆ Cross Map Sets

MapSetId	MapSetName	MapSetSeparator
100046	ICD-9-CM	(vertical bar character)

- ◆ Cross Maps

MapSetId	MapConceptId	MapTargetId	MapAdvice*
100046	22325002	1860057	1
100046	69021004	1860057	1
100046	4855003	9534498053	1

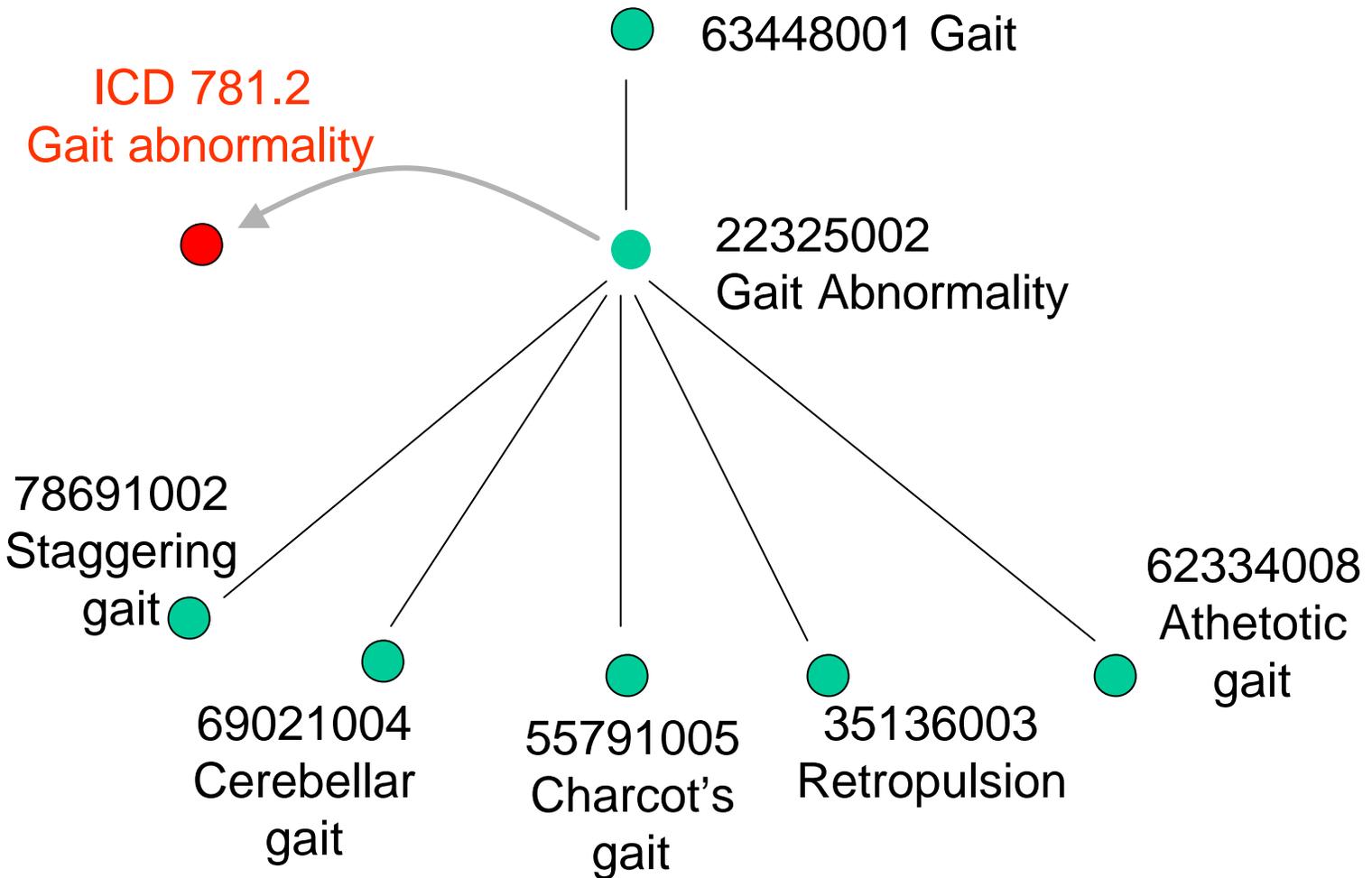
\* 1=The SNOMED and ICD correlates are synonyms or the SNOMED term is listed as an inclusion within the target ICD code description.

