



# Health Professionals: Introduction to SNOMED CT

National Resource Centre for EHR Standards (NRCeS)  
C-DAC, Pune

- SNOMED CT stands for **SNOMED Clinical Terms**
- SNOMED is now an acronym.
- **SNOMED International** (also known as **IHTSDO** stands for International Health Terminology Standards Development Organization)
- Owned, maintained and distributed by SNOMED International, United Kingdom.
- Comprehensive, multilingual clinical healthcare terminology in the world.
- SNOMED CT resulted from the merger of SNOMED Reference Terminology (SNOMED RT) developed by
  - College of American Pathologists (CAP)
  - Clinical Terms Version 3 (CTV3) developed by the National Health Service (NHS) of the United Kingdom.

- It is the richest vocabulary available to describe clinical findings, diseases, procedures etc.
- Contains **4,48,261 concepts**, more than 1.3 million descriptions and more than two and a half million relationships.
- SNOMED CT aims at transmitting all concepts that have been expressed throughout history in the healthcare domain, unambiguously.
- Provides clinical content and expressivity for clinical documentation and reporting.
- Used to code, retrieve, and analyze clinical data.
- The terminology is comprised of concepts, terms and relationships with the objective of precisely representing clinical information across the scope of health care.

- International **not-for-profit** association
  - Based in United Kingdom
  - Owned by National Members
  - Governed by General Assembly of its Members
  - Management Board elected by General Assembly
  - Funded by countries based on national wealth (GNI)
  - A product and service organization
- Delivers SNOMED CT
  - Licensed to registered Affiliates
  - Free use in Member countries
  - Low-cost licenses for institutions in other countries

# Benefits...



- SNOMED CT can **record clinical information** at greater levels of specificity
- Improved **sharing of information** across care settings
- Ability to receive electronic data such as discharge summaries in a coded format
- Ability to **aggregate data across care settings** to support quality outcomes analysis.
- Sharing data can **reduce the need to repeat health history at each new encounter** with a healthcare professional – it also means the clinician does not have to rely on the accuracy of the patient's knowledge.
- **Data can flow electronically across healthcare** without the need to re-enter data or try to find equivalent codes for essential clinical terms from a different coding scheme.

- Detailed and appropriate capture of clinical information
- Continuity of care across different care settings and locations
- Reduces risk of differing and incorrect interpretation
- Appropriate use can contribute to the reduction of error rates
- Improves clinical efficiency by providing a standard clinically relevant terminology to the clinician for documentation of care
- SNOMED CT's history mechanism enables clinical information collected over time to be meaningfully correlated together
- Can assist with identification of patients who match a given set of clinical criteria.

# SNOMED CT Benefits for National EHR



- Enhancing the care of individuals
  - Display appropriate information
  - Guideline & decision support integration
  - Sharing relevant information
  - Retrospective searches for patterns
- Enhancing the care of populations
  - Epidemiology monitoring & reporting
  - Research: cause & management of diseases
- Supporting cost-effective delivery of care
  - Guidelines: minimize risk of costly errors
  - Reducing duplication of investigations
  - Auditing & planning clinical service delivery



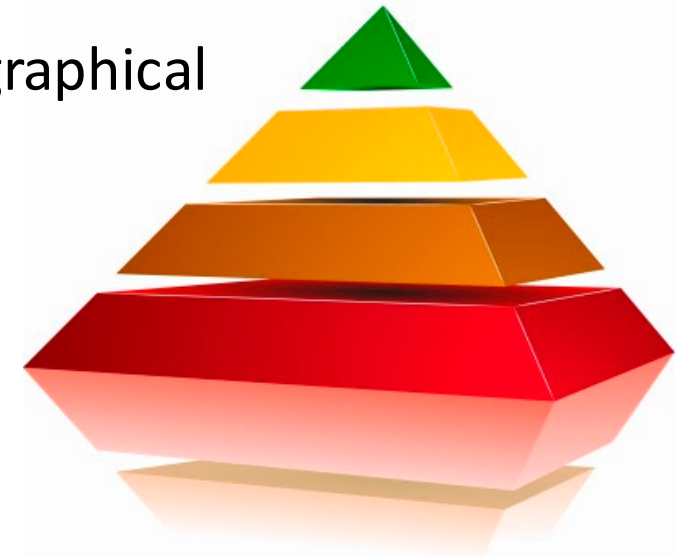




# SNOMED CT HIERARCHIES



- Concepts are divided into 19 hierarchies, which include:
  - Clinical Finding
  - Procedure
  - Situation with explicit context
  - Observable Entity
  - Body structure
  - Organism
  - Substance
  - Pharmaceutical/biologic product
  - Specimen
  - Special Concept
  - Physical Object
  - Physical Force
  - Event
  - Environmental/geographical locations
  - Social Context
  - Staging and scales
  - Qualifier value
  - Record artifact
  - SNOMED CT model component



# Hierarchy – Clinical finding



- Concepts in this hierarchy represent the result of a clinical observation, assessment or judgment , and include both normal and abnormal clinical states. Contains a sub-hierarchy of disease.
- Examples
  - Cough with fever (finding)
  - Normal breath sounds (finding)
  - Malaria (disorder)
- *User for*
  - Reason for admission
  - Diagnosis
  - Sign and symptoms
  - Laboratory test results
  - Assessment results



- Procedure concepts represent activities performed in the provision of health care.
- Includes invasive, administration of medicine, imaging, administrative procedures.
- Examples
  - Appendectomy (procedure)
  - Irrigation of oral wound (procedure)
  - Removal of urethral catheter (procedure)
- *Used for*
  - Procedures performed
  - Planned procedures
  - Requested procedures



# Hierarchy - Situation with explicit context



- Concepts in the **Procedure** and **Clinical finding** hierarchies (given the appropriate record structure) can be used in a clinical record to represent:
  - Conditions and procedures that have not yet occurred  
e.g. **Endoscopy arranged (situation)**  
**Medical history unknown (situation)**
  - Conditions and procedures that refer to someone other than the patient  
e.g. **Family history: Diabetes mellitus (situation)**  
**Discussed with next of kin (situation)**
  - Conditions and procedures that have occurred at some time prior to the time of the current entry in the record  
e.g. **History of injury (situation)**
- *Used for*
  - Family history
  - Past history
  - Care plans



