COMP2322:
Introduction to Health Informatics

Medical Terminologies: Coding Standards

(Semantic Interoperability related standards)

Time: Tues+ Thur: 13:00-13:50

Location: Masri406

Section: 1

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Medical Terminologies: Coding Standards

Learning Objectives:

1. Understanding what is meant by medical coding.
2. Understanding the deference between Classification & Nomenclature
3. Understanding coding process.
4. Identify and understand the purpose and classification structure of different medical terminologies and classification systems:
    1. The International Classification of Diseases (ICD)
    2. The Systematized Nomenclature of Medicine (SNOMED)
    3. The Read codes
    4. Logical Observations, Identifiers, Names and Codes (LOINC)
    5. Standardized (NORMalised) names for clinical drugs (RxNorm)
    6. The Unified Medical Language System (UMLS)
7. E. Distinguish between different classification systems.

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What is clinical coding?

- Translation of or defining narrative text into codes
- Creates consistent understanding of clinical information
- Creates an agreed upon classification of clinical concepts or information within a consistent classification system
- Enables consistently allocating appropriate code(s) to the correct clinical concepts

Classification & Nomenclature

Recall

- **Classification**
  - is a system that classifies or organizes entities or concepts into distinct classes or categories - groups similar or related concepts within connected classes
- **Nomenclature**
  - A system of naming, i.e. a system for devising or choosing of names for things – i.e. for concepts in a domain without looking at similarities.

Classification

- classifies diseases that are similar and groups them under one category (or code class)
- Produces limited number of categories or classes

Nomenclature

- Generates a separate listing for every condition and therefore a separate code for every disease
- Produces very extensive and detailed codes

Clinical Data Terminology/Vocabulary/ Coding Standards

- Controlled Medical Terminology/ Vocabulary:
  - **ICD9/ICD10** (International Classification of Diseases, ver. 9/ver. 10)
  - **SNOMED -CT** (Standardized Nomenclature of Medicine, Clinical Terms)
  - **LOINC** (Logical Observation, Identifiers, Names and Codes) – Lab results
  - **RxNorm** (normalized naming system for generic and branded drugs)
  - **RCT** (Read Codes Terms, ver. 2.x, ver. 3.x) – specific to the UK
  - **NLM UMLS** (Unified Medical Language System): inclusive of all coding systems, and mapping between them

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ICD

The International Classification of Diseases

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ICD: The International Classification of Diseases

- ICD provides a code sets for
  - diseases, signs and symptoms,
  - abnormal findings, complaints, social circumstances, and
  - external causes of injury or diseases.

- ICD-9 was widely used, currently in its tenth revision (ICD-10).
- Eleventh version under development.

ICD: Revisions

- ICD-7:
  - The Seventh Revision Conference was held in Paris in **1955** and, the revision was limited to essential changes.
- ICD-8:
  - The Eighth Revision Conference was convened by WHO in Geneva in **1965**. The Eighth Revision was much more extensive.
- ICD-9:
  - The International Conference for the Ninth Revision was convened by WHO in Geneva in **1975** and it came into effect from 1979.
- ICD-10:
  - was endorsed by the Forty-third World Health Assembly in May **1990** and came into use in WHO Member States as from 1994.

ICD: The International Classification of Diseases

- Published by World Health Organization (WHO).
- Updated every year, but major revisions in every roughly 10 years.

- ICD-9-CM: US adopted its clinically modified version in 1979.
- ICD-10-CM: used to code death on death certificates since 1999.

ICD: The International Classification of Diseases

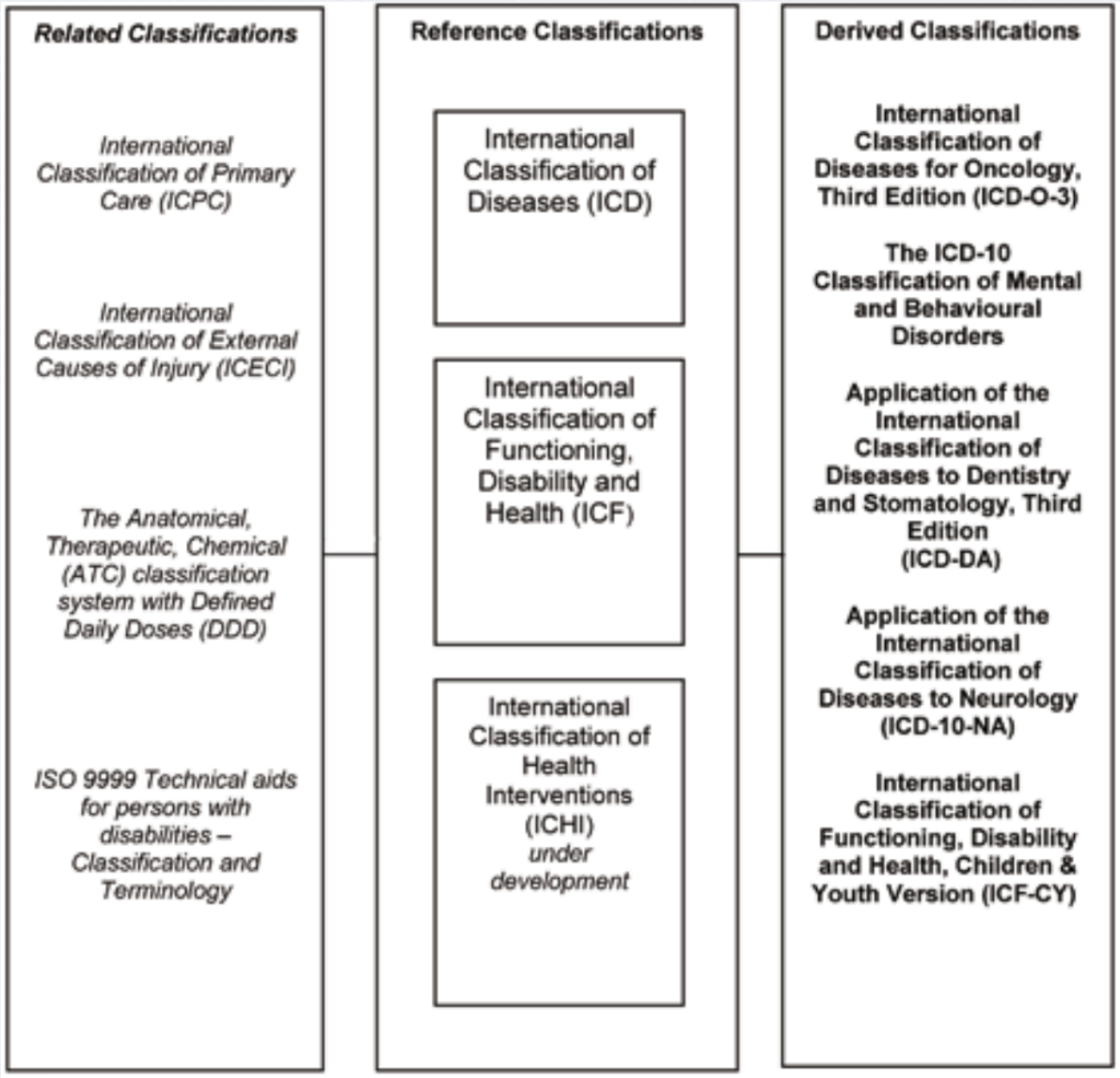
- ICD versions
  - ICD-9 ➔ The old **numeric** version of ICD
  - ICD -10 ➔ The current **alpha-numeric** version of the ICD
  - ICD -11 ➔ The future version of the ICD (under development)
    - More usable and compatible with Web Application
    - Can be easily integrated with the EHR

- ICD-9 has more than ***14,000 disease codes,*** while ICD-10-CM has more than ***68,000 disease codes***, allowing to record or track many new or more specific **diagnosis** (**five time** more than ICD-9)
- ICD-9 has more than ***3,000 procedure coding system***, while ICD-10-PCS has more than ***87,000*** procedure codes

ICD: The International Classification of Diseases

- ICD has
  - **Reference classification** of diseases (main parameters of the health system: death, disease, functioning, disability, health and health interventions):
    - **ICD-10-CM**: Clinical Modification (has 68,000 codes)
    - **ICD-10-PCS**: Procedural Classification System (87,000 codes)
  - **Derived classifications**: support specialty-based adaptions or classifications:
    - **ICD-O-3** : Oncology
    - **ICD-DA**: Dentistry and Stomatology
    - **ICD-10-NA**: Neurology
    - **ICD-10** for Mental and Behavioural Disorders

ICD: The International Classification of Diseases



- Schematic representation of WHO Family of International Classifications

Source: ICD10Volume2

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ICD: Purpose and Usage

- ICD-10 is often used as a coding system for:
  - diseases, and diagnosis,
  - procedure and
  - a point of reference for medication management
- Published by **WHO**:
  - to collect morbidity and mortality data from different countries around the world
  - for the identification of health trends and statistics globally.
  - to ensure Data systematically collected and statistically analysed
  - can be used for both billing and statistical analyses
  - can be used to code and classify mortality data from death certificates.

ICD: Purpose and Usage

- ICD-10 is also used as a point of reference for medication management system (decision support)
  - ICD-10 enables contraindication/precaution checking
  - ICD-10 enables drug-disease interaction checking
- ICD-10 used for EMR
  - ICD-10-CM: often used for (outpatient) medical disease coding and reporting
  - ICD-10-PCS: often used for (inpatient) medical procedure coding
- ICD-10 can help
  - track and reveal information about quality of healthcare.
  - healthcare providers to better understand medical complications, better design treatment and care, and better comprehend and determine the outcome of care.

ICD: Purpose and Usage

- For counting of deaths, diseases, injuries, symptoms, reasons for encounter, factors that influence health status, and external causes of disease.

- It organises information into standard groupings/classes of diseases, which allows for:
  - easy storage, retrieval and analysis of health information for evidence-based decision- making;
  - sharing and comparing health information between hospitals, regions, settings and countries; and
  - data comparisons in the same location across different time periods.

ICD: Who are the Primary Users?

- Users include
  - Physicians,
  - Nurses,
  - health workers,
  - researchers,
  - health information managers,
  - policy-makers
  - insurers and
  - national health programme managers

ICD-10: Basic Classification Structure

- Originally proposed by William Farr,
  - ICD-10 is a variable-axis classification - diseases are classified as:
    - epidemic diseases
    - constitutional or general diseases
    - local diseases arranged by site
    - developmental diseases
    - Injuries
- It has 3 main elements to the structure
  - 3 volumes
  - 22 chapters
  - alphanumeric codes

ICD-10: Classification Structure

- Three-volume clinical classification, comprised of:
  - **Main Classification-Tabular List** (**Volume 1**)
    - Alphanumeric listing of diseases
  - **Instruction Manual** (**Volume 2**)
    - Introduction, instructions and guidelines for Vol 1 & 2
  - **Alphabetical Index** (**Volume 3**)
    - Comprehensive alphabetical index of diseases and conditions found in the Tabular List

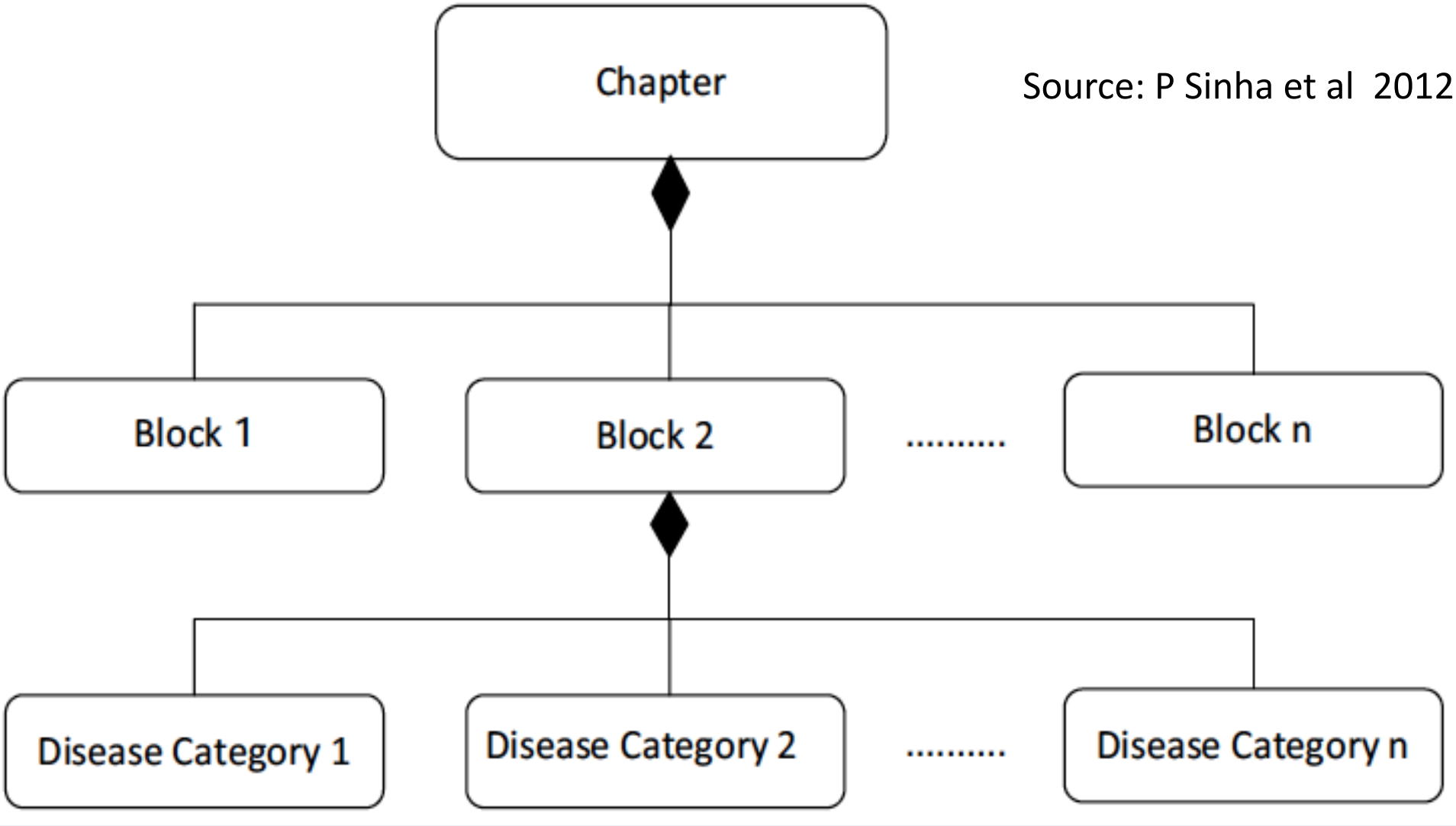
ICD-10: Classification Structure

- **Tabular List – Volume 1 - is** organised into Chapters and blocks:
  - It has 22 chapters, groupings of diseases and injuries, numbered I-XXII (roman numerals).
  - Chapters 1 to 17 deal with a specific types of diseases
  - Chapters 18 to 22 deal with other types of health problems
- ICD **Blocks**: Within the chapters, codes are divided up into blocks of 3 character categories (usually by site or type of disease)
  - Blocks describe diseases of a group of similar categories based on their characteristics within a chapter
- Example
  - Chapter 11 describes diseases of the digestive system
  - Chapter 11 consists of 10 blocks.
  - One block is related to the diseases of appendix.

ICD-10: Chapters

- **Chapters I to XVII (1-17)**: Diseases and other morbid conditions
- **Chapter XVIII (18)**: Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified.
- **Chapter XIX (19)**: Injuries, poisoning and certain other consequences of external causes.
- **Chapter XX (20)**: External causes of morbidity and mortality,
- **Chapter XXI (21)**: Factors influencing health status and contact with health services.