- ◆ Cross Map Targets

TargetId	TargetCodes
1860057	781.2
9534498053	250.50 362.01



## Mapping to ICD-9-CM



## Mapping Existing Local Terms and Codes

- Translation between local codes and SNOMED codes in the interface can obviate the need to re-architect a legacy application
- Mapping can be time consuming and can require considerable QA by domain experts that know SNOMED, the local coding scheme, and the context where the mapping is to be used.



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  - ◆ **Localization**



## Definitions

- Localization
  - ◆ Take existing SNOMED CT content and optimise it for use within the scope of your implementation by constraint or extension.
  - ◆ Localizations can take many forms:
    - Subsets
    - Navigation hierarchies
    - Leaf extensions (e.g. product level drug codes)
    - Cross maps
    - Language-specific dialect

## Why localize a global terminology?

- Many healthcare concepts are globally shared
- Some healthcare concepts are
  - ◆ Regional or national
  - ◆ Specific to a discipline or specialty
  - ◆ Local to an organisation
- Usage of some shared concepts varies by
  - ◆ Language or dialect
    - Different terms for same concepts
  - ◆ Region, country or organisation
    - Different products and business processes
  - ◆ Discipline or speciality
    - Different frequency of use of particular concepts



## Adding local concepts

- Within an extension it is possible to add local
  - ◆ Concepts
  - ◆ Descriptions
  - ◆ Relationships
- However, caution is needed
  - ◆ Think carefully about quality, maintenance and risks of duplication
  - ◆ The request submission process is a better way to get essential content into SNOMED CT
  - ◆ Extensions should only be used for requirements that are really local