# Hierarchy – Observable entity



- Observables are entities that could be used to code elements on a checklist or any element where a value can be assigned.
  - Color of nail (observable entity) is an observable.
  - *Gray nails (finding)* is a finding.
- Example
  - Color of nail (observable entity)
- *Used for*
  - Observations with values

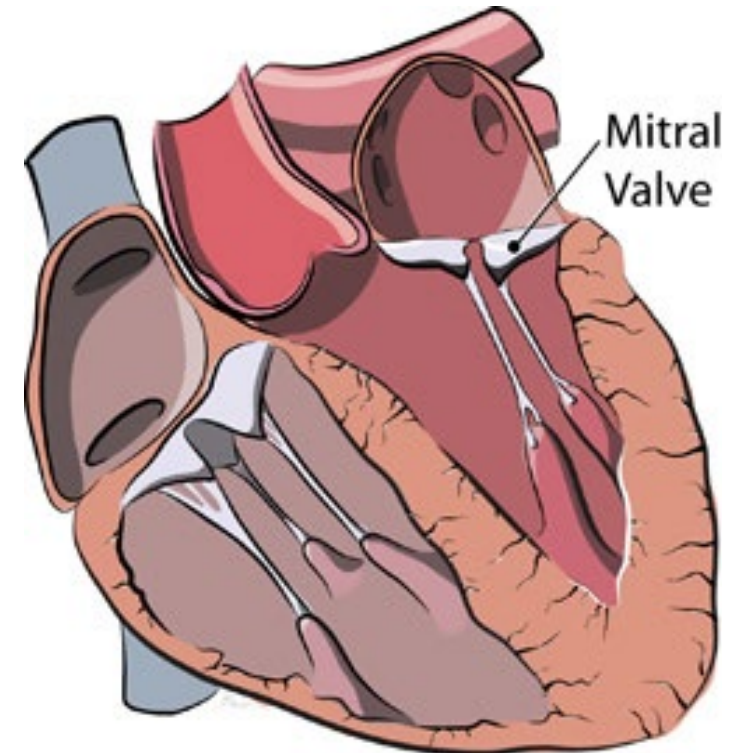




# Hierarchy – Body structure



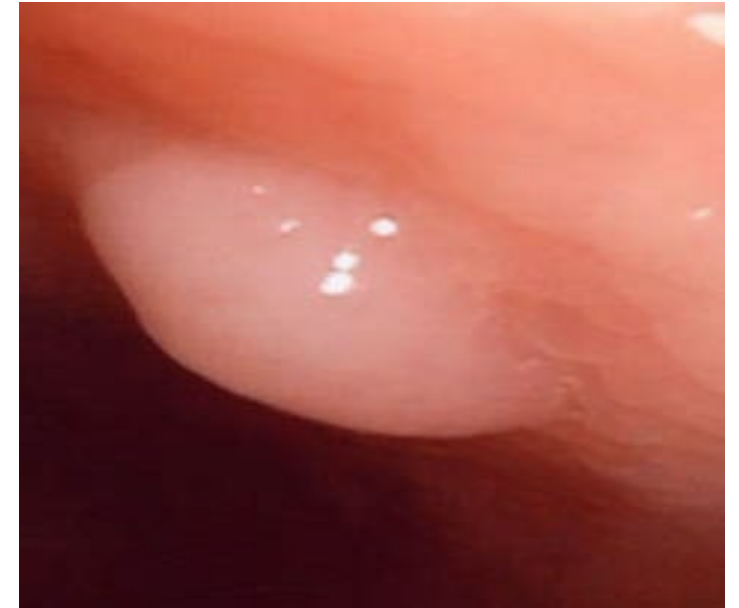
- Concepts include normal as well as abnormal anatomical structures.
- Normal anatomical structures can be used to specify the body site involved by a disease or procedure.
- Examples
  - Mitral valve structure (body structure)
  - Uterine structure (body structure)



# Hierarchy – Body structure



- Morphologic alterations from normal body structures are represented in the sub-hierarchy **Body structure**, altered from its original anatomical structure (morphologic abnormality)
- Examples
  - Bony callus (morphologic abnormality)
  - Giant platelet (morphologic abnormality)
  - Polyp (morphologic abnormality)
- *Used for*
  - Symptom location
  - Disorder location
  - Procedure site
  - Site of administration





# Hierarchy - Organism



- This hierarchy includes organisms of significance in human and animal medicine.
- Organisms are also used in modelling the causes of 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.
- Sub-hierarchies of organism include, but are not limited to:
- Animal (organism) , Microorganism (organism) , Kingdom Plantae (organism) .
- Examples
  - H-1 virus (organism)
  - Glycine (plant) (organism)
  - Texon cattle breed (organism)
  - Bacillus anthracis (organism)
- *Used for*
  - Microorganism susceptibility
  - Cause of a disease / infection



# Hierarchy - Substance

- The **Substance** hierarchy contains concepts that 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 **Pharmaceutical / biologic product (product)** which are in a separate hierarchy.
- Sub-hierarchies of **Substance** also include but are not limited to:
  - Body substance (substance)
  - Dietary substance (substance)
  - Diagnostic substance (substance)
  - Drug or medicament (substance)
  - Chemical Substance (substance)



# Hierarchy -Substance



- Examples
  - Insulin (substance)
  - Dental fluoride gel (substance)
  - Albumin (substance)
  - Endorphin (substance)
  - Sodium hydroxide (substance)
- *Used for*
  - Allergies / adverse reactions
  - Medication ingredients
  - Diagnostic substance