ICD10: Structure Hierarchy



Source: P Sinha et al 2012

Concepts/Coding Standards
ICD Codes Chapters

Chapter No.	Blocks	Contents
Ch. I (1)	A00-B99	Certain infectious and parasitic diseases
Ch. II (2)	C00-D48	Neoplasms
Ch. III (3)	D50-D89	Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism
Ch. IV (4)	E00-E90	Endocrine, nutritional and metabolic diseases
Ch. V (5)	F00-F99	Mental and behavioral disorders
Ch. VI (6)	G00-G99	Diseases of the nervous system
Ch. VII (7)	H00-H59	Diseases of the eye and adnexa
Ch. VIII (8)	H60-H95	Diseases of the ear and mastoid process
Ch. IX (9)	I00-I99	Diseases of the circulatory system
Ch. X (10)	J00-J99	Diseases of the respiratory system
Ch. XI (11)	K00-K93	Diseases of the digestive system
Ch. XII (12)	L00-L99	Diseases of the skin and subcutaneous tissue
Ch. XIII (13)	M00-M99	Diseases of the musculoskeletal system and connective tissues

Concepts/Coding Standards
ICD Codes Chapters

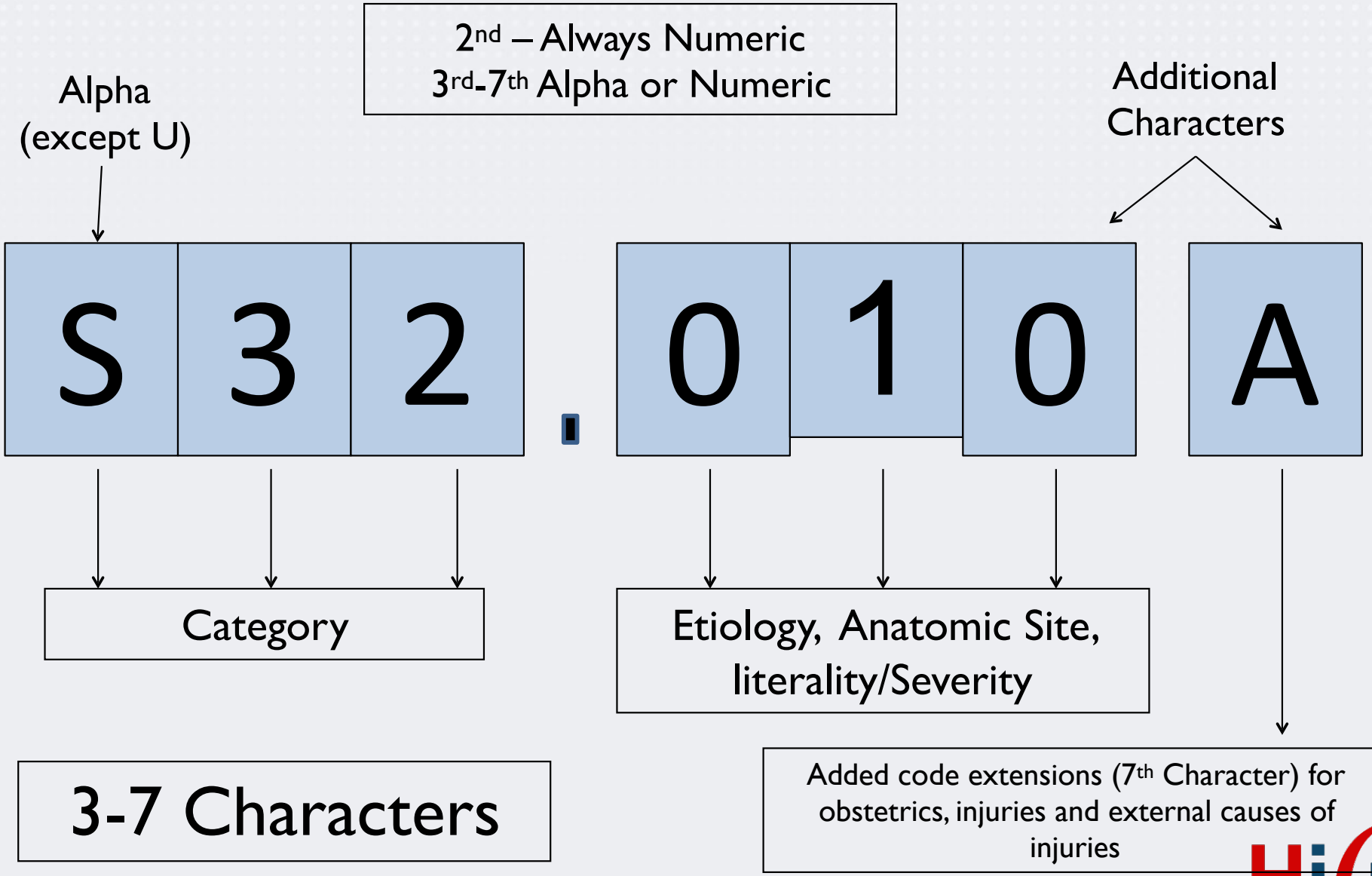
Chapter No.	Blocks	Contents
Ch. XIV (14)	N00-N99	Diseases of the genitourinary system
Ch. XV (15)	O00-O99	Pregnancy, childbirth and the puerperium
Ch. XVI (16)	P00-P96	Certain conditions originating in the perinatal period
Ch. XVII (17)	Q00-Q99	Congenital malformations, deformations and chromosomal abnormalities
Ch. XVIII (18)	R00-R99	Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified
Ch. XIX (19)	S00-T98	Injury, poisoning and certain other consequences of external causes
Ch. XX (20)	V01-Y98	External causes of morbidity and mortality
Ch. XXI (21)	Z00-Z99	Factors influencing health status and contact with health services
Ch. XXII (22)	U00-U99	Codes for special purposes

Table 23.1 The International Classification of Diseases, tenth revision chapter headings

Chapter I	Infectious and parasitic diseases
Chapter II	Neoplasms
Chapter III	Diseases of the blood and blood-forming organs and certain disorders affecting the immune mechanism
Chapter IV	Endocrine, nutritional and metabolic diseases
Chapter V	Mental and behavioural disorders
Chapter VI	Diseases of the nervous system
Chapter VII	Diseases of the eye and adnexa
Chapter VIII	Diseases of the ear and mastoid process
Chapter IX	Diseases of the circulatory system
Chapter X	Diseases of the respiratory system
Chapter XI	Diseases of the digestive system
Chapter XII	Diseases of skin and subcutaneous tissue
Chapter XIII	Diseases of musculoskeletal system and connective tissue
Chapter XIV	Diseases of the genitourinary system
Chapter XV	Pregnancy, childbirth and the puerperium
Chapter XVI	Certain conditions originating in the perinatal period
Chapter XVII	Congenital malformations, deformations and chromosomal abnormalities
Chapter XVIII	Symptoms, signs and abnormal clinical and laboratory findings
Chapter XIX	Injuries, poisoning and certain other consequences of external causes
Chapter XX	External causes of morbidity and mortality
Chapter XXI	Factors affecting health status and contact with health services of a person not currently sick

From World Health Organization, 2011.

ICD-10-CM (diagnosis) Code Format



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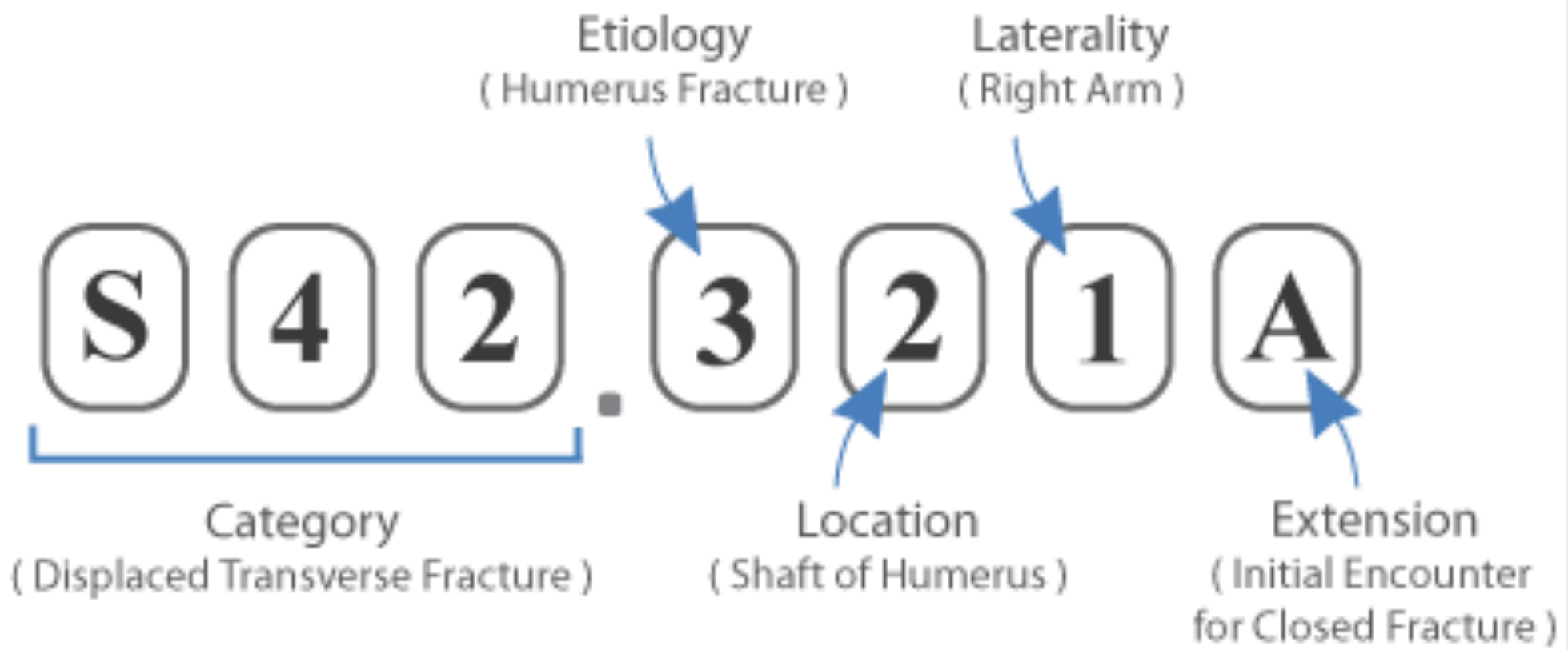
ICD-10 Example

- Displaced transverse fracture of shaft of humerus, right arm, initial encounter for closed fracture



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Why change from ICD9 to ICD 10?

- ICD-9-CM is out-of-room for more codes
- In ICD 9, can only be 10 subcategories for each 3 digit category

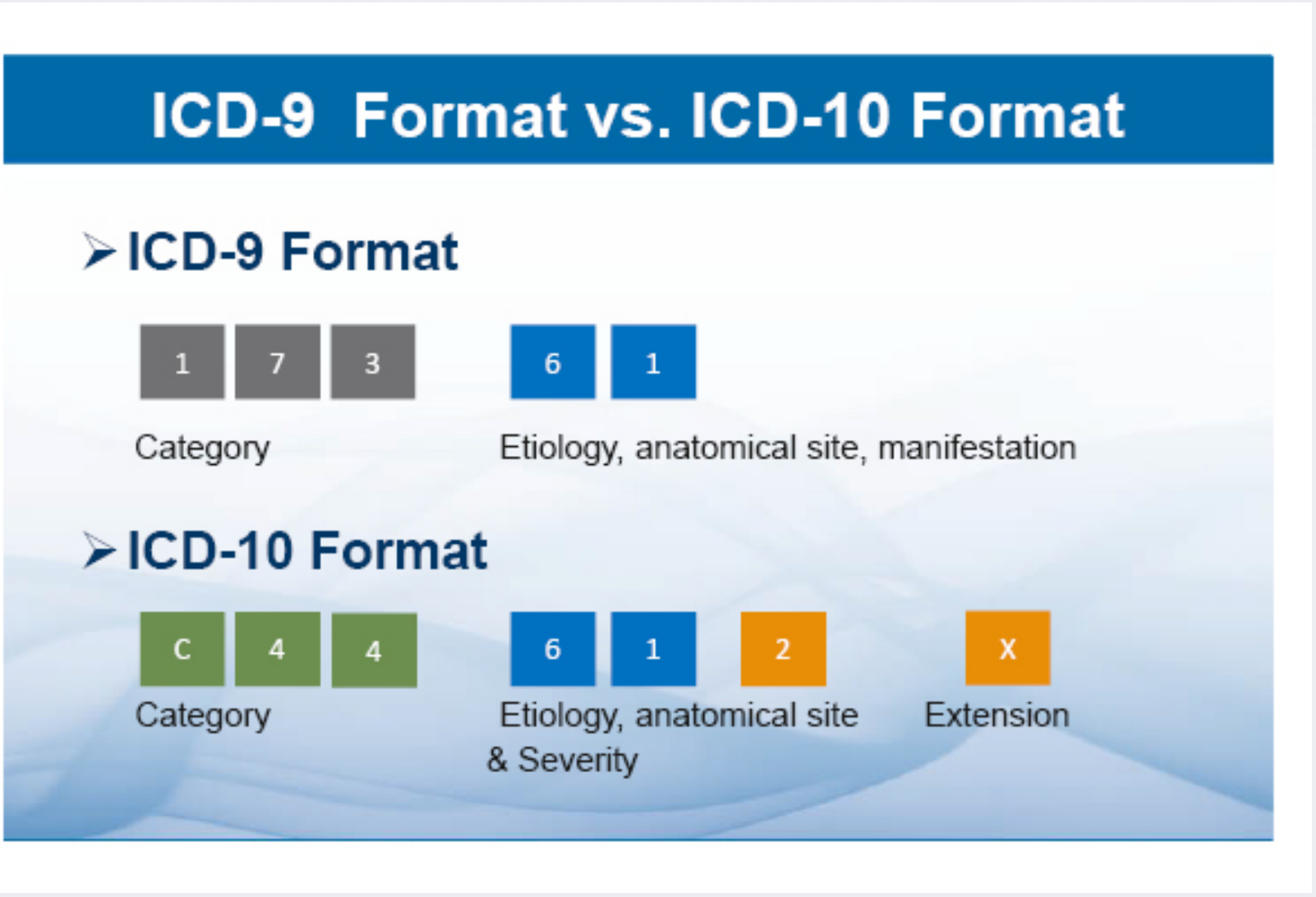
- Whilst, in ICD 10
  - structure is classified scientifically based on purpose
  - disease patterns and outcomes of treatment can be better analysed
  - it provides a clearer view of diagnosis
  - Uses single codes, which can report a disease and current manifestation
  - Provides higher specificity
    - e.g. diseases of the ovary can be reported with ICD-10-CM as unspecified ovary, right ovary, left ovary, or bilateral; ICD-9-CM only specifies disease of ovary

Diagnosis Code Structure Comparison

ICD-9-CM (Volume 1 & 2)	ICD-10-CM
3-5 characters in length	3-7 characters in length
Approximately 14,000 codes	Approximately 68,000 codes
First digit may be alpha (E or V) or numeric; digits 2-5 are numeric	Digit 1 is alpha (to indicate the category); Digit 2 is numeric (in the future, alpha characters may be used if code expansion is needed); Digits 3-7 can be alpha or numeric
Limited space for adding new codes	Flexible for adding new codes
Lacks detail	Very specific
Lacks laterality	Includes laterality (i.e., codes identifying right vs. left)

ICD-9 vs. ICD-10 Code Format

- Example Disease: Basal cell carcinoma of skin of upper limb, including shoulder



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Comparison: ICD-9 to ICD-10

434.11	Cerebral embolism with infarction
Code represents embolism of cerebral arteries with infarction	

With specificity and laterality, one ICD-9 code translates into 14 possible ICD-10 codes

I63.40	Cerebral infarction dew to embolism of unspecified cerebral artery
I63.49	Of other cerebral artery
I63.411	Of right middle cerebral artery
I63.412	Of left middle cerebral artery
I63.419	Of unspecified middle cerebral artery
I63.421	Of right anterior cerebral artery
I63.422	Of left anterior cerebral artery
I63.429	Of unspecified anterior cerebral artery
I63.431	Of left posterior cerebral artery
I63.432	Of right posterior cerebral artery
I63.439	Of unspecified posterior cerebral artery
I63.441	Of right cerebellar artery
I63.442	Of left cerebellar artery
I63.449	Of unspecified cerebellar artery

