COMP2322:
Introduction to Health Informatics

Medical Terminologies: Coding Standards

(Semantic Interoperability related standards)

<Revision>

Time: **Tuesday+ Thursday: 11:25-12:40**

Location: **Masri204**

Section: **1**

HiCure

Excellence in Health Informatics Integrated Curricula

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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.

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

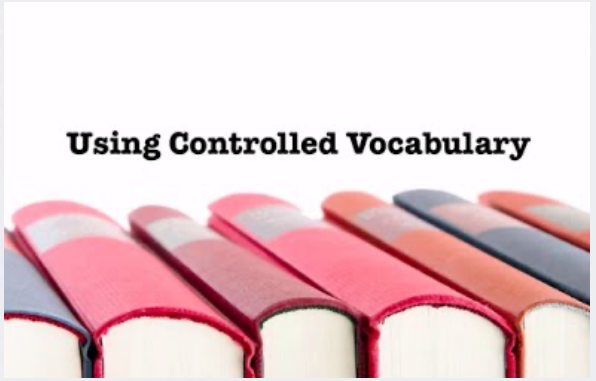
- classifies diseases that are similar and groups them under one category (or code class)
- Produces limited number of categories or classes

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



ICD

The International Classification of Diseases

ICD: The International Classification of Diseases

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

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

ICD: The International Classification of Diseases

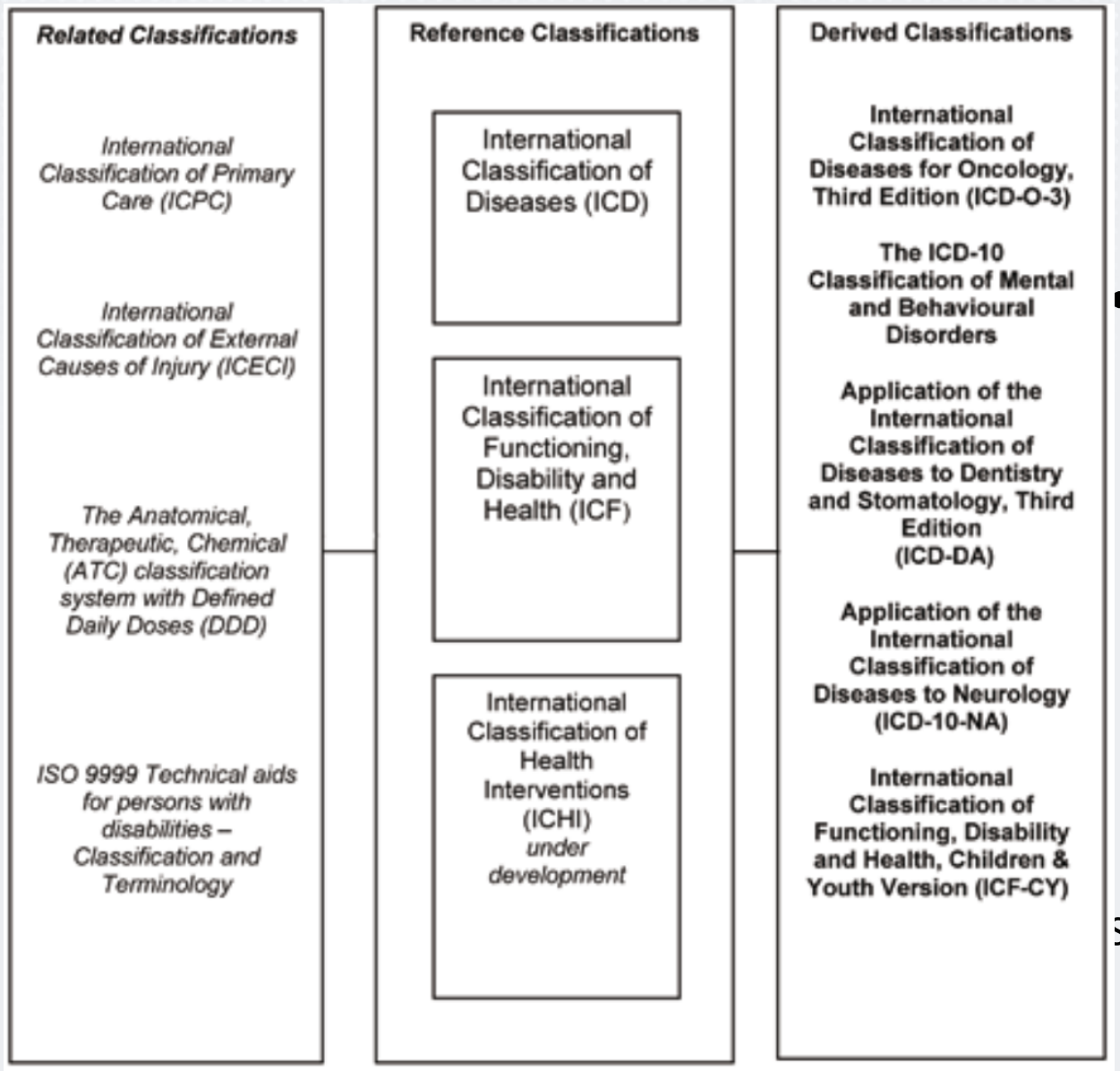
- ICD versions
  - ICD-9 ➔ The old **numeric** version of ICD
  - ICD -10 ➔ The current **alpha-numeric** version of the ICD
  - ICD -11 ➔ The future version of the ICD (under development)
    - More usable and compatible with Web Application
    - Can be easily integrated with the EHR

- 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

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, internationally, 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-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