# Hierarchy - Pharmaceutical/biologic product



- The **Pharmaceutical / biologic product** hierarchy is separate from the **Substance** hierarchy.
- This hierarchy was introduced as a top-level hierarchy in order to clearly distinguish drug products (products) from their chemical constituents (substances).
- It contains concepts that represent the multiple levels of granularity required to support a variety of uses cases such as computerized provider order entry (CPOE), e-prescribing, decision support and formulary management.
- Examples
  - Diazepam 5mg tablet (product)
  - Iodoform (product)
  - beta-Blocking agent (product)
  - Tissue plasminogen activator preparation (product)
- *Used for*
  - Medication lists





# Hierarchy - Specimen

- The **Specimen** hierarchy contains concepts representing entities that are obtained (usually from a patient) for examination or analysis.
- Specimen concepts can be defined by attributes which specify: 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
  - Specimen from prostate obtained by needle biopsy (specimen)
  - Urine specimen obtained by clean catch procedure (specimen)
  - Calculus specimen (specimen)
  - Cerebroventricular fluid cytologic material (specimen)
- *Used for*
  - Pathology test specimen
  - Biopsy specimen



# Hierarchy – Physical Object

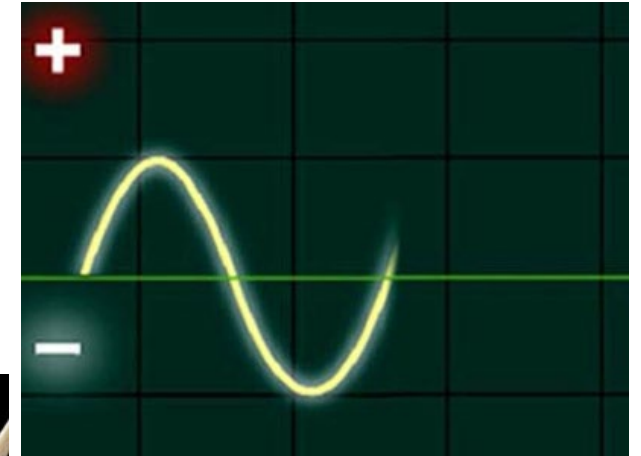


- Concepts in the **Physical object** hierarchy include natural and man-made objects
- One use for these concepts is modelling procedures that use devices (e.g. catheterization )
- Examples
  - Implant, device (physical object)
  - Artificial kidney, device (physical object)
  - Latex rubber gloves (physical object)
  - Vena cava filter (physical object)
- *Used for*
  - Orders and supply of medical devices
  - Procedure devices
  - Stock inventory



# Hierarchy – Physical force

- The concepts in the **Physical force** hierarchy are directed primarily at representing physical forces that can play a role as mechanisms of injury.
- Examples
  - Spontaneous combustion (physical force)
  - Alternating current (physical force)
  - Friction (physical force)
- *Used for*
  - Reason for injury





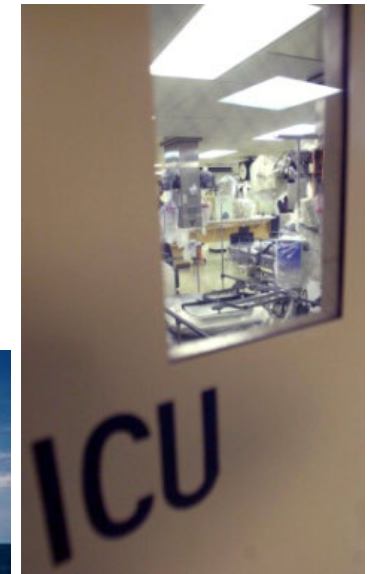
- The **Event** hierarchy includes concepts that represent occurrences (excluding procedures and interventions).
- Examples
  - Flood (event)
  - Bioterrorist attack (event)
  - Earthquake (event)
- *Used for*
  - Reason for admission
  - Past History



# Hierarchy - Environment or geographic location



- The **Environment or geographical location** hierarchy includes types of environments as well as named locations such as countries, states, and regions.
- Examples
  - Andaman and Nicobar Islands (geographic location)
  - Rehabilitation Department (environment)
  - Intensive Care Unit (environment)
- *Used for*
  - Care setting
  - Birth country
  - Living environment
  - Event location type



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# Hierarchy – Staging and scales



- This hierarchy contains such sub-hierarchies as **Assessment scales (assessment scale)**, which names assessment scales; and **Tumor staging (tumor staging)** , which names tumor staging systems.
- Examples
  - Glasgow coma scale (assessment scale)
  - Dukes staging system (tumor staging)
  - Stanford Binet intelligence scale (assessment scale)
- *Used for*
  - Assessments
  - Stage of a disease

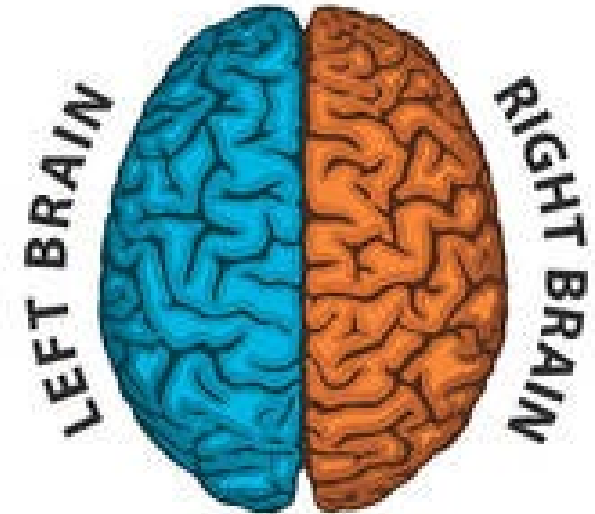
TABLE 38-2		
Glasgow Coma Scale		
BEHAVIOR	RESPONSE	SCORE
Eye opening response	Spontaneously	4
	To speech	3
	To pain	2
	No response	1
Best verbal response	Oriented to time, place, and person	5
	Confused	4
	Inappropriate words	3
	Incomprehensible sounds	2
	No response	1
Best motor response	Obeys commands	6
	Moves to localized pain	5
	Flexion withdrawal from pain	4
	Abnormal flexion (decorticate)	3
	Abnormal extension (decerebrate)	2
	No response	1
Total score:	<i>Best response</i>	15
	<i>Comatose client</i>	8 or less
	<i>Totally unresponsive</i>	3