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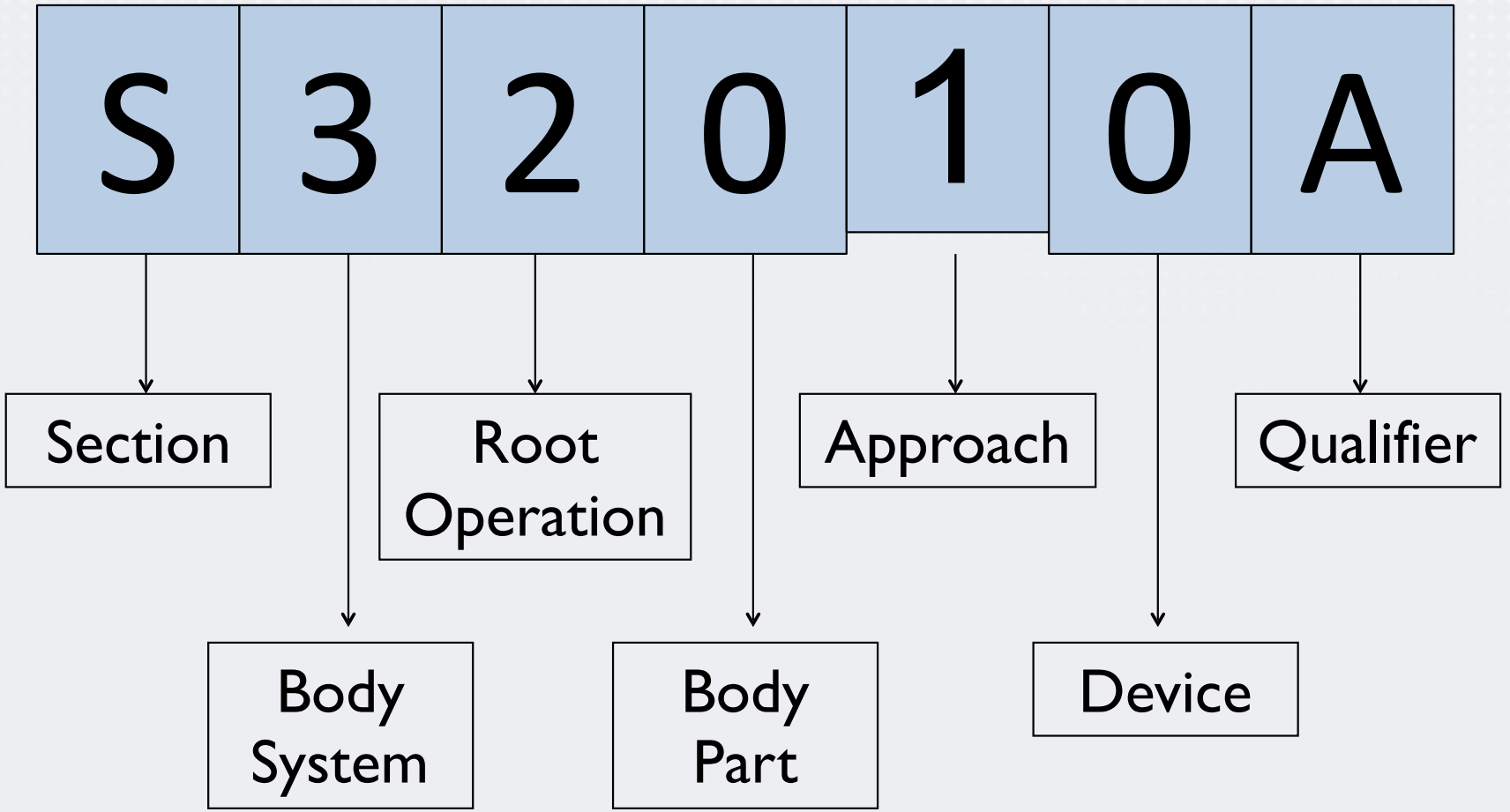
ICD-10-PCS Code Format



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Procedure Code Structure Comparison

ICD-9-CM (Volume 3)	ICD-10-PCS
3-4 numbers in length	7 alpha-numeric characters in length
Approximately 3,000 codes	Approximately 87,000 available codes
Based on outdated technology	Reflects current usage of medical terminology and devices
Limited space for adding new codes	Flexible for adding new codes
Lacks detail	Very specific
Lacks laterality	Has laterality
Generic terms for body parts	Detailed descriptions for body parts
Lacks descriptions of methodology and approach for procedures	Provides detailed descriptions of methodology and approach for procedures
Lacks precision to adequately define procedures	Precisely defines procedures with detail regarding body part, approach, any device used, and qualifying information

Comparison: ICD-9 to ICD-10

ICD-9 Procedure Code
39.50 Angioplasty
39.31 Suture of artery
47.01 Laparoscopic appendectomy

ICD-10 Procedure Code
0DN90ZZ Release of duodenum, open approach
0FB03ZX Excision of liver, percutaneous approach, diagnostic
02PS0CZ Removal, extraluminal device from pulmonary vein, right, open

ICD-10 online Browser

ICD-10 Version:2016

Search [Advanced Search]

ICD-10 | Versions - Languages | Info

ICD-10 Version:2016

I Certain infectious and parasitic diseases

A00-A09 Intestinal infectious diseases

A00 Cholera

A00.0 Cholera due to Vibrio cholerae 01, biovar cholerae

A00.1 Cholera due to Vibrio cholerae 01, biovar eltor

A00.9 Cholera, unspecified

A01 Typhoid and paratyphoid fevers

A02 Other salmonella infections

A03 Shigellosis

A04 Other bacterial intestinal infections

A05 Other bacterial foodborne intoxications, not elsewhere classified

A06 Amoebiasis

A07 Other protozoal intestinal diseases

A08 Viral and other specified intestinal infections

A09 Other gastroenteritis and colitis of infectious and unspecified origin

A15-A19 Tuberculosis

A20-A28 Certain zoonotic bacterial diseases

A30-A49 Other bacterial diseases

International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10)-WHO Version for ;2016

Chapter I
Certain infectious and parasitic diseases (A00-B99)

Intestinal infectious diseases (A00-A09)

A00	**Cholera**
A00.0	**Cholera due to Vibrio cholerae 01, biovar cholerae** Classical cholera
A00.1	**Cholera due to Vibrio cholerae 01, biovar eltor** Cholera eltor
A00.9	**Cholera, unspecified**
A01	**Typhoid and paratyphoid fevers**
A01.0	**Typhoid fever** Infection due to Salmonella typhi
A01.1	**Paratyphoid fever A**
A01.2	**Paratyphoid fever B**
A01.3	**Paratyphoid fever C**
A01.4	**Paratyphoid fever, unspecified** Infection due to Salmonella paratyphi NOS
A02	**Other salmonella infections**

ICD-11: Development

- **Internet-based** permanent platform
  - All year round
  - Open to all people in a structured way
  - Content experts focus
- **Digital** curation
  - Wiki enabled collaboration
  - Ontology based
- Enhanced discussion & peer review
  - TAGs serve as the editorial group
- Will be available in Electronic copy & printed version (multiple languages)

SNOMED CT

Systematized Nomenclature of Medicine

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SNOMED

- The **Systematized Nomenclature of Medicine**
  - A collection of internationally accepted clinical concepts, terms, and their relationships
  - SNOMED is designed to be:
    - Comprehensive, multilingual clinical healthcare terminologies
    - A resource with scientifically validated clinical content.
    - Enables consistent, process-able representation of clinical content in **electronic health records**
    - Can be mapped to other international standards.
    - Already used in more than fifty countries.
  - SNOMED organizes concepts in **hierarchical** manner to describe **specific to general** clinical terms/processes

SNOMED CT

- National Library of Medicine's UMLS is the point of reference for SNOMED codes
- SNOMED is now freely available for use for U.S. and developing countries users
- It is maintained by International Health Terminology Standards Development Organization (IHTSDO)

SNOMED

- SNOMED is a **hierarchical**, **multi-axia** classification system.
- Terms are assigned to 1 of 11 independent **systematized modules**, correspondin to different axes of classification.

Table 23.3 The SNOMED International modules (or axes)

Module designator
Topography (T)
Morphology (M)
Function (F)
Diseases/Diagnoses (D)
Procedures (P)
Occupations (J)
Living Organisms (L)
Chemicals, Drugs and Biological Products (C)
Physical Agents, Forces and Activities (A)
Social Context (S)
General Linkage-Modifiers (G)

SNOMED RT

- **SNOMED RT (Reference Terminology)** was released in 2000 to support the electronic storage, retrieval and analysis of clinical data.
- A reference terminology provides a common reference point of terminology for the entire healthcare process, recorded by multiple different individuals, systems or institutions.
- In SNOMED RT, the relationships between terms and concepts are contained in an optimized hierarchy table.
- Each individual concept is expressed using a description logic/Ontology, which makes explicit the information that was implicit in earlier codes.

SNOMED CT

- **SNOMED CT (Clinical Terminology)** is designed for use
  - in software applications such as the electronic patient record and decision support systems and
  - to support the electronic communication of information among different clinical applications.
- Its designers' ambitious goal was that SNOMED CT should become the accepted international terminological resource for healthcare
- The most comprehensive, multilingual clinical healthcare terminology in the world.
- Created by the merging of SNOMED RT (Reference Terminology) with CTV3 (Clinical Terms version 3, famously known as Read Codes V3) in 2002.

SNOMED CT

- SNOMED covers several types of medical terminologies (named as hierarchies) for
  - Disorders and finding (what was observed)
  - Procedures (what was done)
  - Body structure (locations and literality)
  - Event (what happened)
  - Substance/Medication (what was consumed/administered)
  - + anything to capture Medical data

- SNOMED is designed and formulated as an **Ontology**
  - i.e. Each Concept could have relationships with other Concepts

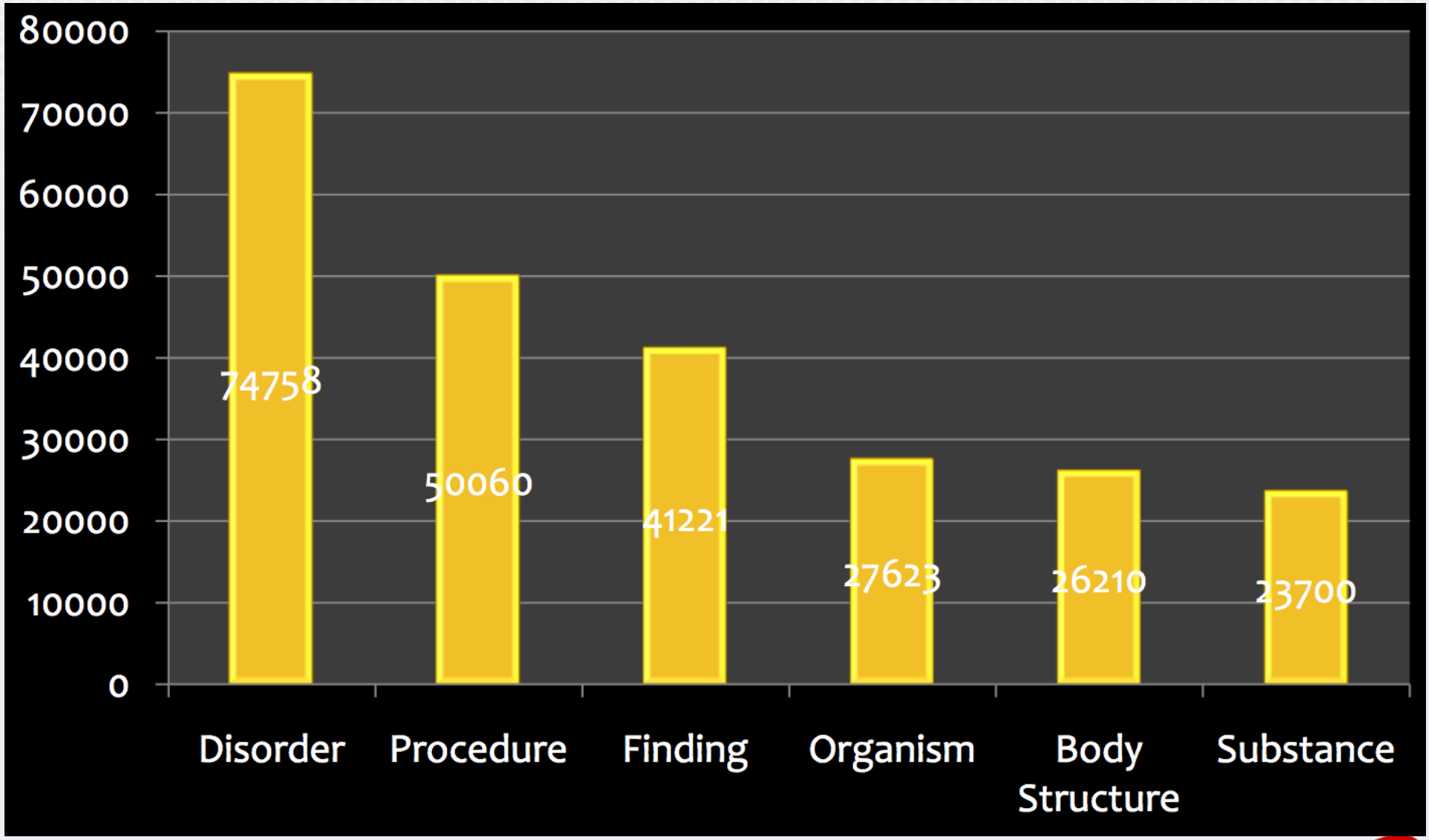
SNOMED-CT Building Blocks: Three parts

- **Concepts**
  - The anchors for meaning
- Concepts have **Descriptions**
  - Terms (strings of readable characters) used to express the meanings of the concepts in human language Relationships
- All Concepts are divided in "**Hierarchies**"
  - Hierarchies do not overlap- e.g. Clinical Finding/Disorder, Procedure, Substance, etc.
  - More than 20 main hierarchies in SNOMED-CT
- **Relationships**
  - Concept-to-concept links used to express information in computer-process-able language

SNOMED-CT: Code vs Concept vs Class vs Instance

- Code:
  - any sequence of characters used to represent something in a coding system
  - SNOMED Clinical Terms Identifier (SCTID):
    - a sequence of 6 to 18 digits that identifies a component
- Concept:
  - an idea which has meaning. Through its meaning, a person can identify specific instances of the concept
- Class:
  - An abstract category of things sharing common features
- Instance:
  - A particular real member of a class

SNOMED-CT Top Hierarchies



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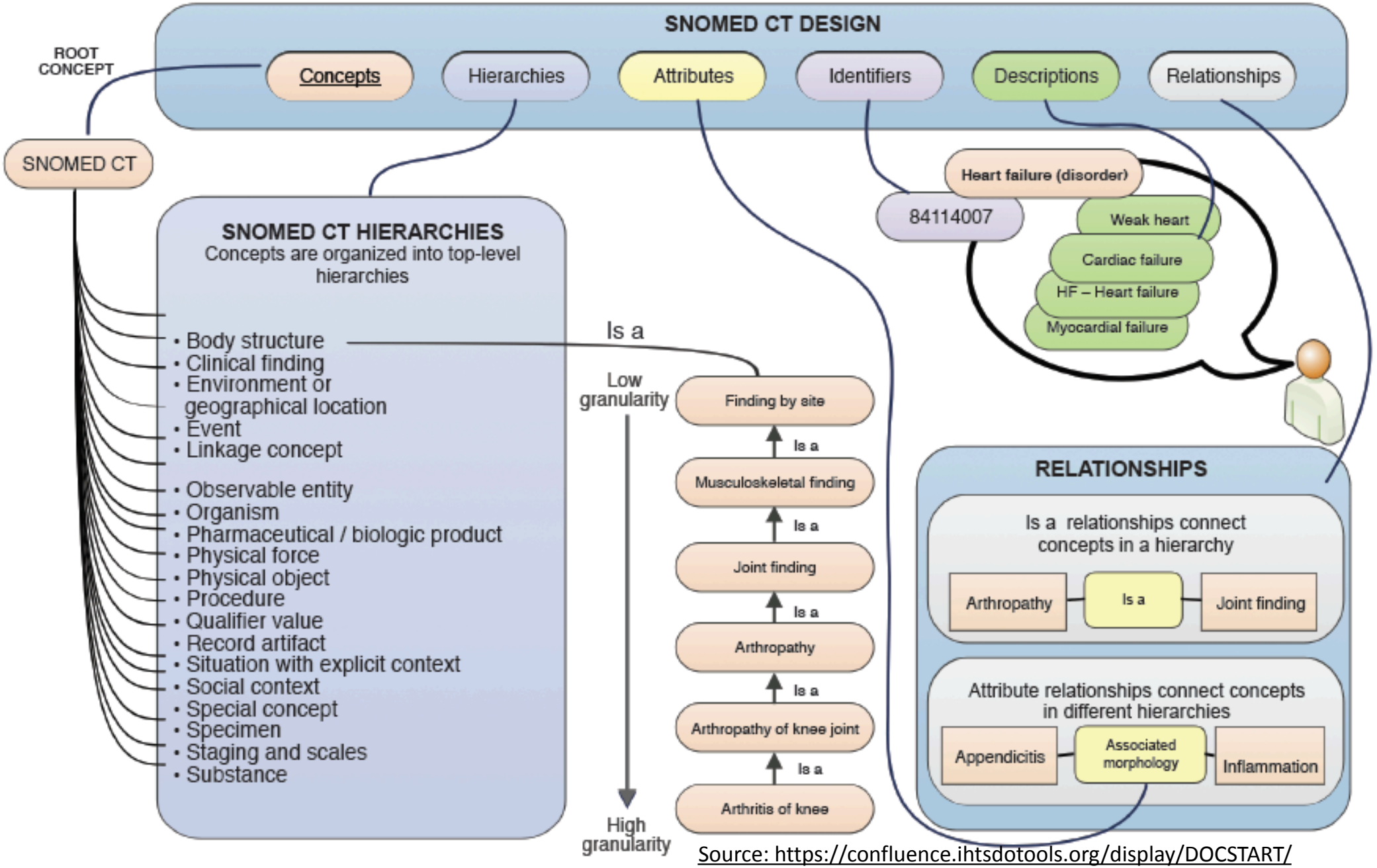
SNOMED-CT: Disorders Vs findings