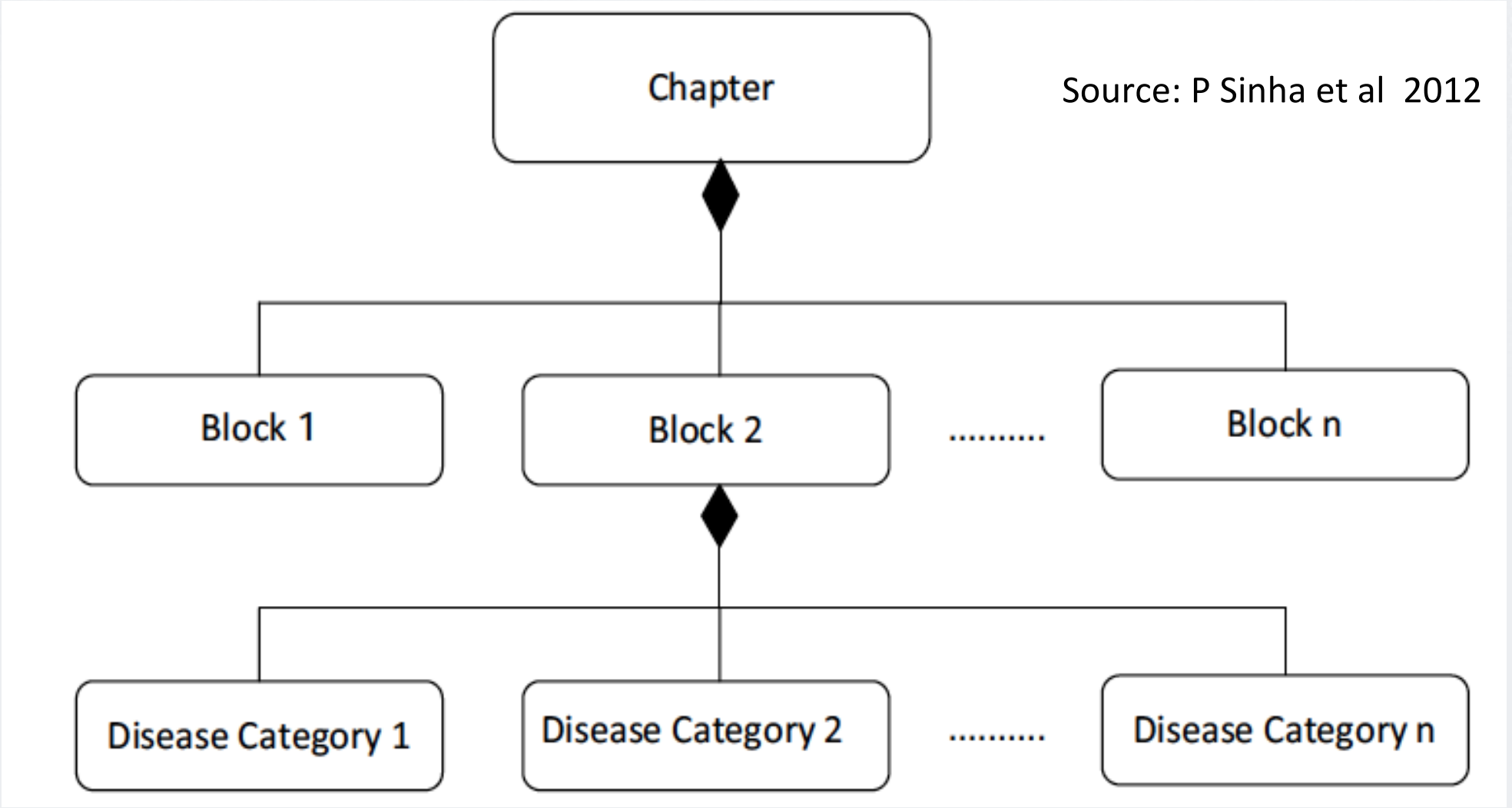
ICD-10: Classification Structure

- **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

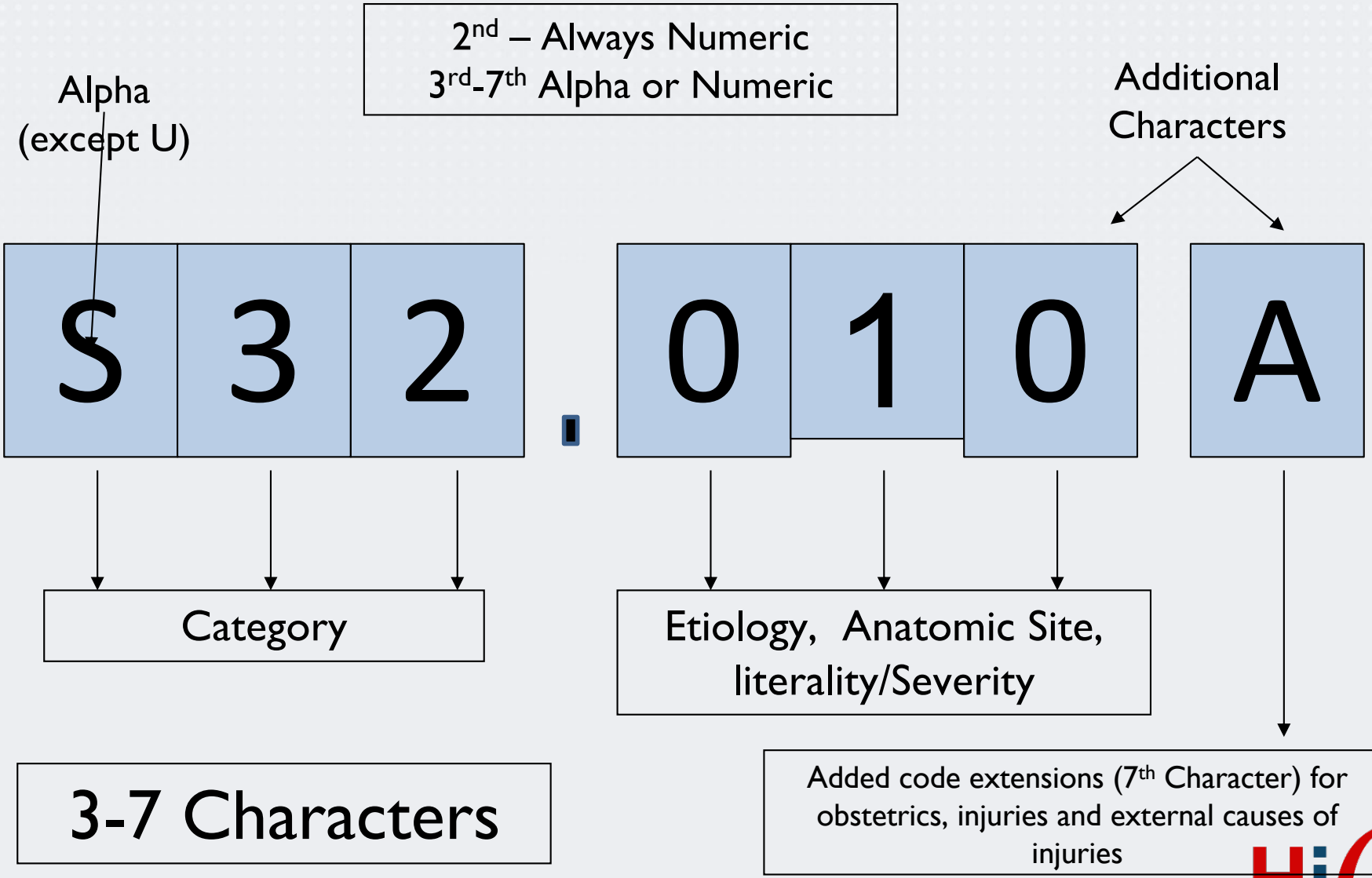
Concepts/Coding Standards
ICD Codes Chapters