# Hierarchy – Qualifier value



- The **Qualifier value** hierarchy contains some of the concepts used as values for SNOMED CT attributes that are not contained elsewhere in SNOMED CT.
- Such a code may be used as the value of an attribute in a defining Relationship in pre-coordinated definitions, and/or as the value of an attribute in a qualifier in a post-coordinated expression.
- Examples
  - Unilateral
  - Left
  - Puncture – action
- *Used for*
  - Laterality
  - Severity
  - Priority
  - Medication dose form
  - Route of administration



# Hierarchy – Record artefact



- A **Record artefact** is an entity that is created by a person or persons for the purpose of providing other people with information about events or states of affairs.
- In general, a record is virtual, that is, it is independent of its particular physical instantiation(s), and consists of its information elements (usually words, phrases and sentences, but also numbers, graphs, and other information elements).
- **Record artefact** need not be complete reports or complete records.
- They can be parts of larger **Record artefact** .
- Example
  - Discharge Summary
  - Procedure report
  - Consent form
  - Care Plan



# Hierarchy – SNOMED CT Model Component



- Contains technical metadata supporting the SNOMED CT release.
- Sub-hierarchies of 'SNOMED CT Model Component'
  - Core metadata concept
  - Foundation metadata concept
  - Linkage concept
  - Namespace concept





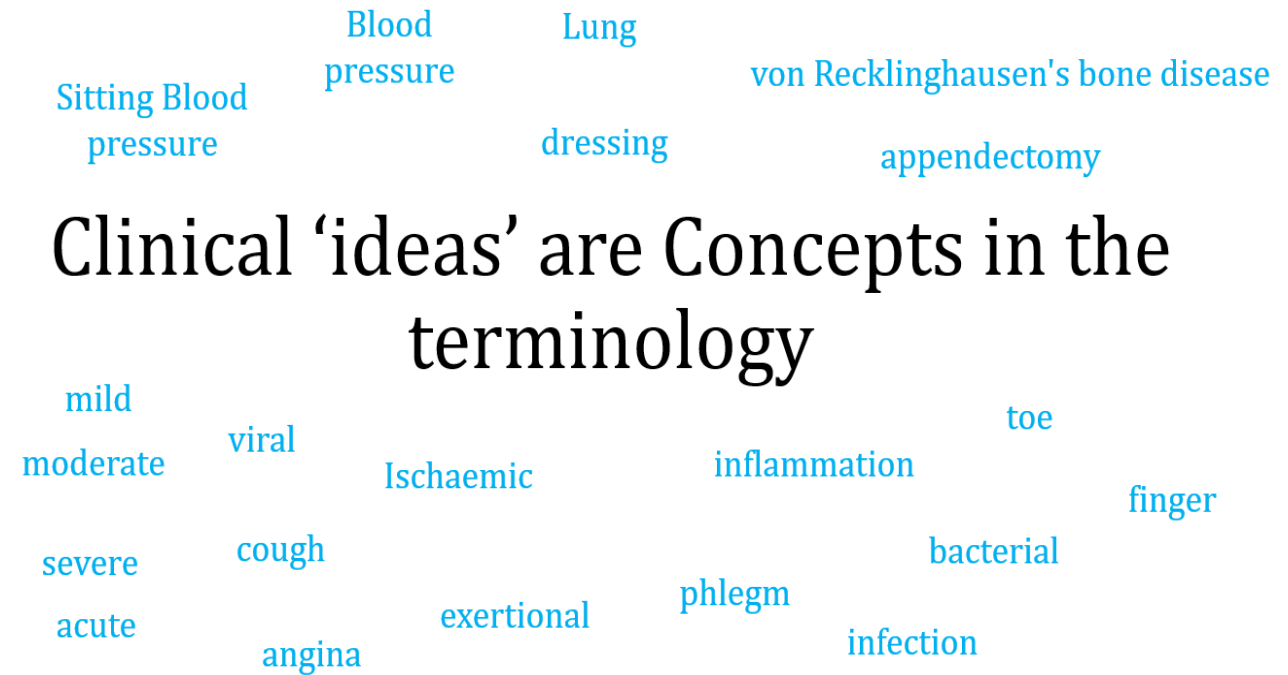
# SNOMED CT BASIC COMPONENTS

# SNOMED CT Basic Components



- Concepts
- Descriptions
- Relationships

- A “concept” is a clinical meaning identified by a unique numeric identifier (ConceptID) that never changes.
- Concepts are represented by a unique human-readable Fully Specified Name (FSN).
- These “logical definitions” give explicit meaning which a computer can process and query on.
- Every concept also has a set of terms that name the concept in a human-readable way.



- Concept is a clinical idea with a **unique numeric identifier**
- SNOMED CT concepts have unique numeric identifiers called ConceptIDs.
- ConceptIDs do not contain hierarchical or implicit meaning.
- The numeric identifier does not reveal any information about the nature of the concept.
- Example:
  - 22298006 | Myocardial infarction(disorder) |

- Concept descriptions are the terms or names assigned to a SNOMED CT concept.
- “Term” in this context means a phrase used to name a concept.
- Types of Descriptions
  - Fully Specified Name (FSN)
  - Synonym

# Descriptions - Fully Specified Name (FSN)



- Each concept has one unique FSN intended to provide an unambiguous way to name a concept.
- The purpose of the FSN is to uniquely identify a concept and clarify its meaning
- Each FSN ends with a “semantic tag” in parentheses at the end of the concept.
- The “semantic tag” indicates the semantic category to which the concept belongs
- Example: Myocardial infarction (disorder)

# Fully Specified Name (FSN)



- Sometimes doctors use the same term to mean different things
- What does FUNDUS mean?
  - Gall bladder fundus
  - Uterine fundus
  - Gastric fundus
  - Fundus of eye
- So how can the confusion be avoided?
- How does the user know which one we are talking about?