- Disorders and findings often used interchangeably
- "Finding"
  - is a general observation or a judgment of the patient's physical, mental or social condition (current or historical).
  - can be vague. e.g.:
    - Patient complaints/Symptoms (e.g., cough, shivering)
    - Lab result observations (e.g., Allergy Skin Test Positive)
    - Social setting (e.g., Unsafe play area, Patient's dependents)
- A "Disorder" or "Disease" is
  - a sub-set of "Finding" concept that are necessarily abnormal physical or mental conditions for the patient. e.g.:
    - Tuberculosis; Angina, Class I
- A Finding may be the initial diagnosis of the patient's condition which may lead to the discovery of a Disorder. e.g.,
  - A complaint of Chest pain (Finding) may lead to a final diagnosis of Angina, Class I (Disorder)
  - Bleeding of Gums (Finding) may lead to Hematoma of gingiva (Disorder)
  - Cough (Finding) may lead to Tuberculosis (Disorder)

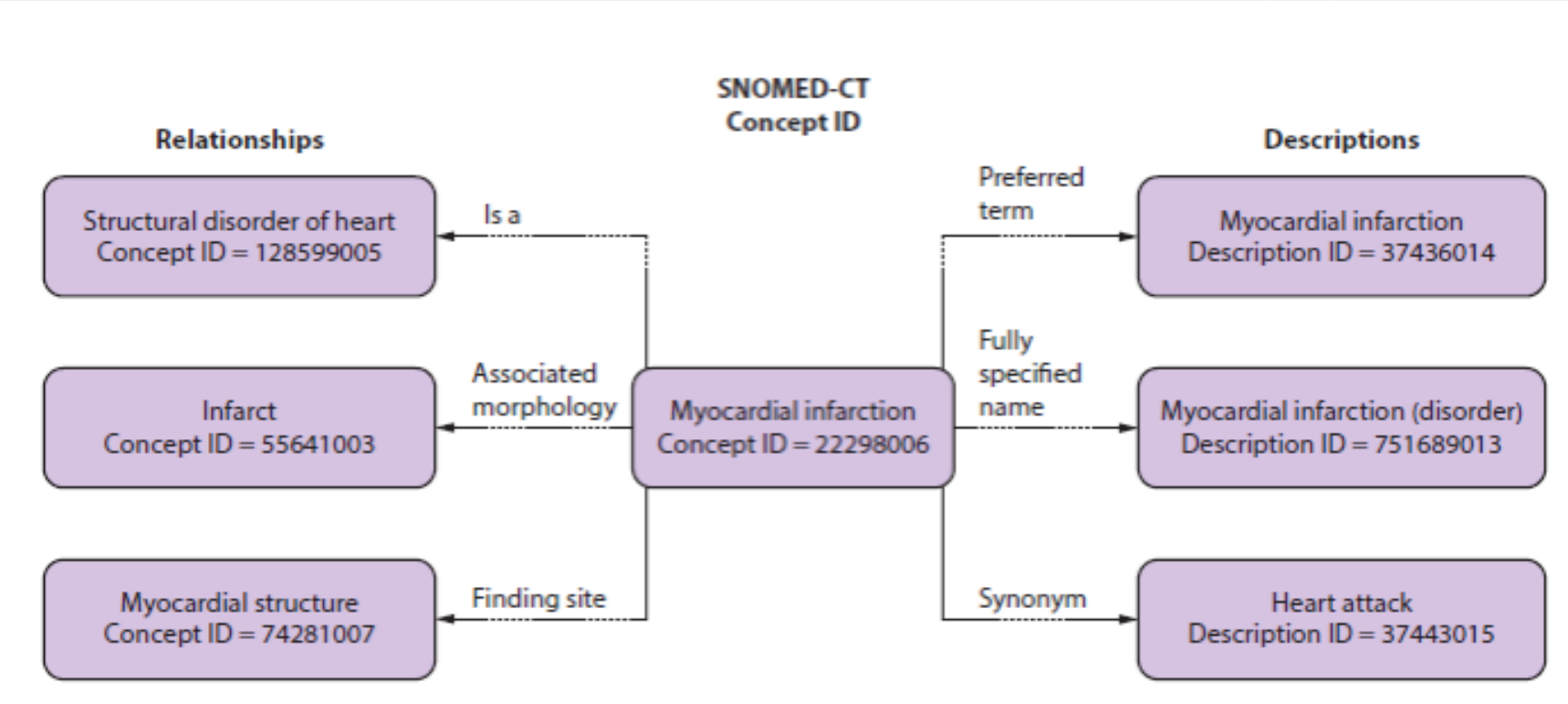
SNOMED CT – General Concept Design



Source: https://confluence.ihtsdotools.org/display/DOCSTART/

SNOMED CT: Classification Structure

- The SNOMED CT core structure includes concepts, descriptions (terms) and the relationships between them.
- Like SNOMED-RT and CTV3, SNOMED CT is a compositional and hierarchical terminology.



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SNOMED CT Building Blocks: Concept Id

1. Concept-Id

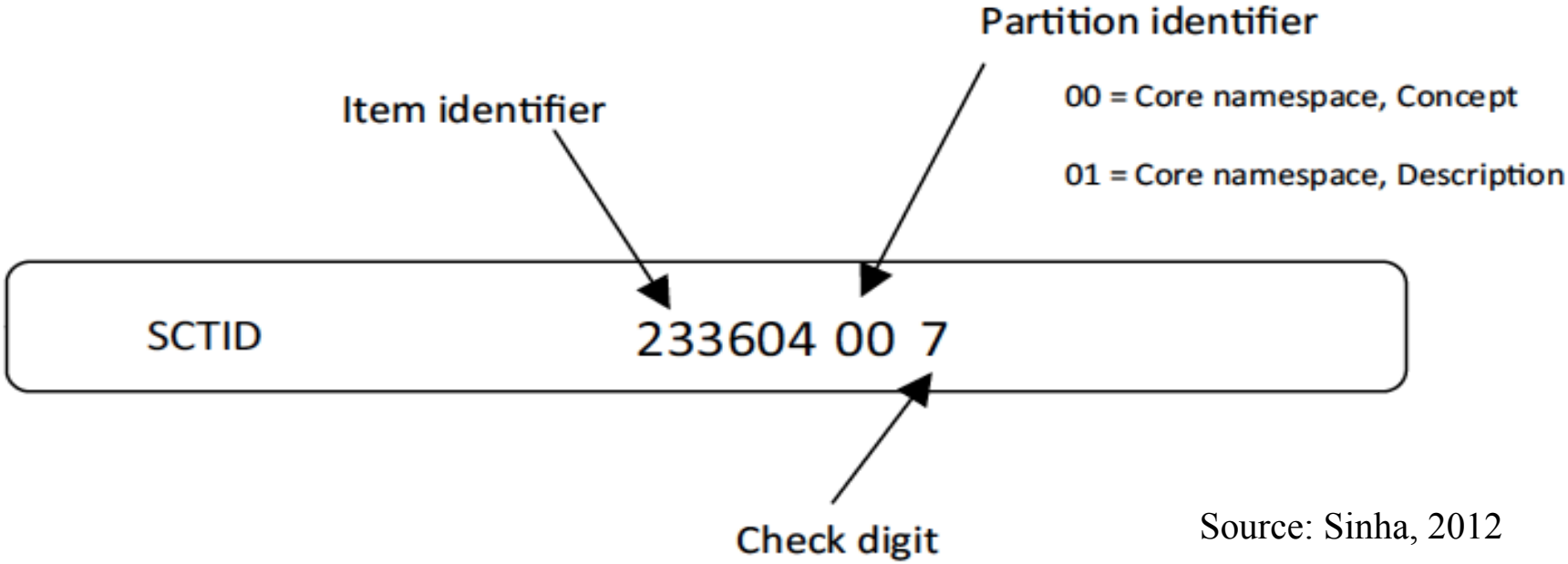
- Unique identifiers which defines **hierarchies of concepts**
- Concept hierarchies are identified according to concepts' areas in clinical recordings such as
  - Clinical finding
  - Procedure
  - Event
  - Body structure
  - Special concept

Example

- Blood bank inventory control **IS-A**
  - Blood bank procedure **IS-A**
    - Procedure

SNOMED CT: Concept-Id

- **Concept-Id** consists of three parts:
  - **Item identifier**: It identifies a particular concept.
  - **Partition identifier**: It represents the namespace for the identifier (e.g., Concept, Description, or Relationship).
  - **Check digit**: It represents validity of the Concept-Id and acts as a checksum digit.



Source: Sinha, 2012

SNOMED CT Codes

- More Examples
  - **333164** 00 8 |Alcohol products (product)|
  - **249368** 00 6 |Bleeding point in nose (finding)|
  - **127848** 00 9 |Spouse (person)|
  - **185349** 00 3 |Encounter for check up (procedure)|

SNOMED CT Building Blocks: Descriptions

2. Descriptions:

- A set of associated **phrases**, each representing a synonym that describes the same clinical concept/term
- It is also providing a human readable description to concept
- Every description has a unique numeric description identifier

Example:

- **Myocardial Infarction** is a SNOMED CT concept with **Id 22298006**
- It is synonymous to **Heart Attack**
- **Myocardial Infarction** having **Description-Id 751689013**.
- **Heart Attack** having **Description-Id 37443015.**
- The same concept can have **multiple descriptions** (?)
- Different health practices may describe it in different way
  - But essentially their meaning is the same.

SNOMED CT Building Blocks: Relationships

3. Relationships:

- define the meaning of a concept in relation to other concepts using relationships such as ***IS-A***
- Different concepts are related with **IS-A relationship**, called defining relationship
- **IS-A relationship** describe **general to specific** categories of a particular concept

Example

Open fracture foot IS-A	(more specific)
Fracture of foot IS-A	(Specific)
Injury of foot IS-A	(general)
Disorder of foot.	(more general)

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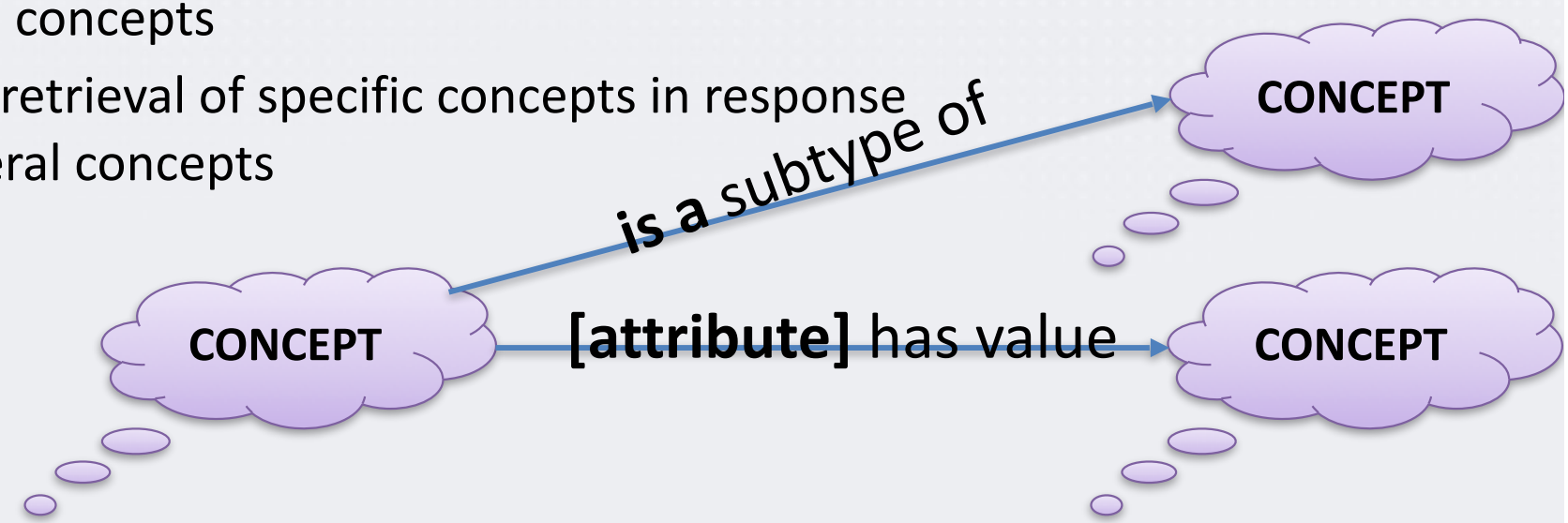
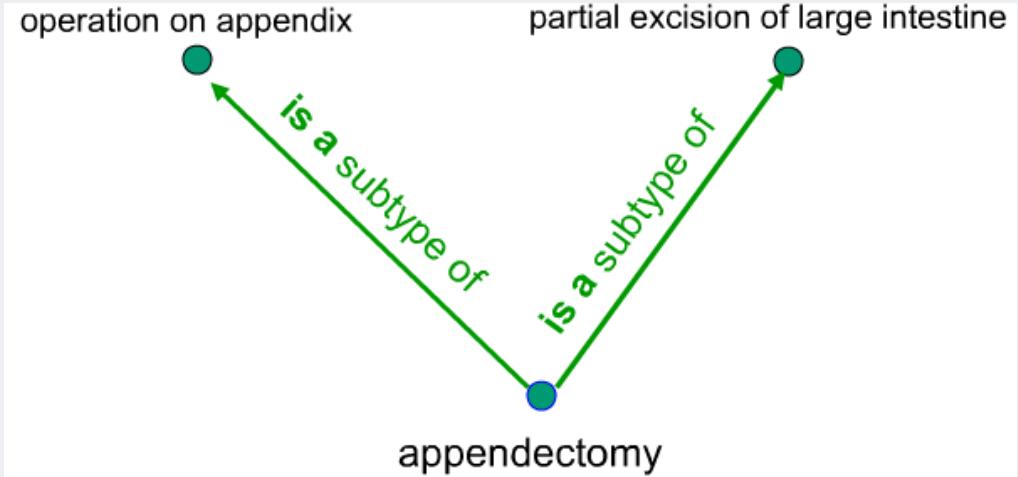
SNOMED CT Building Blocks: Relationships

3. Relationships:

- Subtype relationships
  - Create a hierarchy linking each concept to more general concepts
  - Enable retrieval of specific concepts in response to general concepts