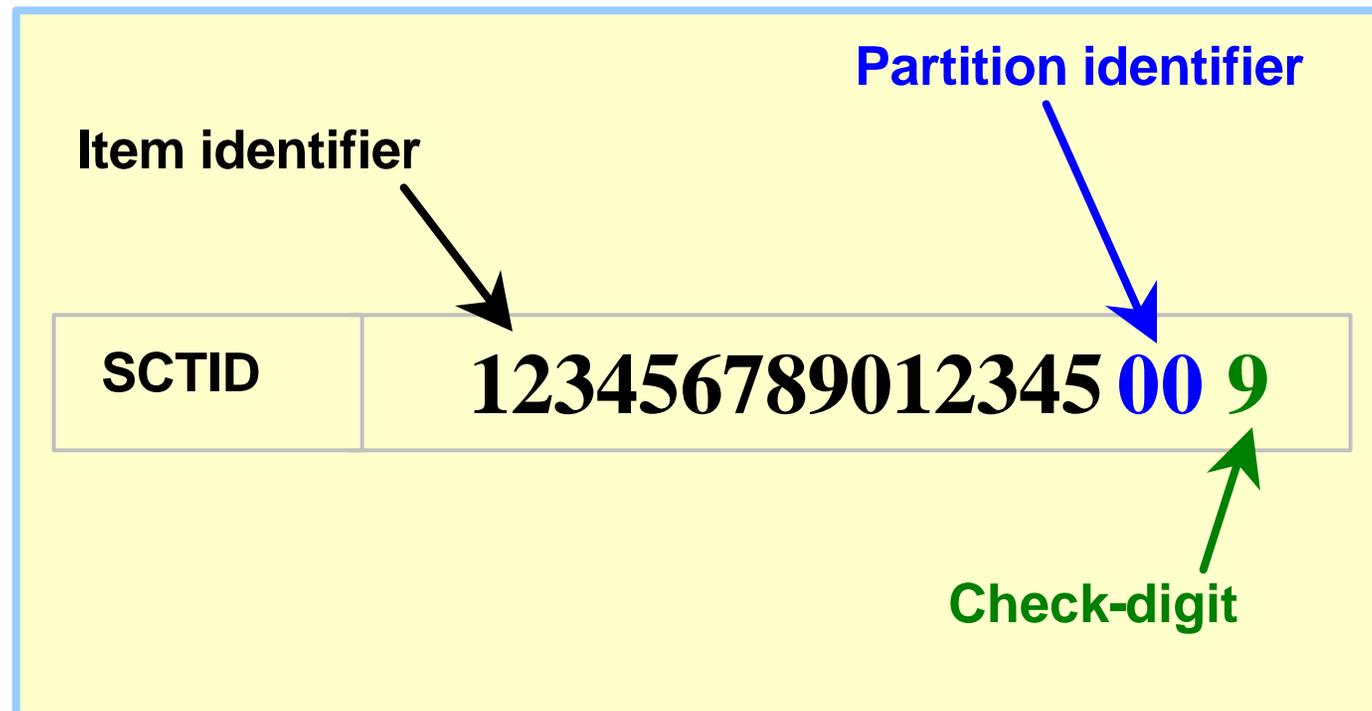


## SNOMED CT Subset Model for Localization

- Many of the requirements for localization of SNOMED CT can be met using the SNOMED CT Subset model.
- The Subset structure supports many different requirements and enables them to be distributed or built locally within a common format.
- Within a subset, components are identified by a SNOMED CT identifier (SCTID)
  - ◆ SCTIDs are unique 64-bit integers
  - ◆ SCTIDs can contain an extension identifier, which can be used to identify local cross maps, concepts, descriptions, relationships, etc.