# Fully Specified Names for Fundus



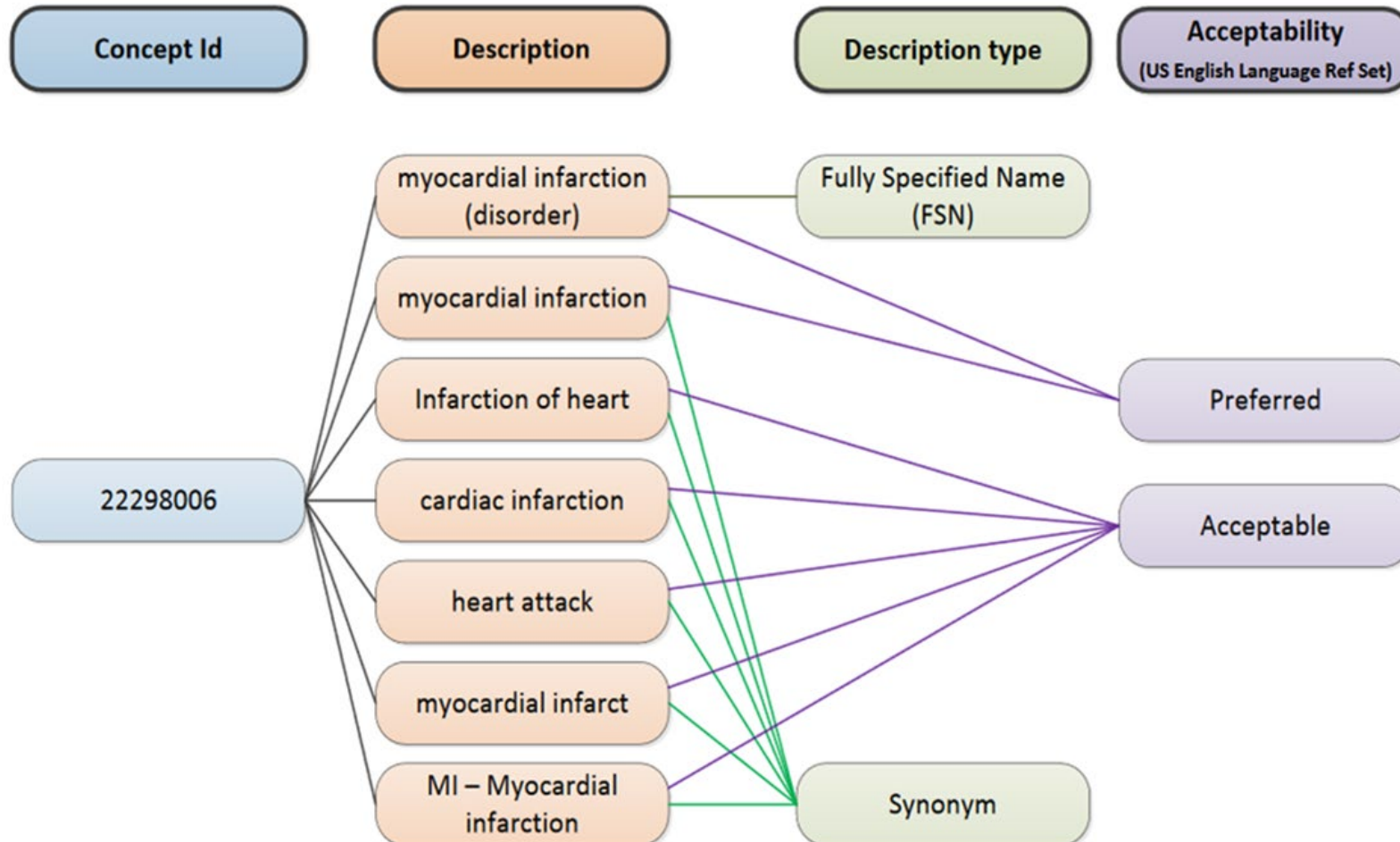
- Structure of fundus uteri (body structure)
  - Structure of fundus of eye (body structure)
  - Structure of fundus of gall bladder (body structure)
  - Gastric fundus structure (body structure)
- 
- If ***fundus*** is selected in a SNOMED CT enabled EMR, the system should also display the FSN to avoid confusion

- Each concept has one Preferred Term meant to capture the common word or phrase used by clinicians to name that concept.
- Preferred Terms are not necessarily unique.
- The Preferred Term for one concept may also be a Synonym or the Preferred Term for a different concept.

Example: Myocardial infarction

# Descriptions

Example of descriptions for a single concept (US - English)



- Clinicians prefer some descriptions to use while communicating
  - e.g. Myocardial infarction
- Some descriptions can be used for the same thing, but are not preferable (acceptable)
  - e.g. MI, infarction of heart
- SNOMED CT includes all these but labels each one appropriately
- So it does not matter which one is used - the end result is always the same. The same ConceptID is saved in the records