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

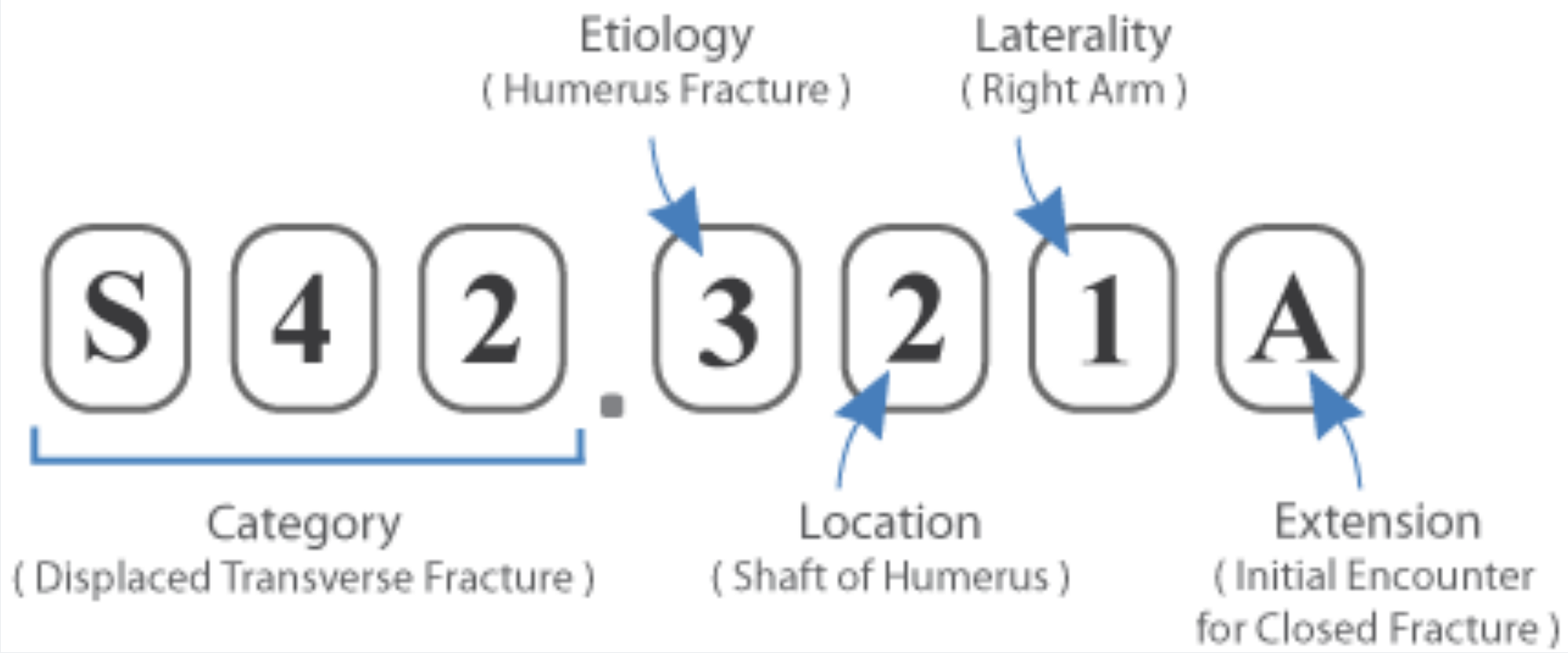
Chapter No.	Blocks	Contents
Ch. XIV (14)	N00-N99	Diseases of the genitourinary system
Ch. XV (15)	O00-O99	Pregnancy, childbirth and the puerperium
Ch. XVI (16)	P00-P96	Certain conditions originating in the perinatal period
Ch. XVII (17)	Q00-Q99	Congenital malformations, deformations and chromosomal abnormalities
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