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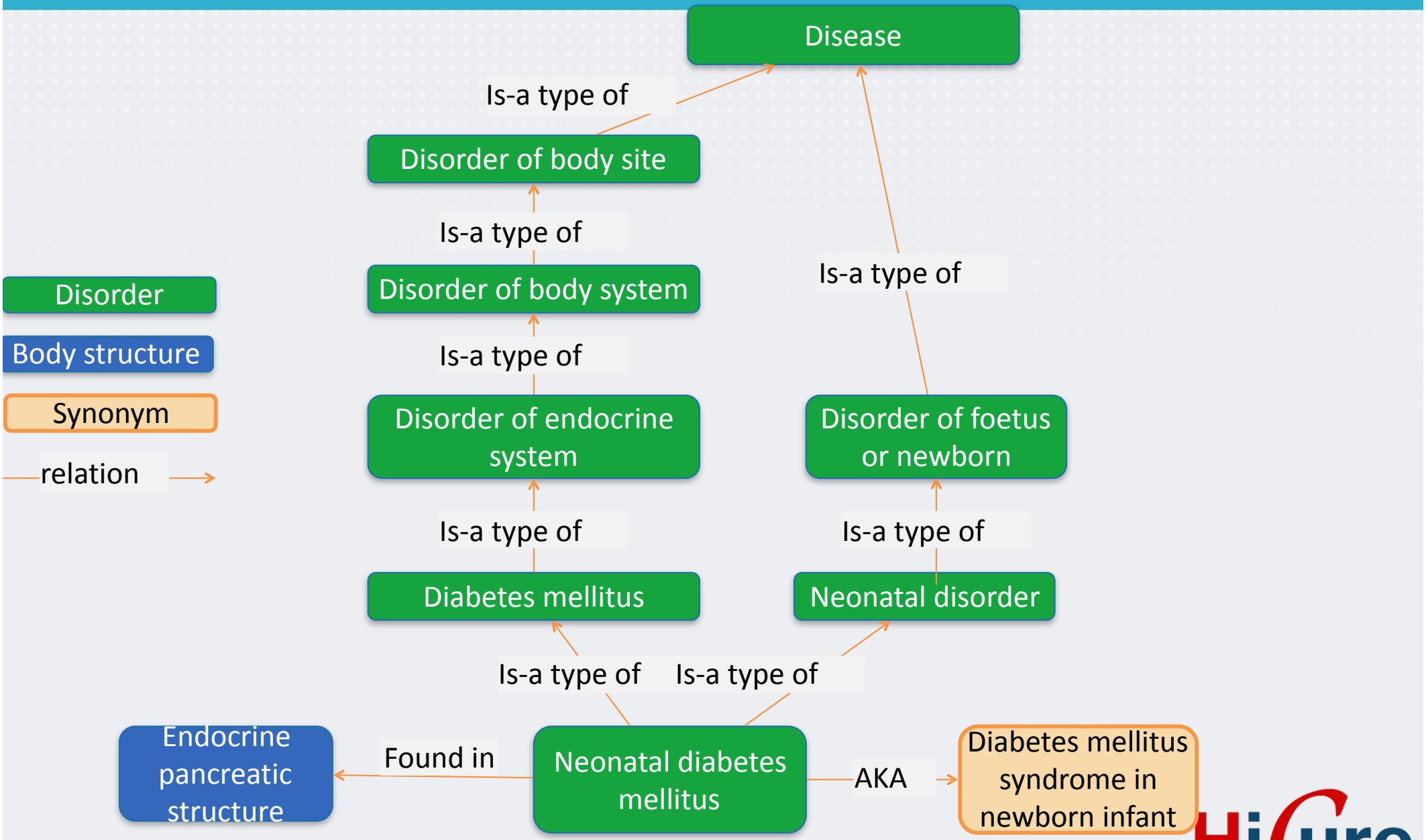
SNOMED-CT: Example-1



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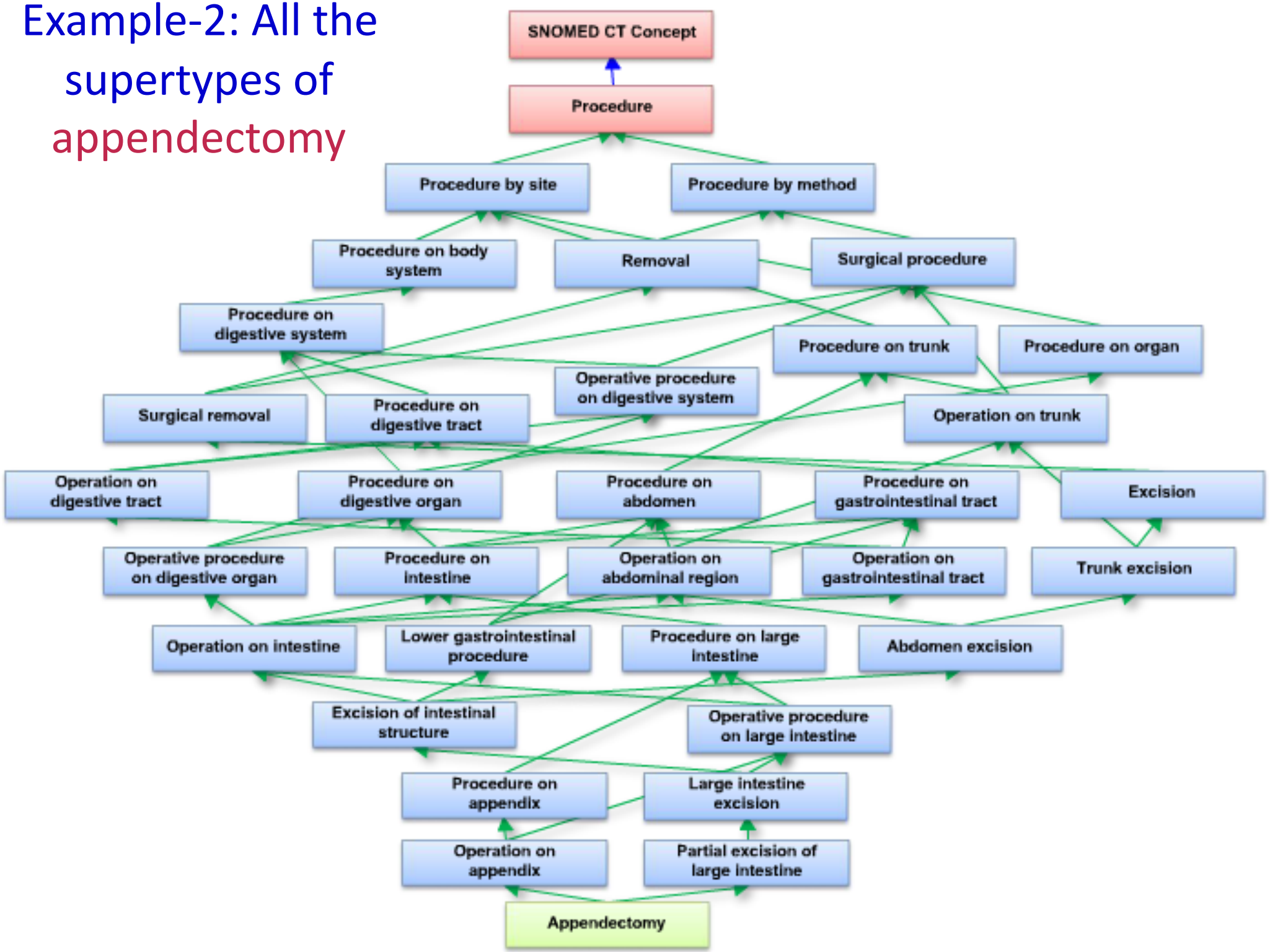
Example-2: All the supertypes of appendectomy



SNOMED CT: Relationship Types

- SNOMED CT defines the following relationships types:
  1. **Defining**: relationships represent **IS-A** relationships to define an attribute.
  2. **Qualifying**: relationships represent **non-defining**, **qualifying** attributes
  3. **Historical:** relationships assist in retiring concepts in SNOMED CT. These relationships relate **retired/inactive** concepts to **active** concepts.
  4. **Additional:** relationships represent other **non-defining** characteristics. For example, previous version of SNOMED CT, called SNOMED RT, had a relationship called **PART_OF**. SNOMED CT retains this as an additional relationship

SNOMED CT & Patient's Health Status

- SNOMED CT coding terminology uses **concept identifiers** and their **relationships** to represent health status of a patient such as **health problem** as follows:
  - Description of the health problem
  - Finding site
  - Position of organ
  - Characteristics of the problem

Example: next slides

SNOMED CT: Example

- **Headache**
  - **IS-A ache**: **finding-site** = **head structure**
  - (and headache is marked as “defined” in concepts table).
- The class “headache” is sufficiently defined as the set of instances of the class “ache”
- Which also have at least one finding-site relationship to an instance of the class “head structure”.
- And all instances of class “ache” with some finding-site relationship to an instance of “head structure” are instance

=> That’s what we mean when you say “headache”? i.e. ache in head

SNOMED CT & Patient's Health Status

Example

Assume a patient that has a Hand pain in his/her left hand's thumb structure. The pain is evaluated as severe

SNOMED CT describes this problem using formal expression as follows:

- **Attribute**: represented as attributeName" = " attributeValue
- **Refinements**: represented by " **:** " explaining parameters of preceding code.

Example➔ **53057004:363698007**

represents **53057004** (Hand pain) that having **363698007** (Finding Site).

- **Attribute Set**: represented by (attribute, attribute) defining list of attributes refining previously described concept.

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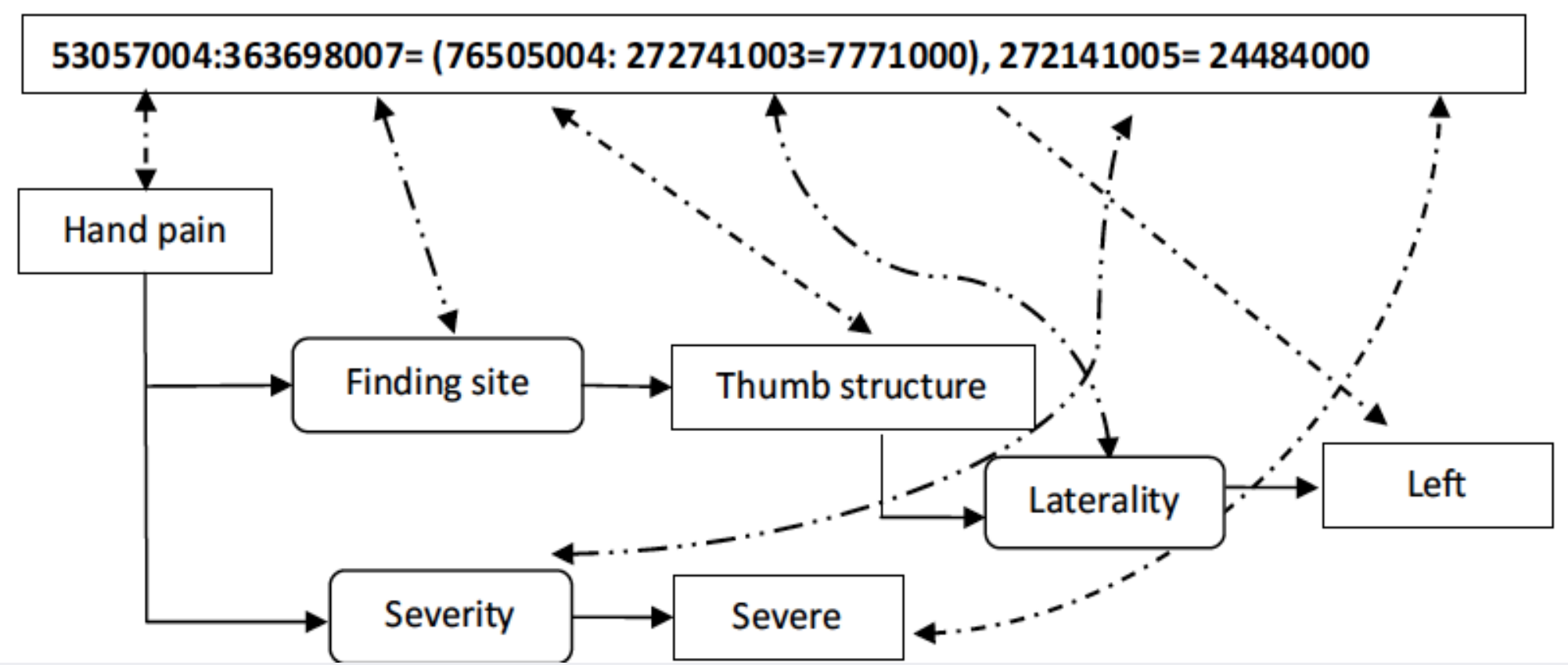
SNOMED CT & Patient's Health Status

Complete Example represented as:



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SNOMED CT: Pre- & post-coordination

- Pre-coordination:
  - how to represent a concept individually using a SNOMED-CT code or concept-id

Terminology producer provides a single conceptid for the meaning

- 31978002
  - means “fracture of tibia”

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SNOMED CT: Pre- & post-coordination

- Post-coordination:
  - how to represent a concept complete with its relationships within SNOMED-CT

A user composes a combination of conceptids to represent the meaning

- 31978002 : 272741003 = 7771000
  - (fracture of tibia : laterality = left)
  - In human readable form …
    "fracture of left tibia"

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SNOMED-CT Vs ICD-9/10

- ICD-9/10 are relatively old:
  - ICD9 was developed in 1970s! ICD10 is ~27 years old!
- ICD is a classification whereas SNOMED is a Nomenclature (complete terminology)
  - ICD tends to be more abstract.
  - With SNOMED the user can get a more accurate description
  - ICD-9/10 tend to have a “unspecified” slot for most disorders.
- SNOMED is far more extensive than ICD9/10 ICD
  - ICD covers disorders/diseases and procedures
- SNOMED is implemented as an ontology
  - Any number of relationships can be defined for each concept

SNOMED-CT Vs ICD-9/10

- SNOMED CT:
  - is better suited for capturing relevant data during an encounter
  - Allows the user to capture the various aspects associated with a disorder
  - Allows the user to capture associated information like Severity, Body part affected, Cause (force or substance), laterality (viz., left or right), Morphology (form) in structured form

- ICD9/10 – used in cases where data need NOT be very granular
  - Each code is very rigidly defined and does not support qualifiers
  - Used in Insurance billing, Morbidity recording (death cause etc.), Epidemiological tracking (public health surveillance)

- Usually, SNOMED CT is considered a good way to enter the medical information and ICD9/10 is considered a good way to export information

Mapping ICD-10, ICD-9, & SNOMED

Clinical Interface to the Standards

IMO Clinical Terms	IMO Mappings		
	ICD-10-CM	ICD-9-CM	SNOMED-CT
Hypertension	I10	401.9	38341003
Type II diabetes mellitus	E11.9	250.00	44054006
COPD (Chronic obstructive pulmonary disease)	J44.9	496	13645005
Seborrheic dermatitis	L21.9	690.10	50563003
Hemorrhoids	K64.9	455.6	70153002
Lactose intolerance	E73.9	271.3	267425008

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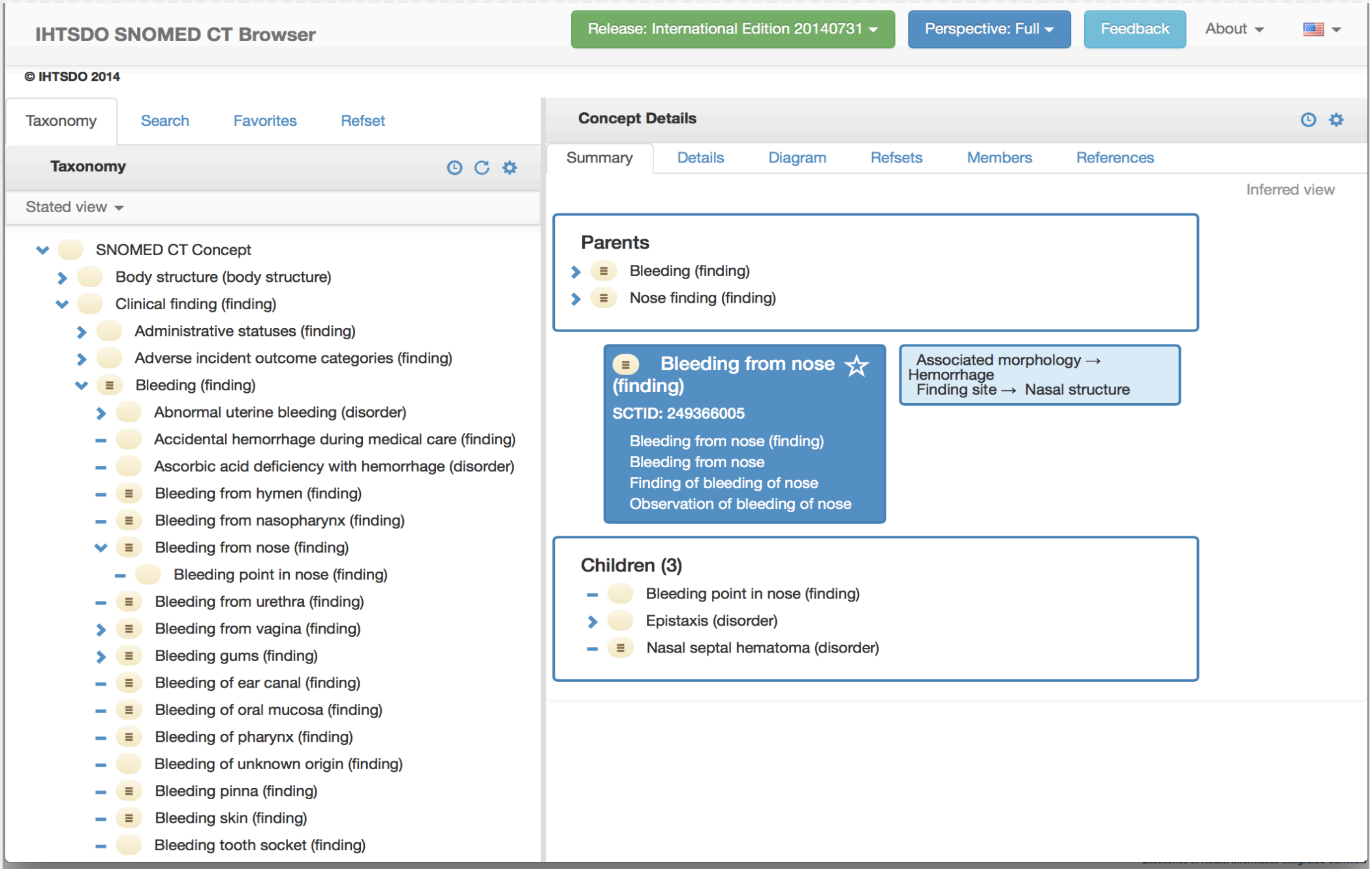
Concepts/Coding Standards
SNOMED CT – Online Browser



The Read Codes

Clinical Terms Version 3 (CTV3)

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The Read Codes

- The Read codes (now called Clinical Terms) are used in
  - primary care to record the every day care of a Patient
  - Developed in the United Kingdom and were originally produced for clinician use.