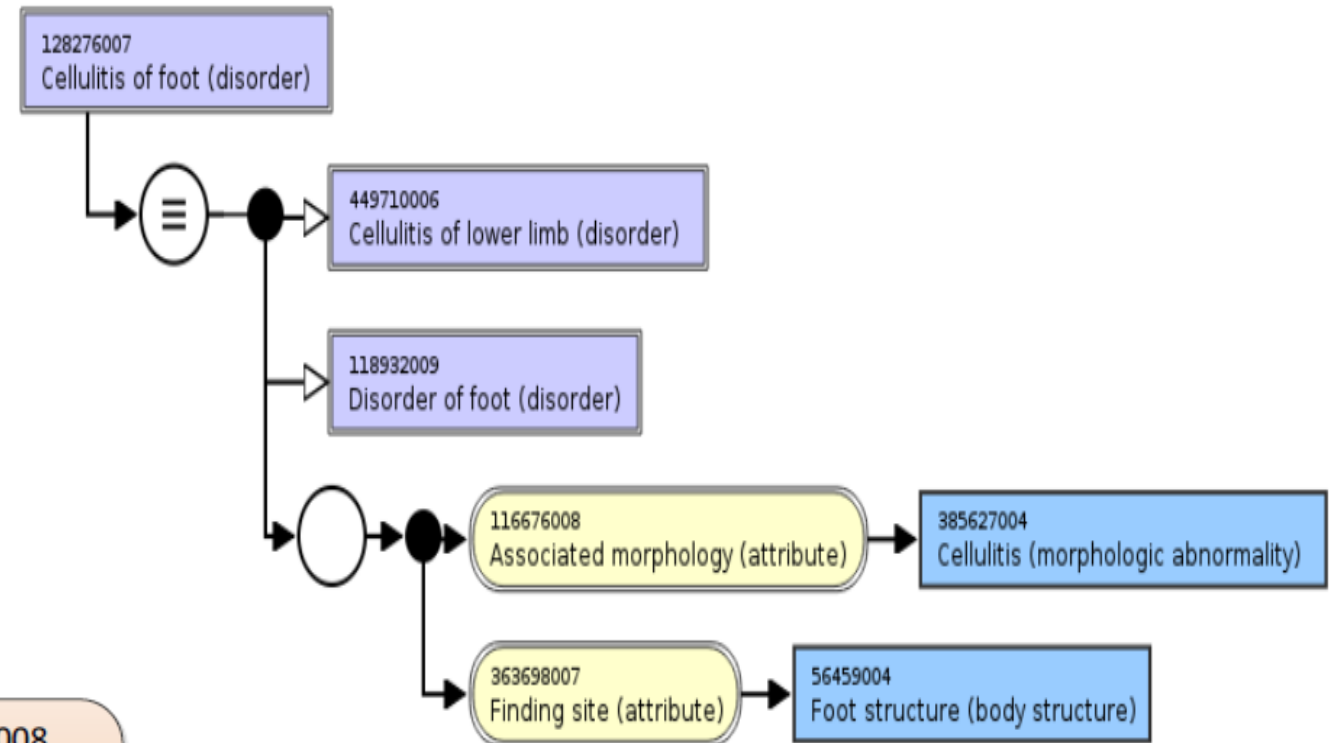
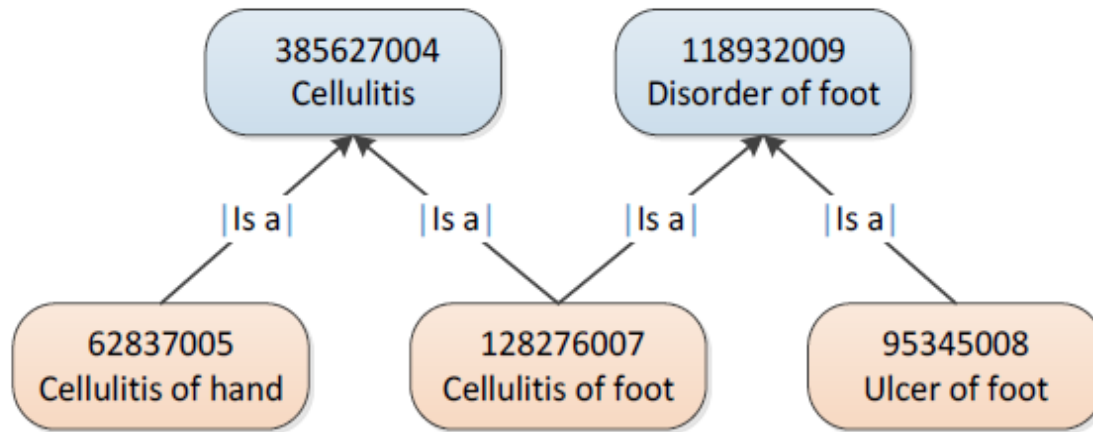
- Relationships link concepts in SNOMED CT.
- Relationships and concept definitions
  - Each concept in SNOMED CT is logically defined through its relationships to other concepts.
  - Every active SNOMED CT concept (except the “SNOMED CT Concept” Root concept) has at least one
- IS\_A relationships
- IS\_A relationships are also known as “Supertype-Subtype relationships” or “Parent-Child relationships.” IS\_A relationships are the basis of the SNOMED CT’s hierarchies.
- Example:
  - Fracture of tarsal bone (disorder)
    - IS\_A Fracture of foot (disorder)
    - FINDING SITE Bone structure of tarsus (body structure)
    - ASSOCIATED MORPHOLOGY Fracture (morphologic abnormality)
  - e IS\_A relationship to a supertype concept.



- Example:
  - Disorder of foot (disorder)
    - IS\_A
  - Injury of foot (disorder)
    - IS\_A
  - Fracture of foot (disorder)
    - IS\_A
  - Open fracture of foot (disorder)