ICD-10-CM (diagnosis) Code Format



ICD-10 Example

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

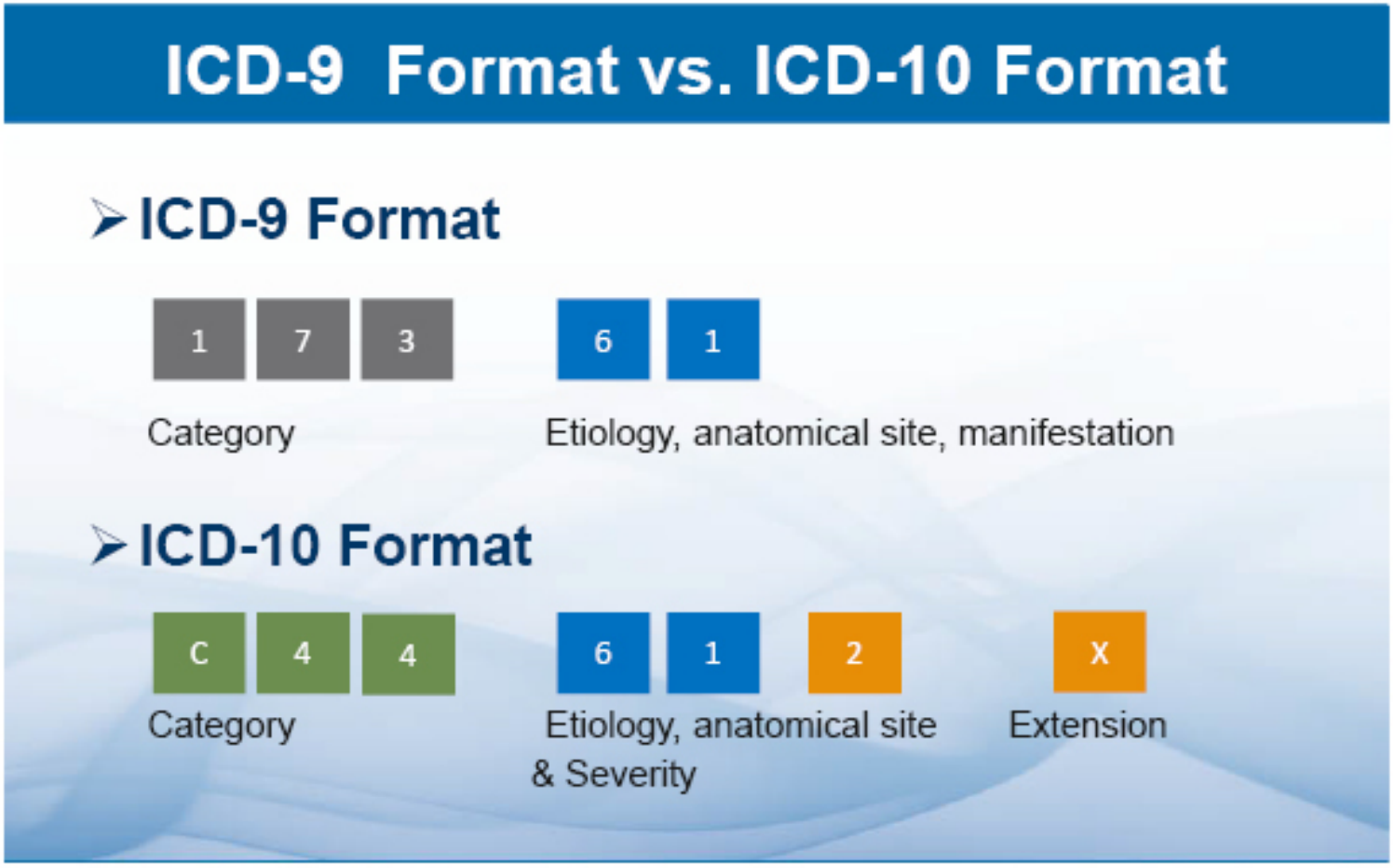


Diagnosis Code Structure Comparison

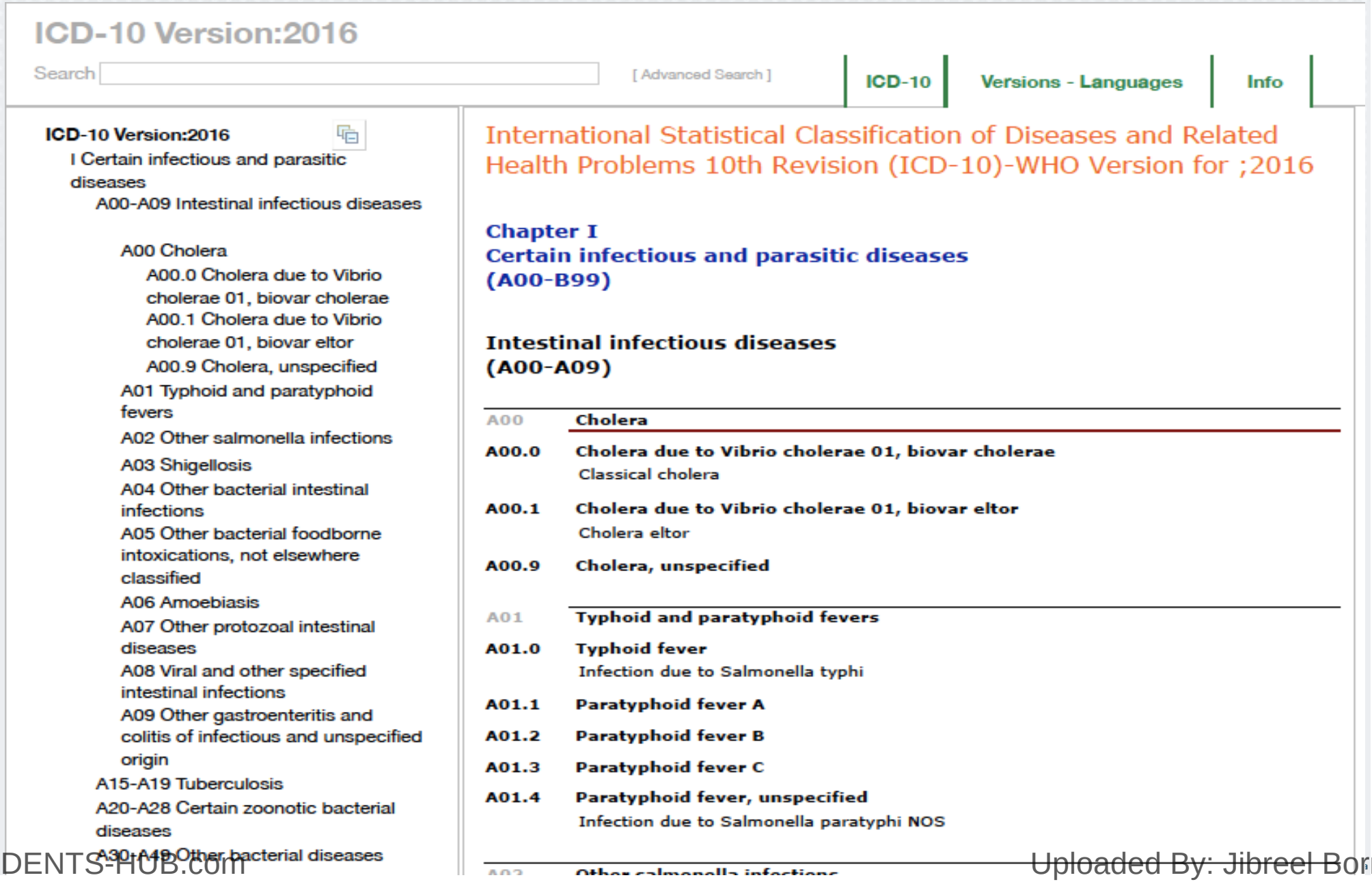
ICD-9-CM (Volume 1 & 2)	ICD-10-CM
3-5 characters in length	3-7 characters in length
Approximately 14,000 codes	Approximately 68,000 codes
First digit may be alpha (E or V) or numeric; digits 2-5 are numeric	Digit 1 is alpha (to indicate the category); Digit 2 is numeric (in the future, alpha characters 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



ICD-10 online Browser



SNOMED CT

Systematized Nomenclature of Medicine

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, computer 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 organises 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-axial** classification system.
- Terms are assigned to 1 of 11 independent **systematised modules**, corresponding 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 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), which was released in 2000, with CTV3 (Clinical Terms version 3, famously known as Read Codes V3) in 2002.