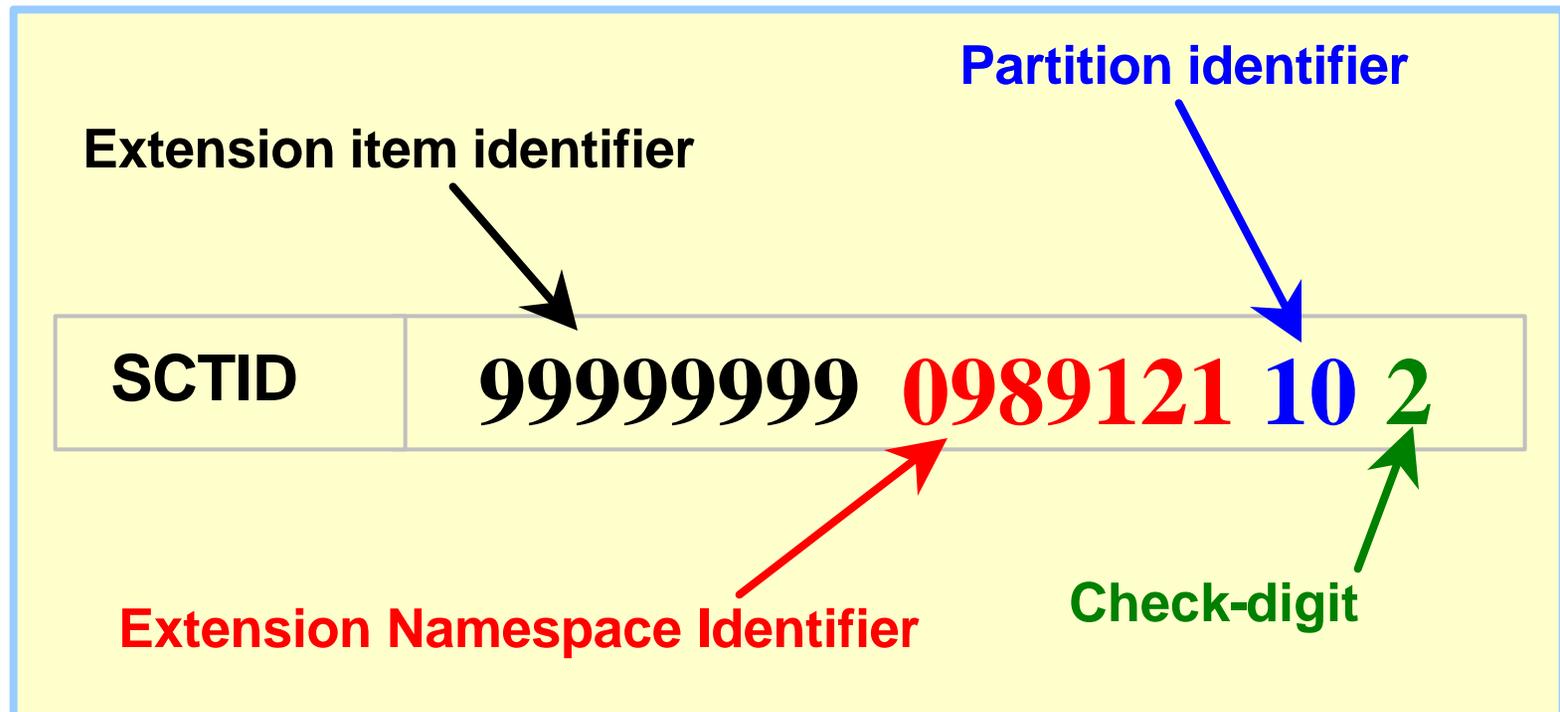
## The SNOMED CT Identifier

- A 64-bit integer
- Partition Id distinguishes between types of components (00=concept; 01=description; 02=relationship)
- Check-digit detects missing digits and transpositions



## SCTID are unique in local extensions

- Partition Id distinguishes between types of components (10=extension concept; 11=extension description; 12=extension relationship)
- Items are unique with a partition of a namespace.





# Example: SNOMED CT Subtype hierarchy



## Deep venous thrombosis

- Antepartum deep phlebothrombosis
  - Antenatal deep vein thrombosis - delivered
  - Antenatal deep vein thrombosis NOS
  - Antenatal deep vein thrombosis unspecified
  - Antenatal deep vein thrombosis with antenatal complication
- Deep thrombophlebitis
  - Deep vein thrombophlebitis of the leg unspecified
  - Portal thrombophlebitis
  - Postpartum pelvic thrombophlebitis
  - Thrombophlebitis of deep veins of lower extremity
    - Thrombophlebitis of popliteal vein
      - Thrombophlebitis of the popliteal vein
    - Thrombophlebitis of the common iliac vein
    - Thrombophlebitis of the external iliac vein
    - Thrombophlebitis of the femoral vein
    - Thrombophlebitis of the internal iliac vein
  - Thrombophlebitis of deep veins of upper extremities
  - Thrombophlebitis of femoropopliteal vein
  - Thrombophlebitis of iliac vein
    - Thrombophlebitis of the common iliac vein
    - Thrombophlebitis of the external iliac vein
    - Thrombophlebitis of the iliac vein unspecified
    - Thrombophlebitis of the internal iliac vein
  - Thrombophlebitis of mesenteric vein
  - Thrombophlebitis of pelvic vein
  - Thrombophlebitis of vena cava
- Deep venous thrombosis of lower extremity
  - Deep vein thrombosis of leg related to air travel
  - Ileofemoral deep vein thrombosis
  - Lower venous segment thrombosis
  - Phlegmasia alba dolens
    - Phlegmasia alba dolens - obstetric
    - Puerperal phlegmasia alba dolens
  - Phlegmasia cerulea dolens
- Deep venous thrombosis of pelvic vein
  - Ileofemoral deep vein thrombosis
  - Thrombophlebitis of pelvic vein

## Example: SNOMED CT Navigation Subset

Deep venous thrombosis (DVT)  
DVT antepartum  
DVT of pelvic vein  
DVT of lower extremity  
DVT of upper extremity  
DVT postoperative  
DVT postpartum



## Example: Product-level drug extensions

- SNOMED CT provides and maintains core drug integration
  - ◆ Generic clinical drugs (name, strength, dose form)
  - ◆ generic ingredients and their classes
  - ◆ therapeutic drug monitoring tests
  - ◆ administration of medications
  - ◆ adverse effects
  - ◆ allergies, poisonings
  - ◆ indications and contraindications
- Specific manufacturing and proprietary brand names are maintained in realm-specific extensions (such as the UK or US drug extensions)



# The integrated model for drugs

Snomed® CT™ core

Realm extension

Generic

Manufacturer specific

Virtual Therapeutic Moiety\*

furosemide containing product

\*Has ACTIVE-INGREDIENT relationship to furosemide (substance)

Virtual Medicinal Product (name, strength, dose form)

furosemide 20mg tablet

Actual Medicinal Product

Lasix 20mg tablet

Virtual Medicinal Product Pack

furosemide 20mg tablets, x 50

Actual Medicinal Product Pack

Lasix 20mg tablets, x 50

Is a

Is an instantiation of

Is a pack of

Is a pack of

Is an instantiation of



**Questions?**