# Relationships

*Example of is a relationships*

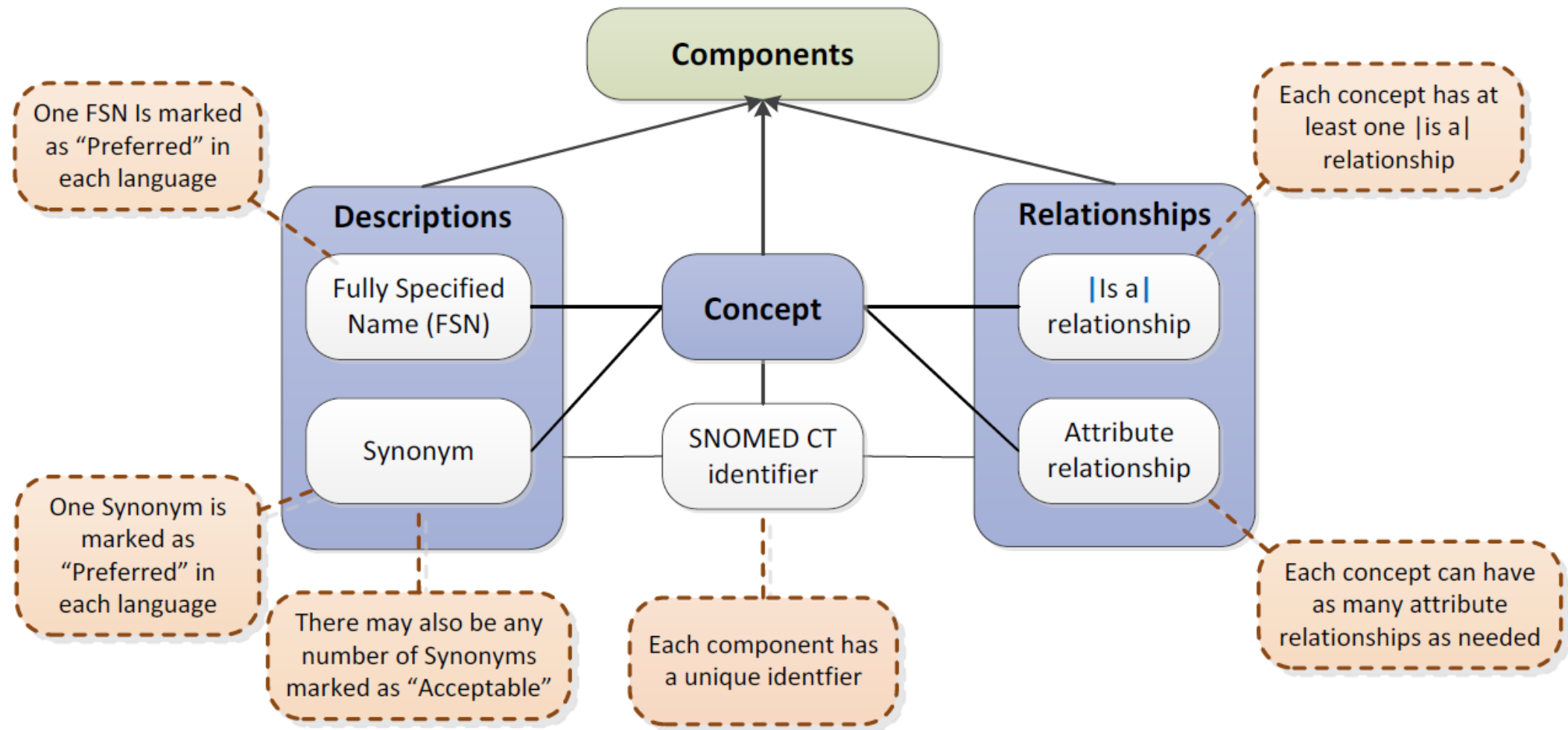


# Aim of Relationships



- To ensure each concept is correctly located in the hierarchy
- To allow querying of data based on any known relationship
- Querying by any of the attribute relationships allows extraction of data matching that attribute relationship

# SNOMED CT Logical Model





# SNOMED CT EXPRESSIONS

- Precoordinated Expression
  - Representation of a clinical meaning using a single concept identifier is referred to as a precoordinated expression.
  - Examples:
    - 31978002 | Fracture of tibia (disorder) |
    - 174041007 | Laparoscopic emergency appendectomy (procedure) |
- Postcoordinated Expression
  - Representation of a clinical meaning using a combination of two or more concept identifiers is referred to as postcoordination.
  - Examples:
    - Laparoscopic removal of device from abdomen
    - 68526006 | Removal of device from abdomen (procedure) | + 86174004 | Laparoscope, device (physical object) |





# SNOMED CT ADDITIONAL COMPONENTS

# SNOMED CT Additional components



- Subsets & Reference Sets
- Extensions
- Cross Maps

- Local or national configuration.
- A SNOMED CT subset is a set of Concepts, Descriptions, or Relationships that is appropriate to deployment to support particular requirements of implementation.
- Descriptions or concepts for particular realms or specialties.
- Suitability of particular concepts for use in a particular context in a record.

Examples: Diagnoses, Procedures, Allergies, Cancer Care

- Extensions
  - The International Edition contains the core content of SNOMED CT.
  - Extensions can be added to the International Edition to meet specific national or local needs.
- Cross Maps
  - Mapping of concepts to other international standards and classifications such as ICD or LOINC.



# ICD AND SNOMED CT

# Difference between ICD and SNOMED CT



Criteria	ICD	SNOMED CT
Scope	<p>Limited</p> <ul style="list-style-type: none"> <li>•Diseases</li> <li>•Related health problems</li> <li>•Procedures</li> </ul>	<p>Broad</p> <ul style="list-style-type: none"> <li>•Diseases</li> <li>•Signs / Symptoms / Other clinical findings</li> <li>•Procedures</li> <li>•Observables</li> <li>•Body structures</li> <li>•Organisms</li> <li>•Substances</li> <li>•Pharmaceutical products</li> <li>•Physical objects</li> <li>•Physical forces</li> <li>•Specimens</li> </ul>
Granularity	<ul style="list-style-type: none"> <li>•Summarizes and aggregates data into broad categories</li> </ul>	<ul style="list-style-type: none"> <li>•Each distinct meaning has a different concept identifier</li> <li>•Records data at a granular level</li> <li>•Allows clinicians to record data at appropriate level of detail</li> </ul>
Statistical Classification Terminology vs.	<p>Mono-hierarchy</p> <p>Each code is grouped into a single grouping</p> <p>E.g. 'viral pneumonia' classified as 'respiratory disease' but not a 'viral disease' or 'infection'</p>	<p>Poly-hierarchy</p> <p>Codes can belong to different groupings based on meaning</p> <p>E.g. 'viral pneumonia' classified as both a 'respiratory disease' and a 'viral disease' (which is a 'infectious disease')</p>