SNOMED CT

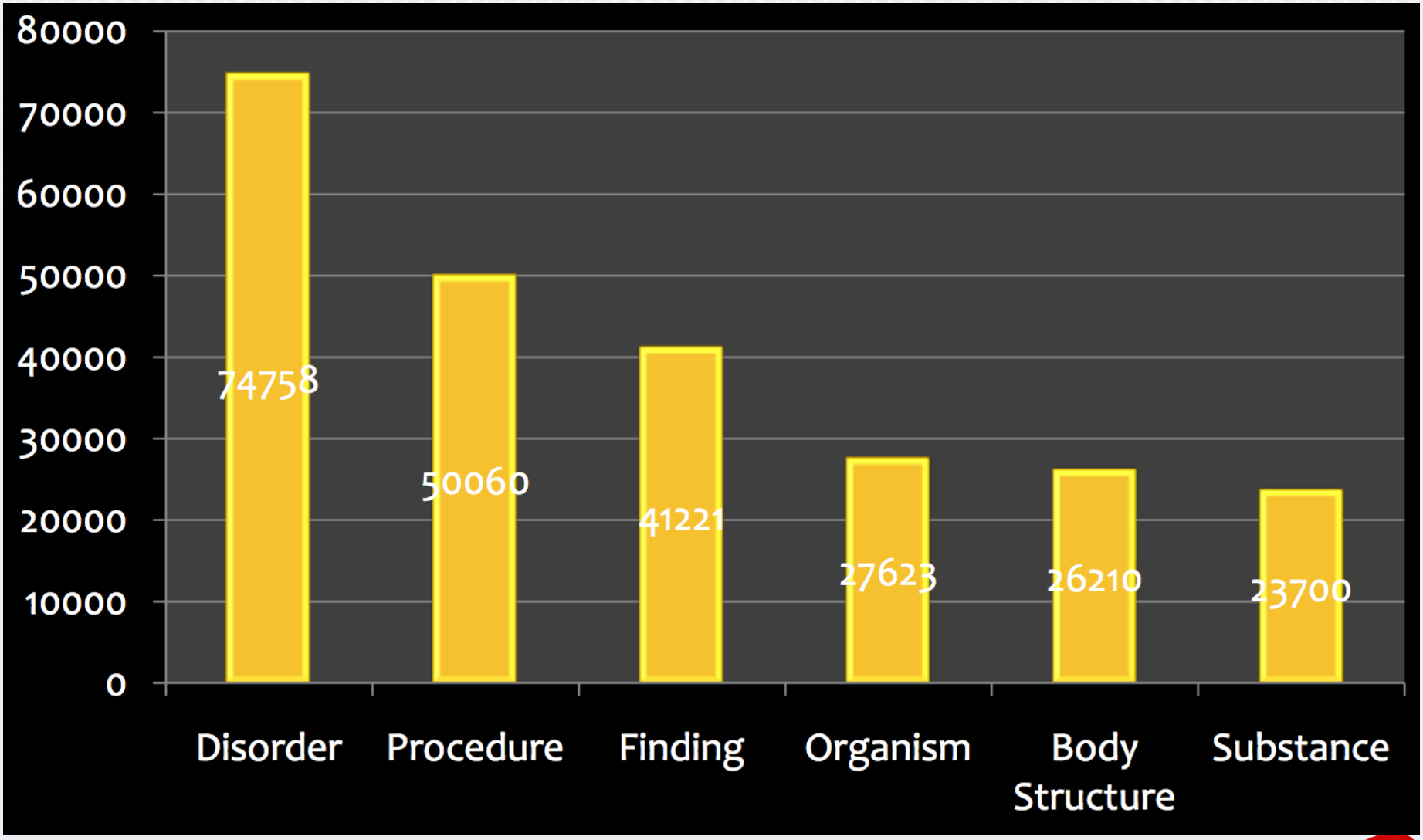
- SNOMED covers several types of medical terminologies (named as hierarchies) for
  - Disorders and finding (what was observed)
  - Procedures (what was done)
  - Body structure (locations and literality)
  - Event (what happened)
  - Substance/Medication (what was consumed/administered)
  - + anything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