- Developed by Dr James Read (GP, Loughborough), 1982
- Purchased and adopted by NHS 1990
- Recognized standard for General Practice

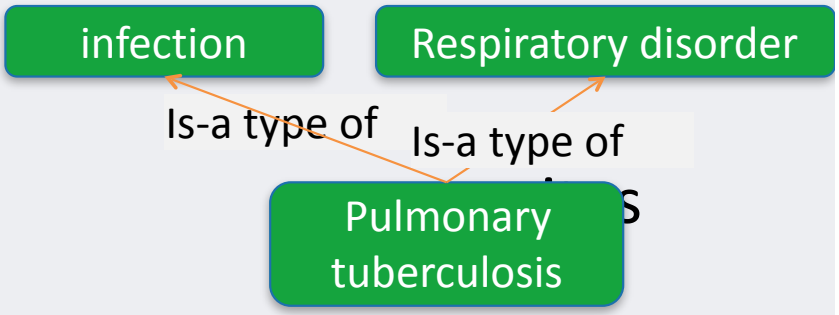
- The Clinical Terms Version 3 (CTV3) was intended, to code events in the electronic patient record.

The Read Codes

- The Read codes have undergone substantive changes through their various revisions.
  - In Versions 1 and 2, Read Codes structure was a strictly hierarchical classification system.
  - Read Version 3 was released in two stages and was a 'super-set' of all previous releases, containing all previous terms, to allow retro-compatibility with past versions.
- Version 3.0 is (a kind of) compositional classification system.
  - i.e. composed from several related concepts, or relationships may be derived from several concepts

The Read Codes

- A term can appear in several different 'hierarchical structures', classified against different axes.
- Unlike the ICD, the codes themselves do not reflect a given hierarchy. They simply act as a unique identifier for a clinical concept.
- The 'hierarchy' exists as a set of links between concepts. Terms can inherit properties across these links.
  - *For example, 'pulmonary tuberculosis' may naturally be inherited from a parent 'respiratory disorder' or a parent 'infection' term.*



- When terms are combined, these exist outside any strict hierarchy.

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The Read Codes

- To combine qualifiers with terms, terms are grouped into templates (instead of using an explicit ontology)
- Like other major systems, Read Codes offers mapping to ICD codes to permit international reporting.

Table 23.2 Example Read Version 3.1 template showing allowable combinations of terms with qualifier attributes and attribute values

Object	Applicable attribute	Applicable values
Bone operation	Site	Bone, part of bone
Fixation of fracture	Reduction method	Percutaneous, open, closed
Fixation of fracture using intramedullary nail	Reaming method	Hand, powered rigid, powered flexible, etc.
Fixation of fracture using intramedullary nail	Nail type	Flexible, locking, rigid, etc.

The Read Codes: Structure

- Sorted into categories and chapters
- Has a hierarchical structure
- **Code**: Combination of letters and numbers
- CaSe-SeNsItIve
- Version 1: Maximum of 4 characters (1983)
  Version 2: Maximum of 5 characters (1985)

The Read Codes: Chapters

- **Diagnoses**
  - Codes all begin with a capital letter
  - e.g. **H**33 (Asthma), **C**10E (Type 1 diabetes mellitus)

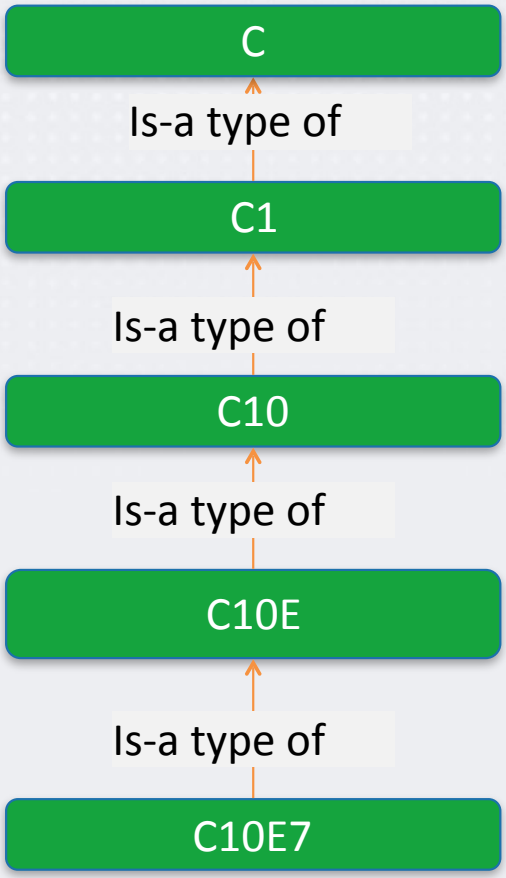
- **Processes of Care**
  - Codes all begin with a number
  - Used to record history, symptoms, examinations, tests, screening, operations and patient administration, etc
  - e.g. **4**4P (Serum cholesterol), **6**5E (Influenza vaccination)

- **Medication**
  - Codes all begin with a small case letter
  - Automatically entered into the patient record when any treatment is prescribed
  - e.g. **b**u25 (Aspirin 75mg tablets)

The Read Codes: Chapters

Example:

C	Endocrine, nutritional, metabolic and immunity disorders
C1	Other endocrine gland diseases
C10	Diabetes mellitus
C10E	Type 1 diabetes mellitus
C10E7	Type 1 diabetes mellitus with retinopathy



- Could refer to these as “families” of codes – Parent and Child Codes
- C10 is a parent code to C10E, and a child code to C1
- Each code begins the same way as the one before but contains an extra layer of detail
- Enables data to be entered at the required level of detail

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The Read Codes: Example Structure

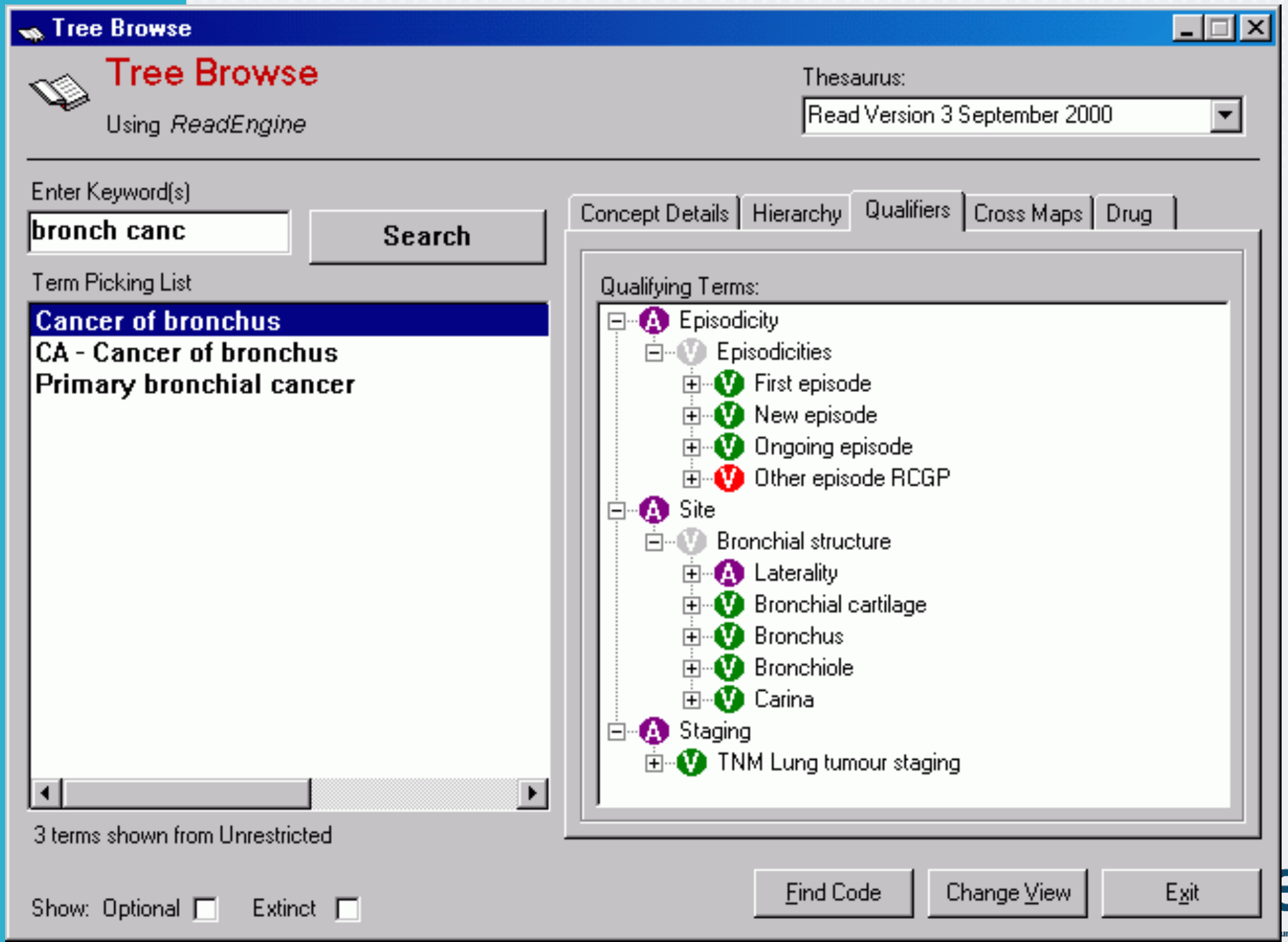
Level One Codes	Level Two Codes	Level Three Codes
Circulatory System Disease (G.....)	Hypertensive Disease(G2)	Benign Essential Hypertension (G201)
		Secondary Hypertension(G24)
		Acute MI (G30)
	Ischaemic Heart Disease(G3)	Angina Pectoris (G33)
		TIA (G65)
	Cerebrovascular Disease(G6)	Stroke and CVA unspecified (G66)
		Subarachnoid Haem. (G60)

Read Codes V3, Clinical Terms

- Known as
  - Read version 3, clinical terms
  - Clinical Terms version 3

- Was combined with SNOMED-RT to create SNOMED-CT

Read Codes Browsers



LOINC

Logical Observations, Identifiers, Names and Codes

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LOINC

- A standard for electronic exchange of lab results transmitted to hospitals, clinics, and payers.
- The database has more than 72,000 terms (and increasing!) used for lab results.
- Widely accepted internationally.
- Have been cross referenced to SNOMED-CT

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LOINC design summary

- **LOINC Term**
  - Represents a measurement, question or observation
- **LOINC Part**
  - Represents a value for one of **six dimensions** used to specify a LOINC Term

LOINC design summary

- **LOINC Term**
  - Consists of (3-7 long, but may increase!)
    - LOINC Code (Numeric with dash and check-digit)
    - LOINC Name (in SNOMED CT called a term)

2951-2: The LOINC code for serum sodium

LOINC design summary

- **LOINC Part**
  - Consists of
    - LOINC Part Number (LP prefix, numeric then dash and check-digit)
    - LOINC Part Name (in SNOMED CT called a term)
  - Is specified by values applied to six dimensions or Part Types
    - **Component**: the name of the measurement
    - **Property**: kinds of quantities of the substance: Mass, Substance, Catalytic Activity, Arbitrary, and Number
    - **Time**: A measurement may be taken at a moment in time or measured over a specified time interval
    - **System**: system used for lab test measurement
    - **Scale**: Quantitative(Qn), Ordinal(Ord), Nominal(Nom), Narrative(Nar)
    - **Method**: method of testing

2951-2: The LOINC code for serum sodium

SODIUM: SCNC: PT: SER/PLAS:QN
(component:property:timing:specimen:scale)

LOINC Part: Code structure

COMPONENT (ANALYTE)

The substance or entity being measured or observed.

PROPERTY

The characteristic or attribute of the analyte.

TIME

The interval of time over which an observation was made.

SYSTEM (SPECIMEN)

The specimen or thing upon which the observation was made.

SCALE

How the observation value is quantified or expressed: quantitative, ordinal, nominal.

METHOD

OPTIONAL *A high-level classification of how the observation was made. Only needed when the technique affects the clinical interpretation of the results.*

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LOINC: *manual count of white blood cells in cerebral spinal fluid specimen*

***Lab test**: manual count of white blood cells in cerebral spinal fluid specimen*

***LOINC code**: 806-0*

COMPONENT (ANALYTE)	PROPERTY	TIME
Leukocytes (white blood cells)	NCnc (Number concentration)	Pt (Point in time)

SYSTEM (SPECIMEN)	SCALE	METHOD
CSF (Cerebral spinal fluid)	Qn (Quantitative)	Manual Count

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LOINC Example – Sodium concentration in serum of plasma

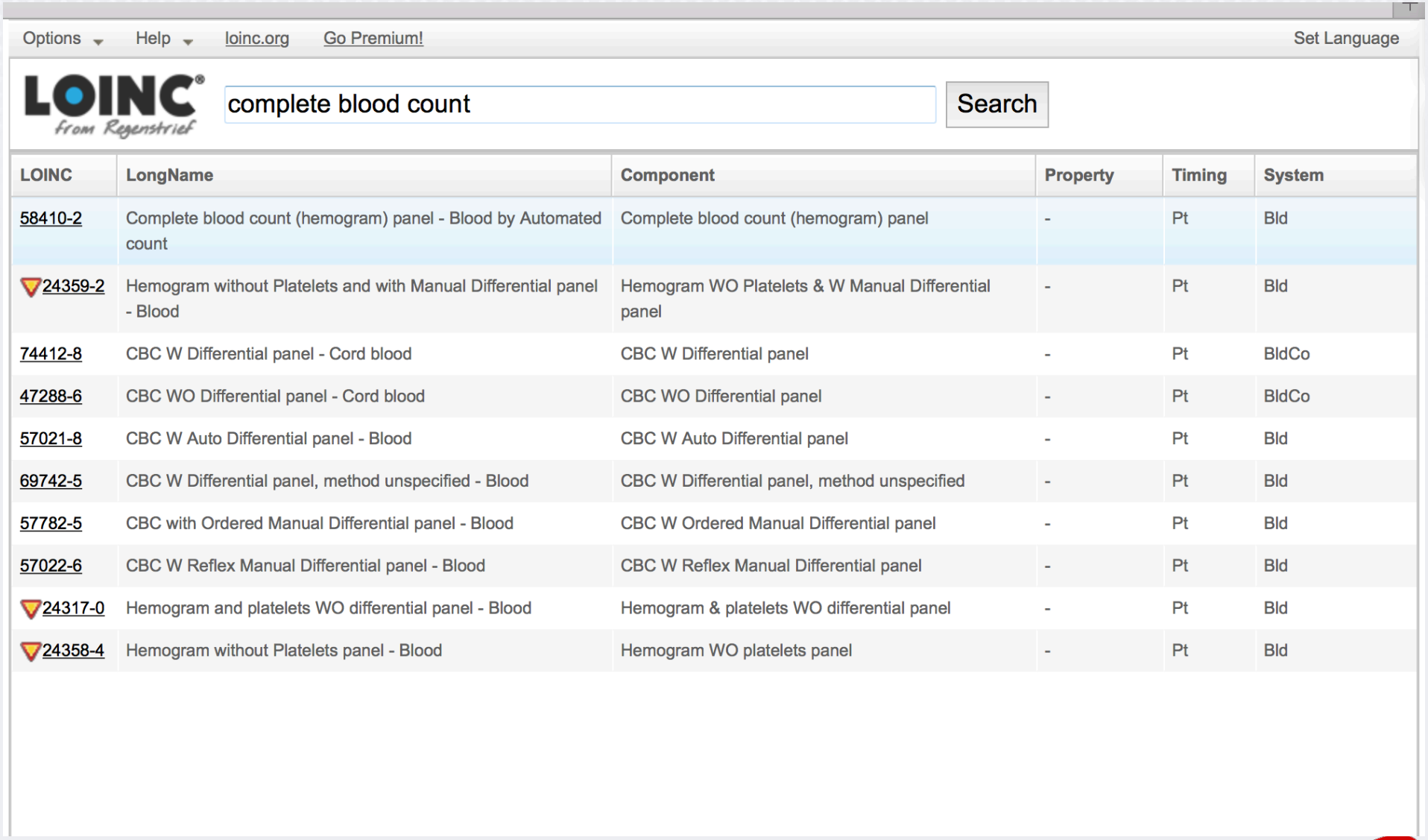
	LOINC Code	LOINC Name
LOINC Term	2951-2	Sodium [Mass or Moles/volume] in Serum or Plasma
Part Type	Part No.	Part Name
Component	LP15099-2	Sodium
Property	LP6860-3	SCnc [Substance Concentration]
Time	LP6960-1	Pt [Point in time (spot)]
System	LP7576-4	Ser/Plas [Serum or Plasma]
Scale	LP7753-9	Qn
Method		