# Difference between ICD and SNOMED CT



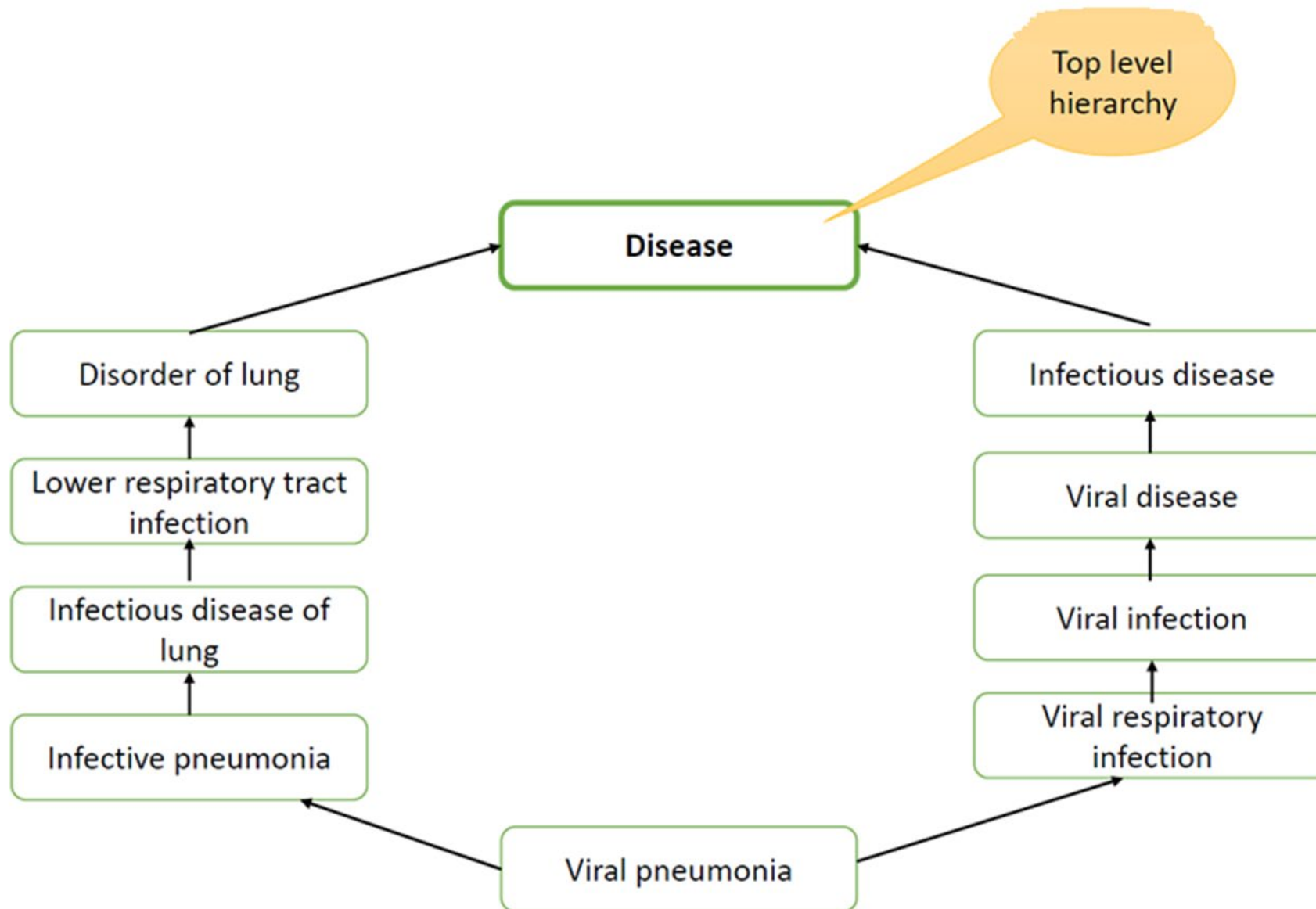
Criteria	ICD	SNOMED CT
Purpose and use	<p>Classifications are essential to the big picture view of healthcare</p> <ul style="list-style-type: none"><li>•Used to summarize and aggregate data</li><li>•Adds statistical value to data</li><li>•Important for use cases where each code must be grouped only once – e.g. billing &amp; statistics</li></ul>	<ul style="list-style-type: none"><li>•Allows data to be recorded at a granular level for clinical purposes</li><li>•Allows data to be grouped and aggregated in different ways</li><li>•Allows data to be queried using relationships between concepts</li></ul>
Purpose and use	<p>Limited value in an individual patient EHR</p> <ul style="list-style-type: none"><li>•Represents one dimension of meaning</li><li>•No links to body sites, causes etc</li><li>•Groups multiple clinical meanings together using a single code</li><li>•Does not always represent sufficient detail for clinical purposes</li></ul>	
Other	Not sufficient for clinical queries	Supports meaningful health records

# SNOMED CT to ICD-10 Example



- Direct Map (single group): 246951001  
Group 1 Rule1 ALWAYS H10.8
- Gender Based Map (male, female): 84814009  
Group 1 Rule1 FEMALE Q52.8  
Group 1 Rule2 MALE Q55.8
- Gender Map (female, otherwise): 398318005  
Group 1 Rule1 FEMALE N76.8  
Group 1 Rule2 ALWAYS N49.8
- Direct Map (multiple group): 713175006  
Group 1 Rule1 ALWAYS J20.9  
Group 2 Rule1 ALWAYS Y83.9

# Poly-hierarchy in SNOMED CT



- 75570004 |Viral pneumonia (disorder)|
  - Viral lower respiratory infection
  - Infective pneumonia
- In SNOMED CT these linkages are already present
- In ICD these will have different codes.....so what will the doctor enter?
  - One code or two codes...
- So to conclude – SNOMED CT will be more beneficial in encoding clinical data

- SNOMED CT has concepts, each one for a discrete clinical idea
- Each concept can have multiple descriptions, in different languages or dialects
- One of these descriptions is marked as the preferred term
- The coverage of SNOMED CT is very extensive as well as granular
- All concepts are arranged in a hierarchy so that the data can be viewed at any level of granularity
- There is an independent system of classification (poly-hierarchy) not relying on code structures (as in the case with ICD-10)

- [SNOMED CT Starter Guide](#)
- [SNOMED CT Technical Implementation Guide](#)



# Thank You

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