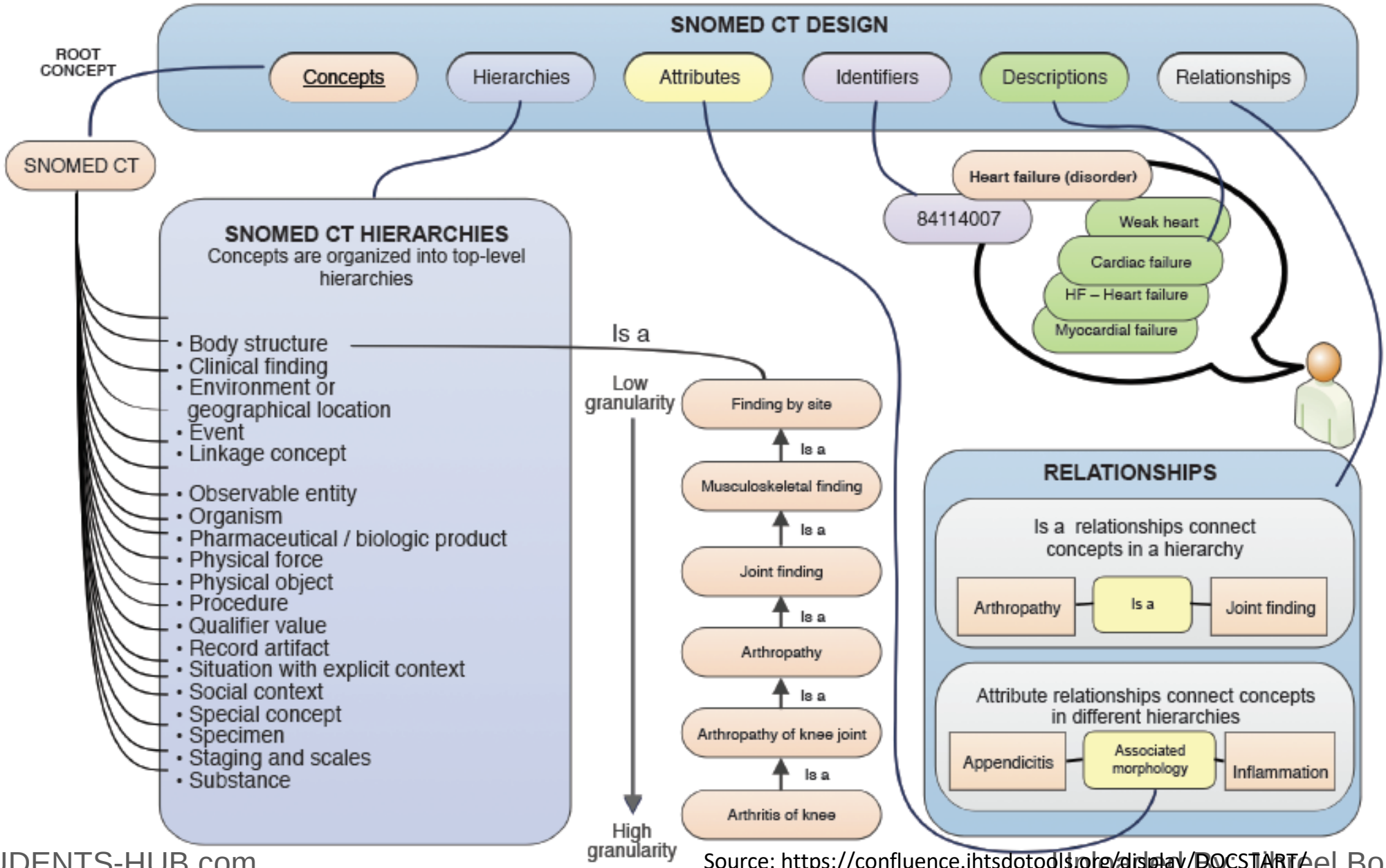
SNOMED-CT Top Hierarchies



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

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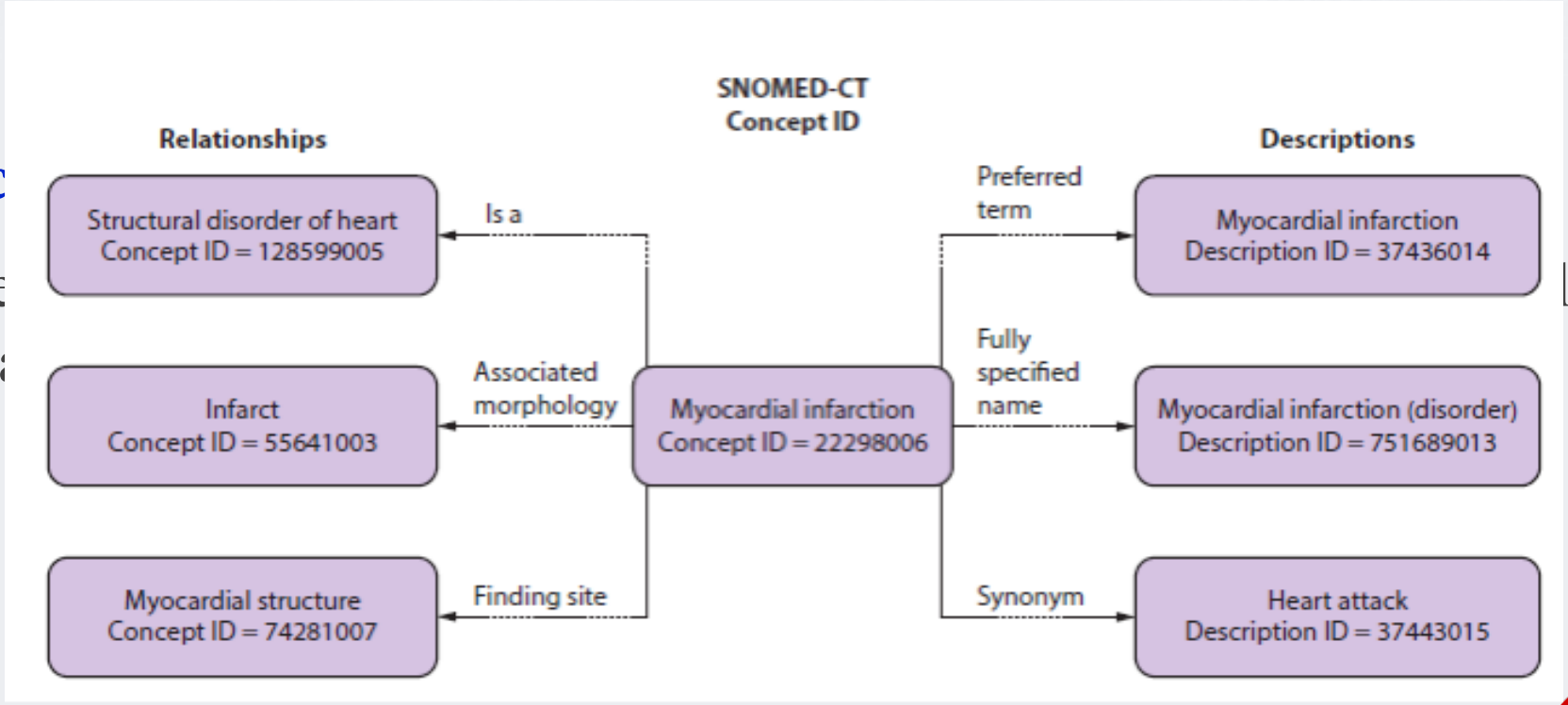


and

SNOMED CT Building Blocks: Concept Id

1. Concept-Id

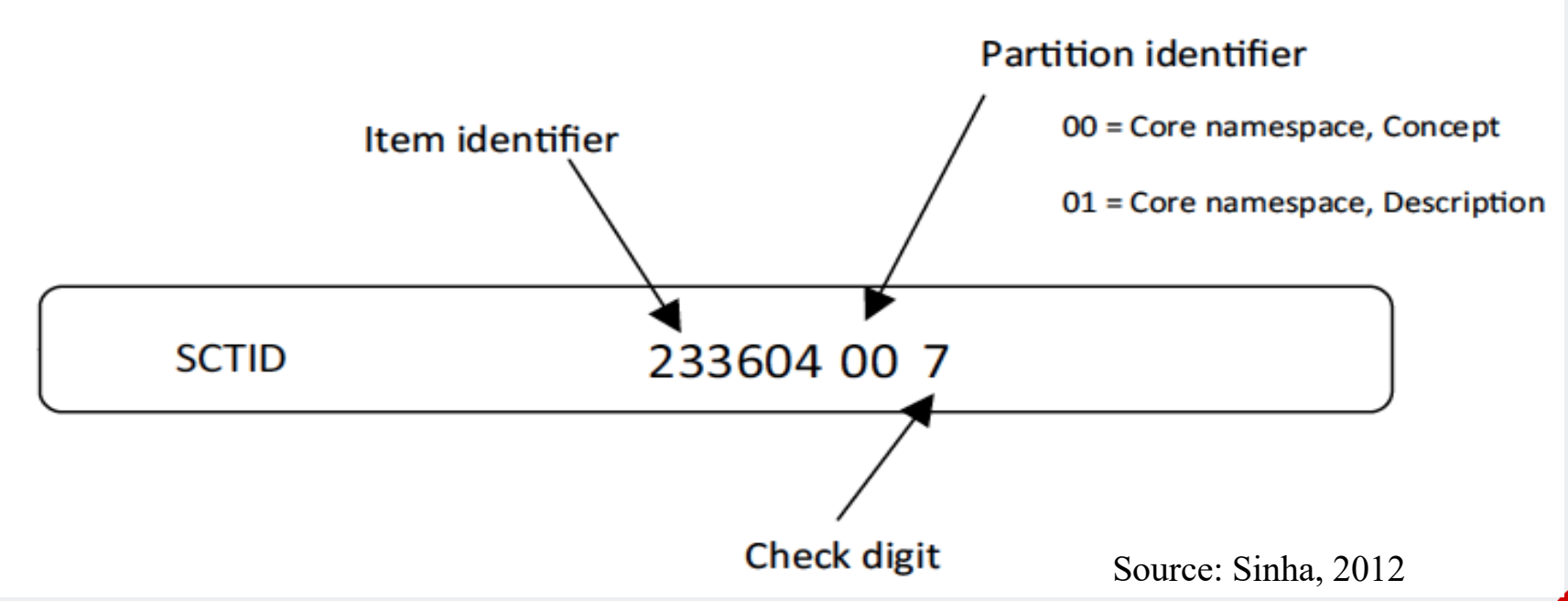
- Unique identifiers which defines **hierarchies of concepts**
- Concept hierarchies are identified according to concepts' areas in clinical recordings such as
  - Clinical finding
  - Procedure
  - Event
  - Body structure
  - Special concept