LOINC Example – Colour of Urine

	LOINC Code	LOINC Name
LOINC Term	5778-6	Colour of Urine
Part Type	Part No.	Part Name
Component	LP28806-5	Colour
Property	LP6886-8	Type
Time	LP6960-1	Pt [Point in time (spot)]
System	LP7681-2	Urine
Scale	LP7750-5	Nom [Nominal]
Method		

LOINC Browser

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



LOINC	LongName	Component	Property	Timing	System
58410-2	Complete blood count (hemogram) panel - Blood by Automated count	Complete blood count (hemogram) panel	-	Pt	Bld
24359-2	Hemogram without Platelets and with Manual Differential panel - Blood	Hemogram WO Platelets & W Manual Differential panel	-	Pt	Bld
74412-8	CBC W Differential panel - Cord blood	CBC W Differential panel	-	Pt	BldCo
47288-6	CBC WO Differential panel - Cord blood	CBC WO Differential panel	-	Pt	BldCo
57021-8	CBC W Auto Differential panel - Blood	CBC W Auto Differential panel	-	Pt	Bld
69742-5	CBC W Differential panel, method unspecified - Blood	CBC W Differential panel, method unspecified	-	Pt	Bld
57782-5	CBC with Ordered Manual Differential panel - Blood	CBC W Ordered Manual Differential panel	-	Pt	Bld
57022-6	CBC W Reflex Manual Differential panel - Blood	CBC W Reflex Manual Differential panel	-	Pt	Bld
24317-0	Hemogram and platelets WO differential panel - Blood	Hemogram & platelets WO differential panel	-	Pt	Bld
24358-4	Hemogram without Platelets panel - Blood	Hemogram WO platelets panel	-	Pt	Bld

RxNorm

Standardized (NORMalized) names for Clinical Drugs

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RxNorm

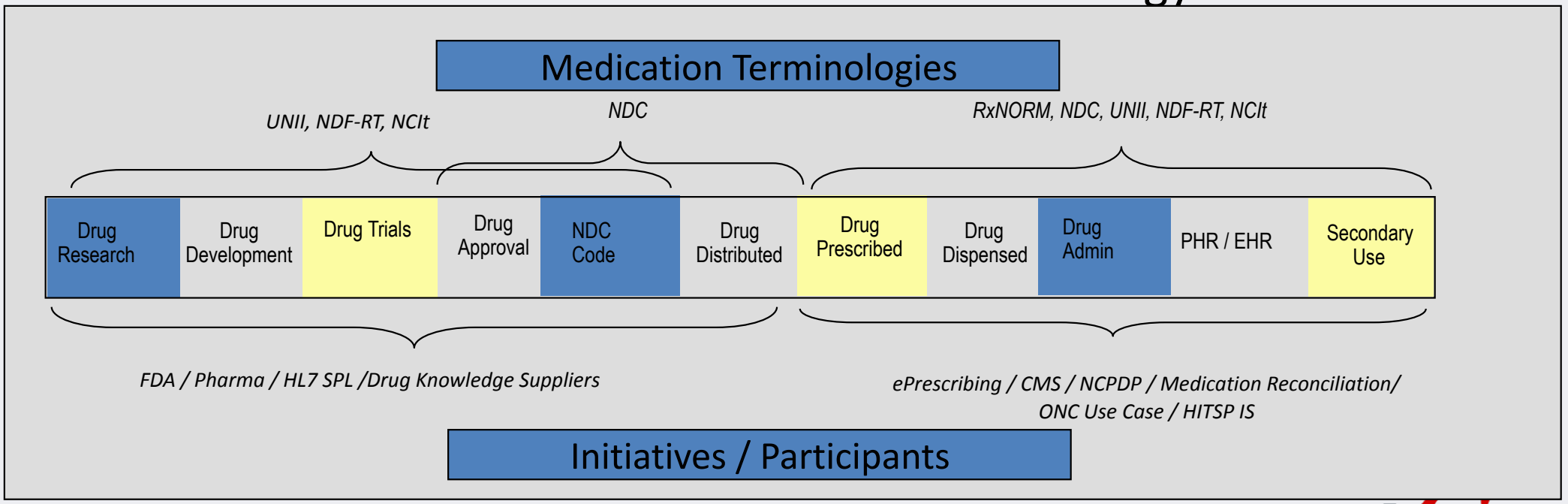
- Developed as part of UMLS, maintained and distributed by NLM (USA)
- Free dataset published monthly (with weekly FDA adds) by NLM
  - Also a browser and API access to the data
- RxNorm takes terms and codes from several sources and vendors
  - It indicates when names from different sources are synonymous, and gives them the same RxNorm identifier (RxCUI)

RxNorm and its sources

- Data sources aggregated and organized
  - FDA: Structured Product Label – SPL (DailyMed)
  - First Databank
  - Multum
  - MicroMedex
  - Gold Standard
  - Medi-Span
  - VA: NDF-RT and VANDF
  - SNOMED CT

RxNorm: Background

- Consolidated Health Informatics (CHI) 2003-2006
  - National Committee on Vital and Health Statistics (NCVHS) / CHI endorsed selection of medication standards http://www.hhs.gov/healthit/chiinitiative.html
  - Drug code, semantic clinical drug, classifications, ingredients, units
- Need for standardization of medication terminology



The Clinical Drug Problem

- Ciprofloxacin 100mg/50mL IV Infusion
- Ciprofloxacin 400mg/200 ml IV Infusion
- Ciprofloxacin Lactate 0.2% in Saline (Base Equiv)
- Ciprofloxacin IV Soln 2 MG/ML

➔Are these the Same or Different?

- Clinical Drug Defined
  - Ingredient plus Strength or Form or Both?

Source names vs. normalized name

"Ranitidine Hydrochloride **15 MG** ORAL SYRUP"

"Ranitidine Hydrochloride **16.8 MG** ORAL SYRUP"

"Ranitidine Hydrochloride **75 MG** ORAL SOLUTION"

Ranitidine 15 MG/ML Oral Solution (normalized name)

- SY: ranitidine 15 MG (ranitidine hydrochloride 16.8 MG) per ML Oral Solution
- SY: ranitidine 75 MG per 5 ML Syrup

Normalized Names

- Name of a clinical drug combines its ingredient(s), strength(s), form, and brand name if present:
  - Acetaminophen 500 MG Oral Tablet
  - Acetaminophen 500 MG Oral Tablet [Tylenol]

RxNorm building blocks: term types (TTYs)

- **SCD - Semantic Clinical Drug**
- **SBD - Semantic Branded Drug**
- SCDC - Semantic Clinical Drug Component
- SBDC - Semantic Branded Drug Component
- IN – Ingredient
- SCDF – Semantic Clinical Drug Form
- SBDF – Semantic Branded Drug Form
- DF – Dose Form

RxNorm building blocks: term types (TTYs)

- SCD (Semantic Clinical Drug): Core concept for RxNorm
  - Ingredient + strength+ Unit + dose form
    - Azithromycin 250 MG Oral Tablet - RxCUI 308460
    - Diazepam 10 MG Oral Tablet – RxCUI 197590

- SBD (Semantic Branded Drug):
  - <SCD> [Brand name (BN)]
    - Azithromycin 250 MG Oral Tablet [Zithromax] = 212446
    - Amoxicillin 250 MG / Clavulanate 125 MG [Augmentin] RxCUI = 824184

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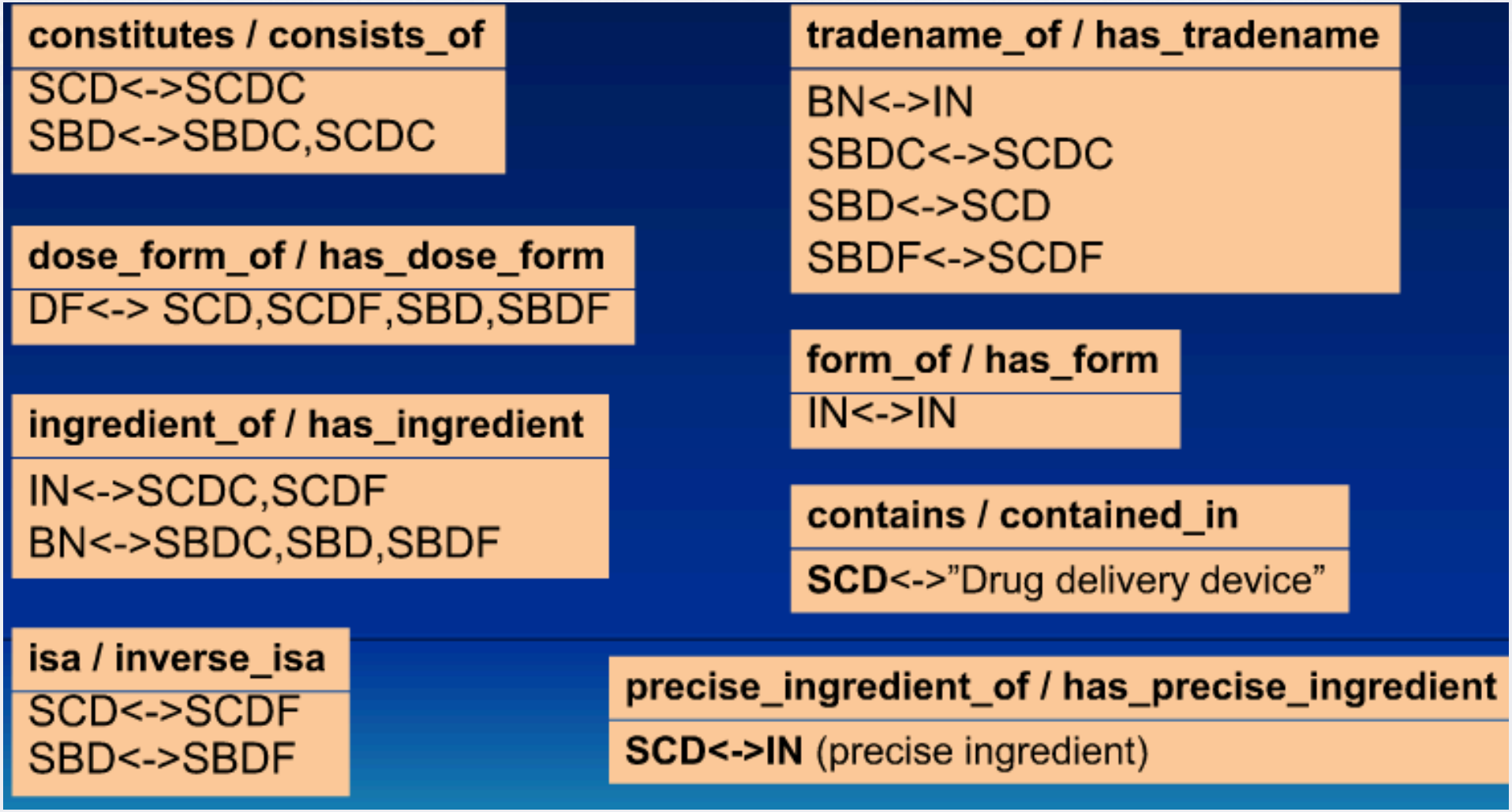
RxNorm as a set of “concepts”

- The names in a single concept mean (essentially) the same thing
- RxCUI = 392151
  - AMOXICILLIN 200 MG ORAL TABLET
  - Amoxicillin 200 MG Oral Tablet
  - Amoxicillin trihydrate 200mg tablet
  - Amoxicillin trihydrate 200mg tablet (product)

Relationships



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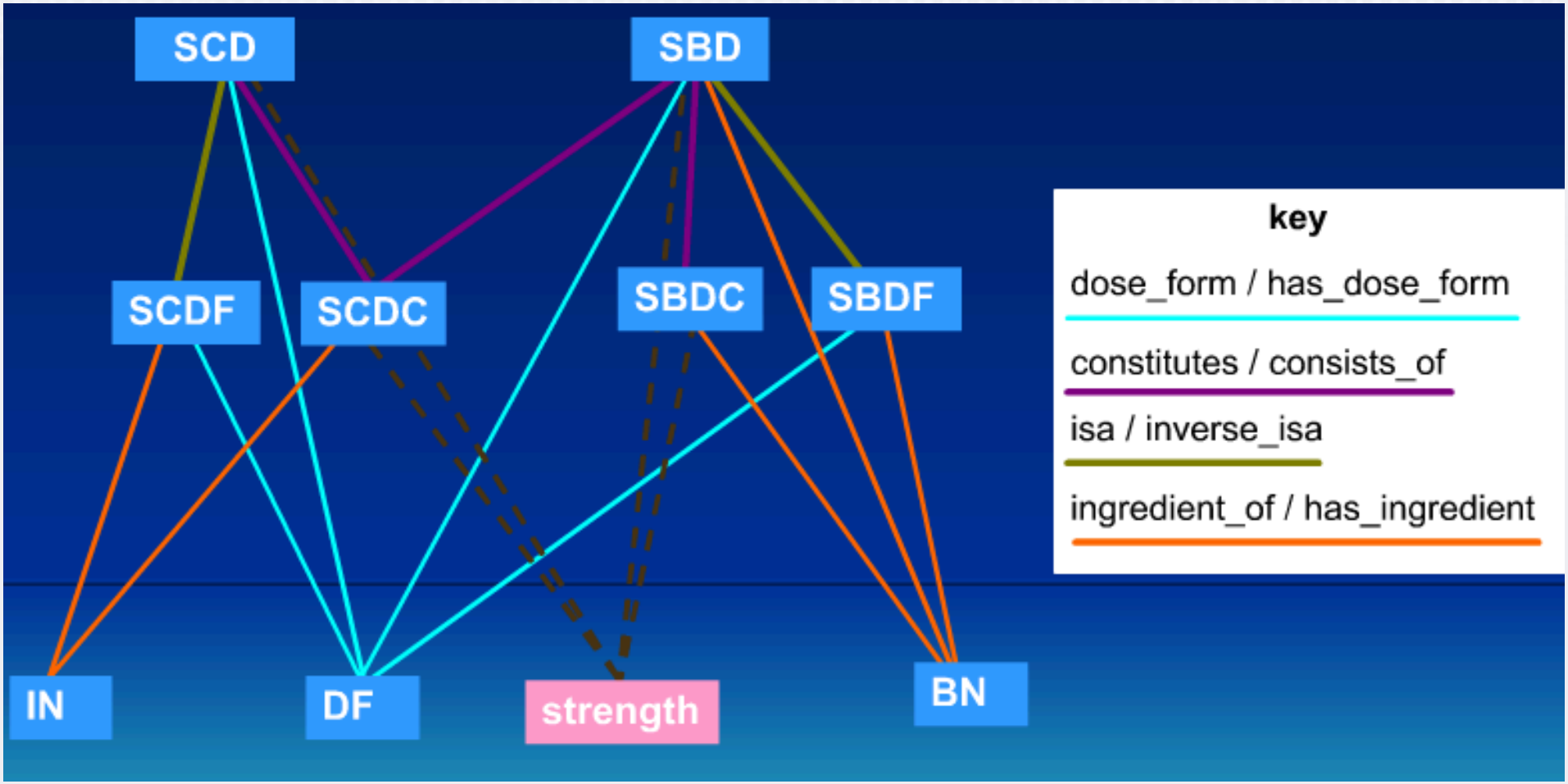
RxNorm Term Types: Relationships