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

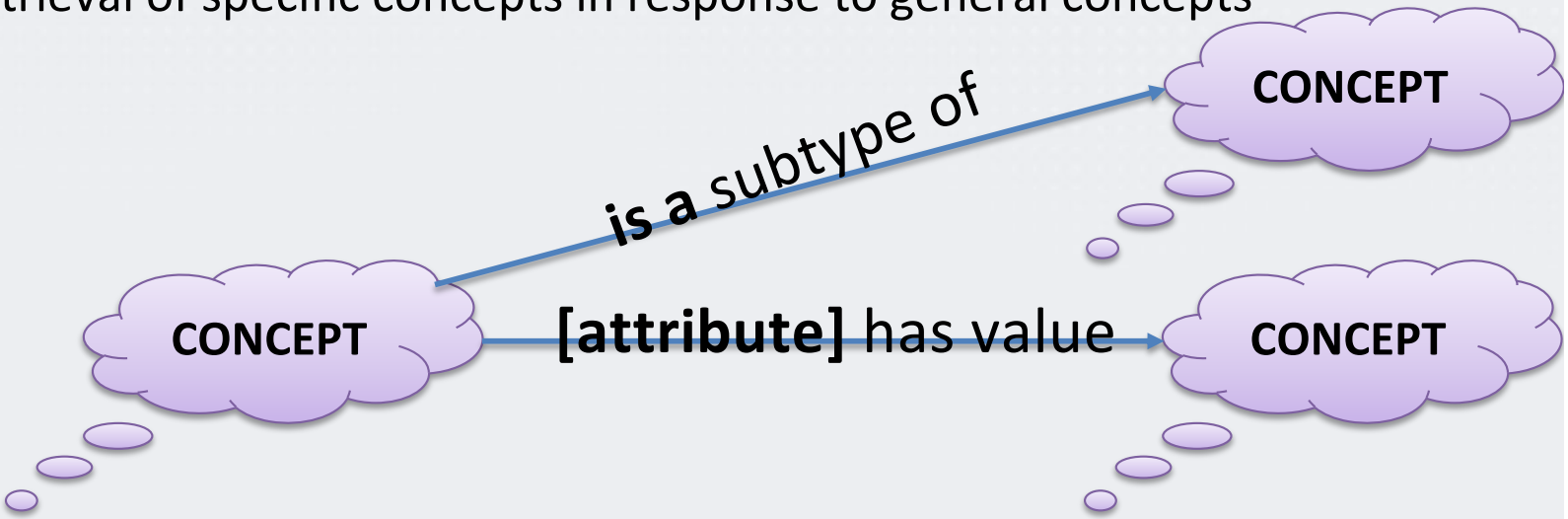
Example

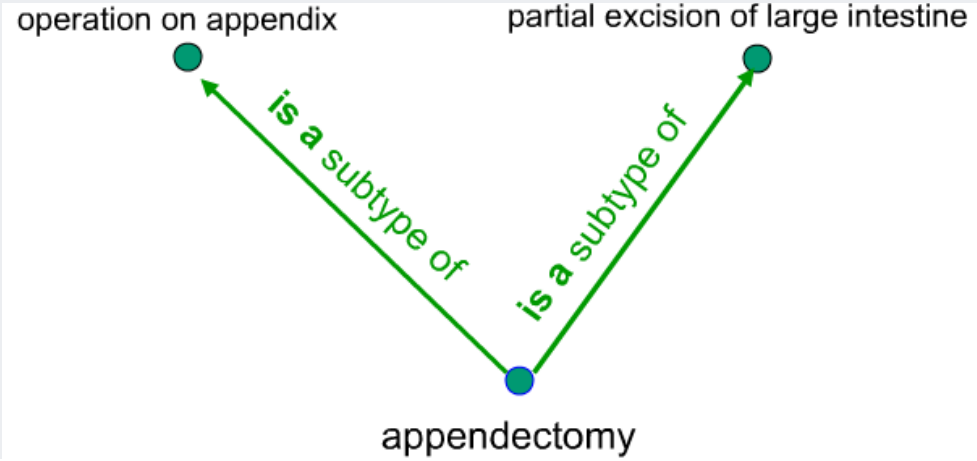
Open fracture foot IS-A (more specific)
Fracture of foot IS-A (Specific)
Injury of foot IS-A (general)
Disorder of foot. (more general)