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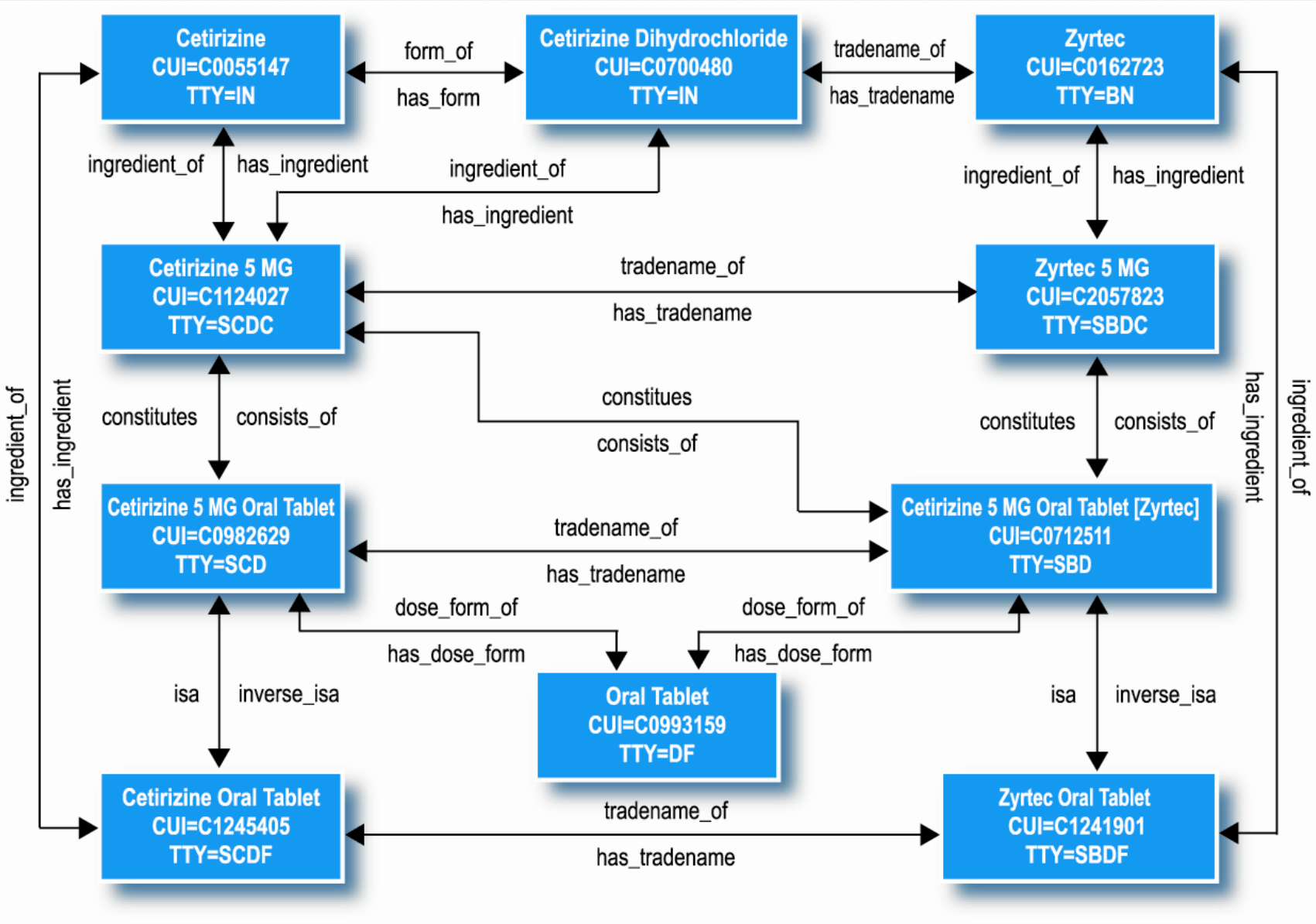
The RxNorm Model



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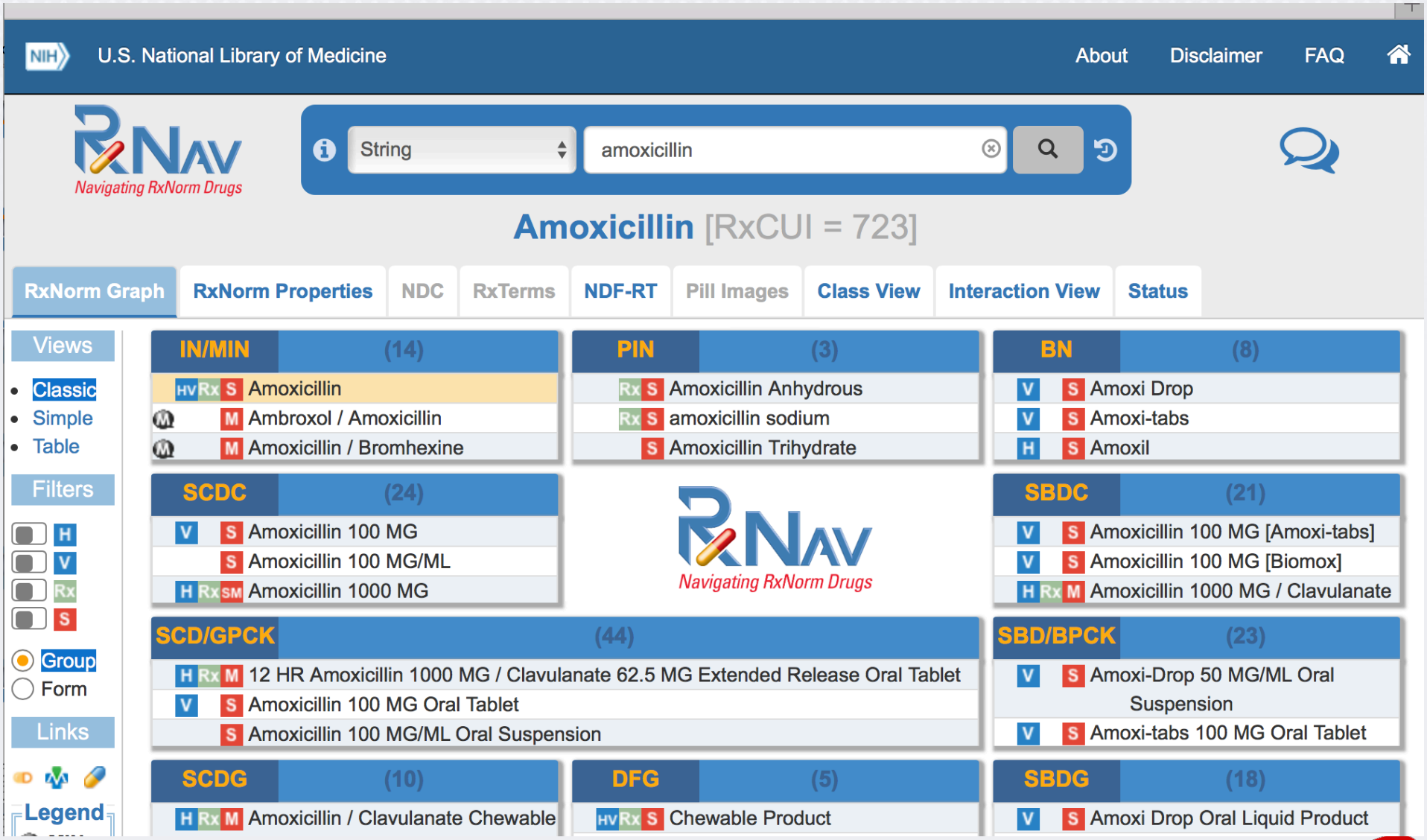
RxNorm Browser: RxNav

https://mor.nlm.nih.gov/RxNav/



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UMLS

The Unified Medical Language System

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UMLS

- UMLS links the major international terminologies into a common structure and provides a translation mechanism between them.

- Designed to retrieve and integrate electronic biomedical information from a variety of sources and to permit the linkage of disparate information systems (i.e. EHRs, bibliographic databases and decision support systems).

UMLS

- The UMLS is composed of three ‘knowledge sources’:
  - **a Metathesaurus,**
  - **a semantic network, and**
  - **a lexicon.**

- The UMLS Metathesaurus
  - is intended for system developers
  - provides a uniform format for more than 150 different biomedical vocabularies and classifications.
- Terminologies integrated within the UMLS include the ICD-9, ICD-10, Medical Subject Headings (MeSH), ICPC, WHO Adverse Drug Reaction Terminology and SNOMED CT.

UMLS

- The **Metathesaurus** is conceptualized as
  - a web (rather than as a hierarchical tree), by linking alternative names and views of the same concept together and identifying useful relationships among different concepts.

- Major **UMLS semantic types** include
  - More than 132 sematic types
  - They include organisms, anatomical structures, biologic function, chemicals, events, physical objects and concepts or ideas.
- The **UMLS Semantic Network** is used
  - to ensure the integrity of meaning between different concepts.

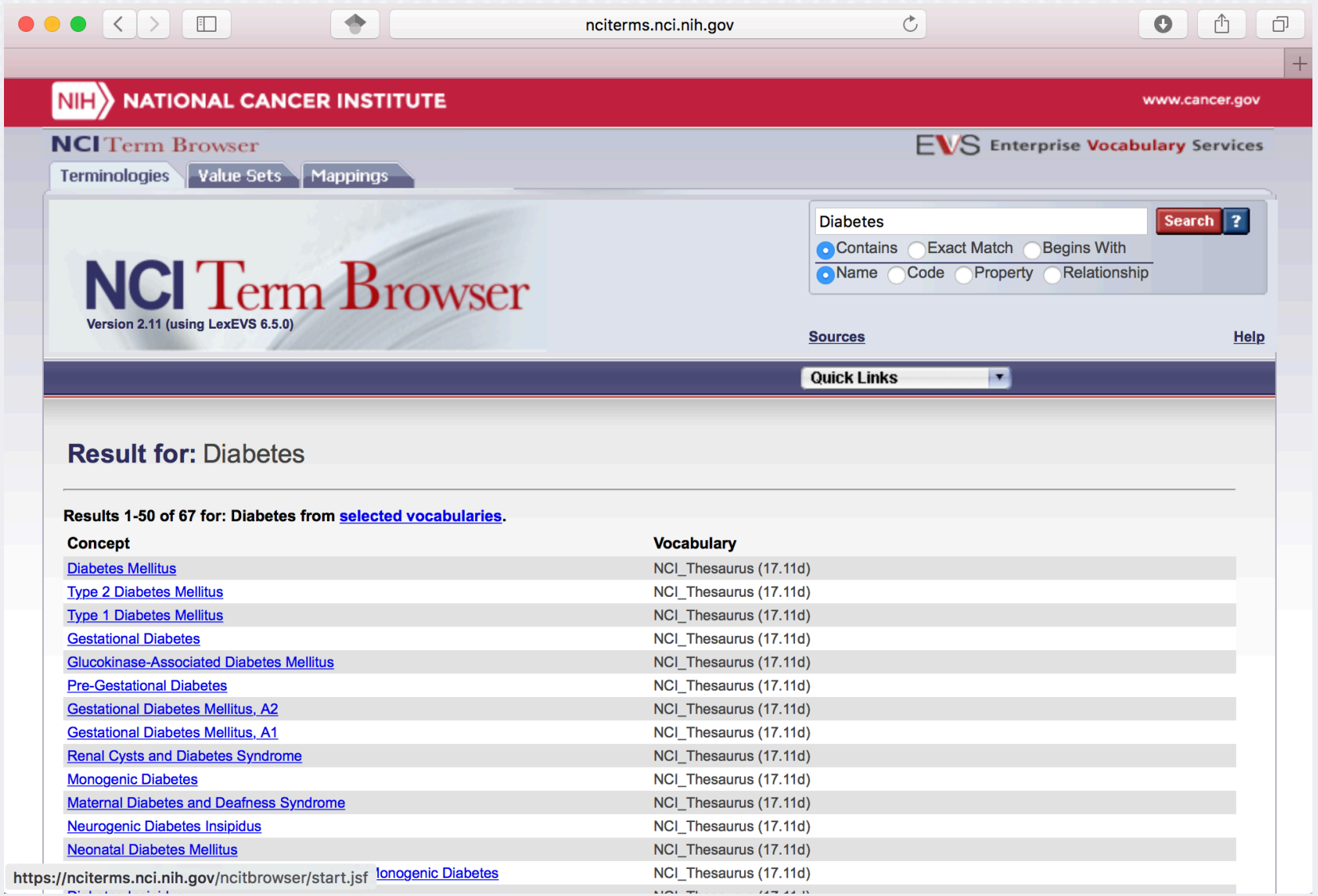
UMLS

- The **SPECIALIST Lexicon**
  - is intended to assist in producing computer applications that need to translate free-form or natural language into coded text.
  - It contains syntactic information for terms and English words, including verbs that do not appear in the Metathesaurus, and multi-word expansions of generally used acronyms and abbreviations.

- It can be used to generate natural language or lexical variants of words. *For example:*
  - *the word 'treat' has three variants that all have the same meaning as far as the Metathesaurus is concerned – treats, treated or treating.*

UMLS Browser:

https://nciterms.nci.nih.gov/ncitbrowser/pages/multiple_search.jsf?nav_type=terminologies



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A comparison of coding for four different clinical concepts using some of the major coding systems

Table 23.7 A comparison of coding for four different clinical concepts using some of the major coding systems

Clinical concept	UMLS	ICD-10	ICD-9-CM 4th edition	Read, 1999	SNOMED International, 1998	SNOMED CT, 2002
Chronic ischaemic heart disease	448589 Chronic ischaemic heart disease	I25.9 Chronic ischaemic heart disease	414.9 Chronic ischaemic heart disease	XE0WG Chronic ischaemic heart disease NOS	14020 Chronic ischaemic heart disease	84537008 Chronic ischaemic heart disease
Epidural haematoma	'453700 Hematoma, epidural'	S06.4 Epidural haemorrhage	432.0 Nontraumatic extradural haemorrhage	Xa0AC Extradural haematoma	89124 Extradural haemorrhage	68752002 Nontraumatic extradural haemorrhage
Lymphosarcoma	'1095849 Lymphoma, diffuse'	C85.0 Lymphosarcoma	200.1 Lymphosarcoma	B601z Lymphosarcoma	'95923 Lymphosarcoma, diffuse'	'1929004 Malignant lymphoma, non-Hodgkin'
Common cold	1013970 Common cold	J00 Acute nasopharyngitis (common cold)	460 Acute nasopharyngitis (common cold)	XE0X1 Common cold	35210 Common cold	82272006 Common cold

References:

- World Health Organisation. International Statistical Classification of Diseases and Related Health Problems 10th Revision Volume 2 Instruction manual 2010 Edition

- Introduction to ICD-10: Importance, Structure and Principles of Classification Dr. S.K.Nath, Deputy Director General, Central Statistical Organisation India.

- ICD-11 in eleven points James Harrison Research Centre for Injury Studies, Flinders University, Adelaide

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References:

- http://perspectives.ahima.org/a-comparison-between- a-snomed-ct-problem-list-and-the-icd-10-cmpcs-hipaa- code-sets/ - Comparing ICD10 and SNOMED CT
- http://www.connectingforhealth.nhs.uk/elearning/sn omedct/ flash/ - SNOMED Intro by NHS
- 2005, S. De Ludignan: Codes, classifications, terminologies and nomenclatures
- 2006, R. Cornet: A framework for characterizing terminological systems
- Presentations
    - IHTSDO: Why Clinical Terminology Matters
    - Health Informatics: Terminology and classification
- What is ICD 10? https://www.youtube.com/watch?v=ZPDgtDDTc8k

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References:

- Books
  - Pradeep K. Sinha, Gaur Sunder, Prashant Bendale, Manisha Mantri, Atreya Dande, Electronic Health Record - Standards, Coding Systems, Frameworks, and Infrastructures, John Wiley, 2012
  - ELECTRONIC HEALTH RECORDS for QUALITY NURSING & HEALTH CARE, 2016

References:

- Robin Beaumont. (2011). Types of Health Information Systems. Retrieved from: http://www.floppybunny.org/robin/web/virtualclassroom/chap12/s2/systems1.pdf
- Klaus Krickeberg. (2007). Health Information Management Journal, 36(3), 8-20. Retrieved from: http://himaa.org.au/members/journal/HIMJ_36_3_2007/Krickeberg%20Principles%20of%20HIS%20in%20developing%20countries.pdf
- WHO. (2000). Design and implementation of health information systems.
- Amenwerth, E. Graber, S. Herrmann, G. Burkl, T. & Konig, J. (2003). Evaluation of health information systems—problems and challenges. International Journal of Medical Informatics, 71, 125-135.

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References:

- https://healthit.ahrq.gov/key-topics/consumer-health-it-applications
- Coiera, E. (2006) .Communication Systems in Healthcare. *Clinical Biochemical Review*, 27(2), 89–98. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1579411/
- https://imscdrmba.wordpress.com/206-unit-iii/

Thanks!

Any questions?

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