SNOMED CT Building Blocks: Relationships

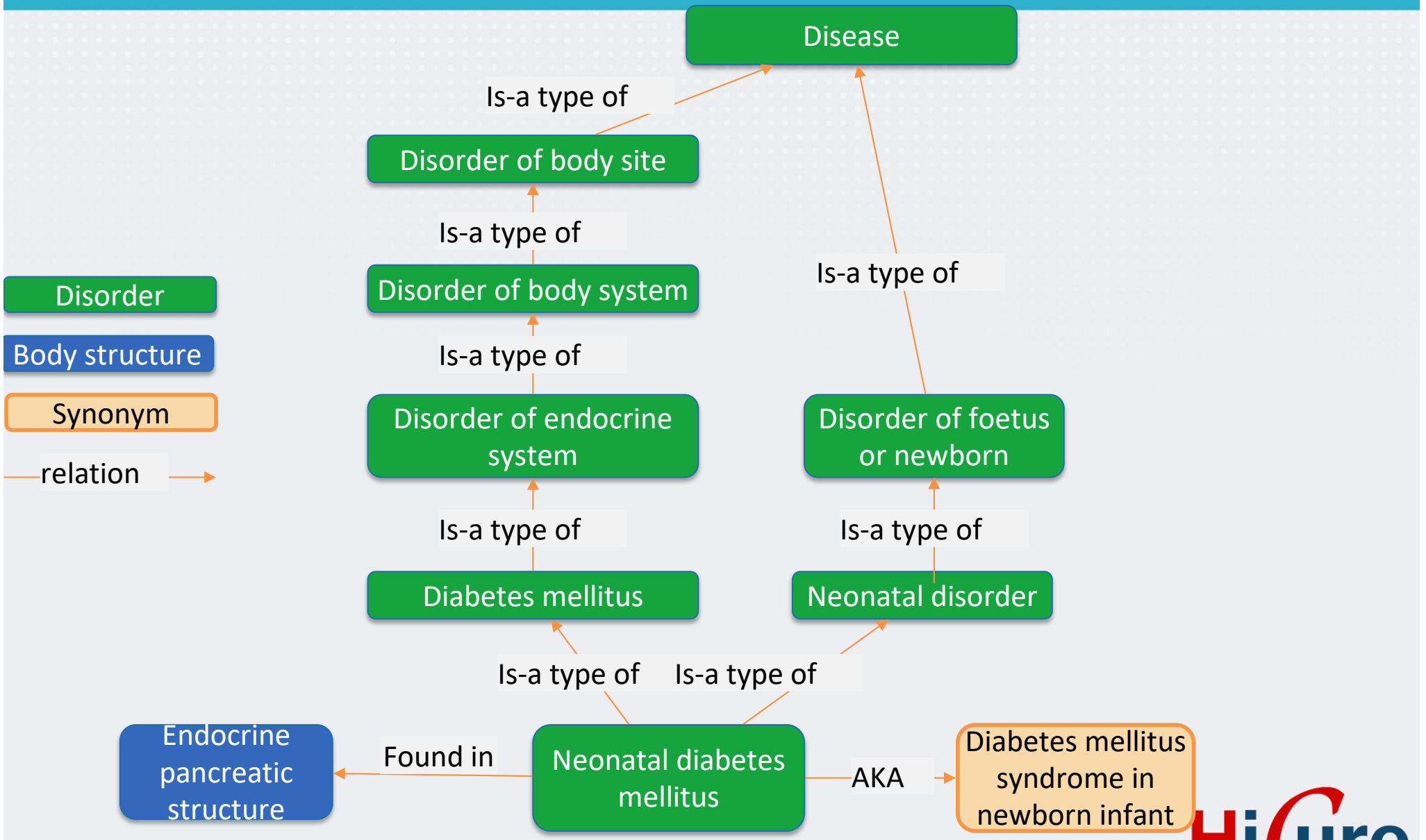
3. Relationships:

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





SNOMED-CT: Example-1



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 slide

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:

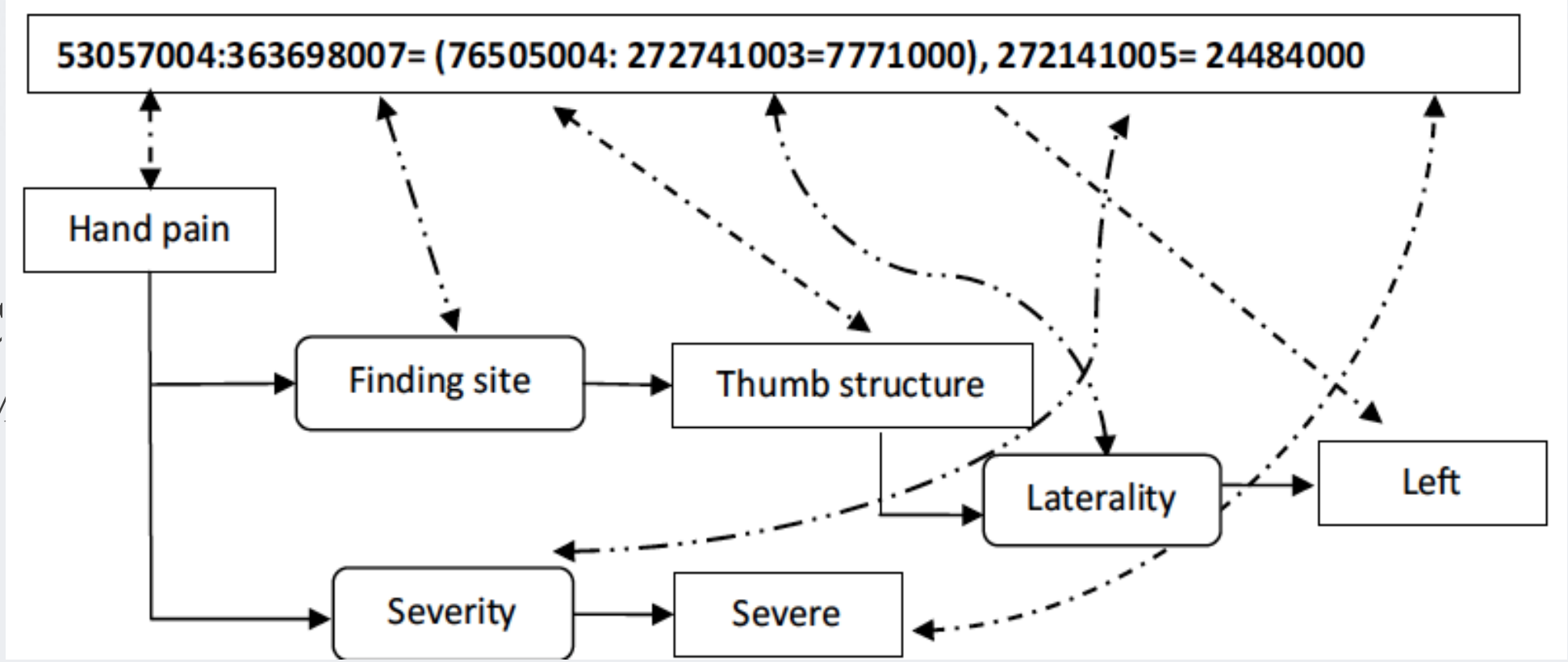
- **Attribute**: represented as attributeName" = " attributeValue
- **Refinements**: represented by " **:** " explaining parameters of preceding code.

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.

SNOMED CT & Patient's Health Status



Human Readable form=> **Severe Hand pain** in the **Left Thumb**

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”

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"

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

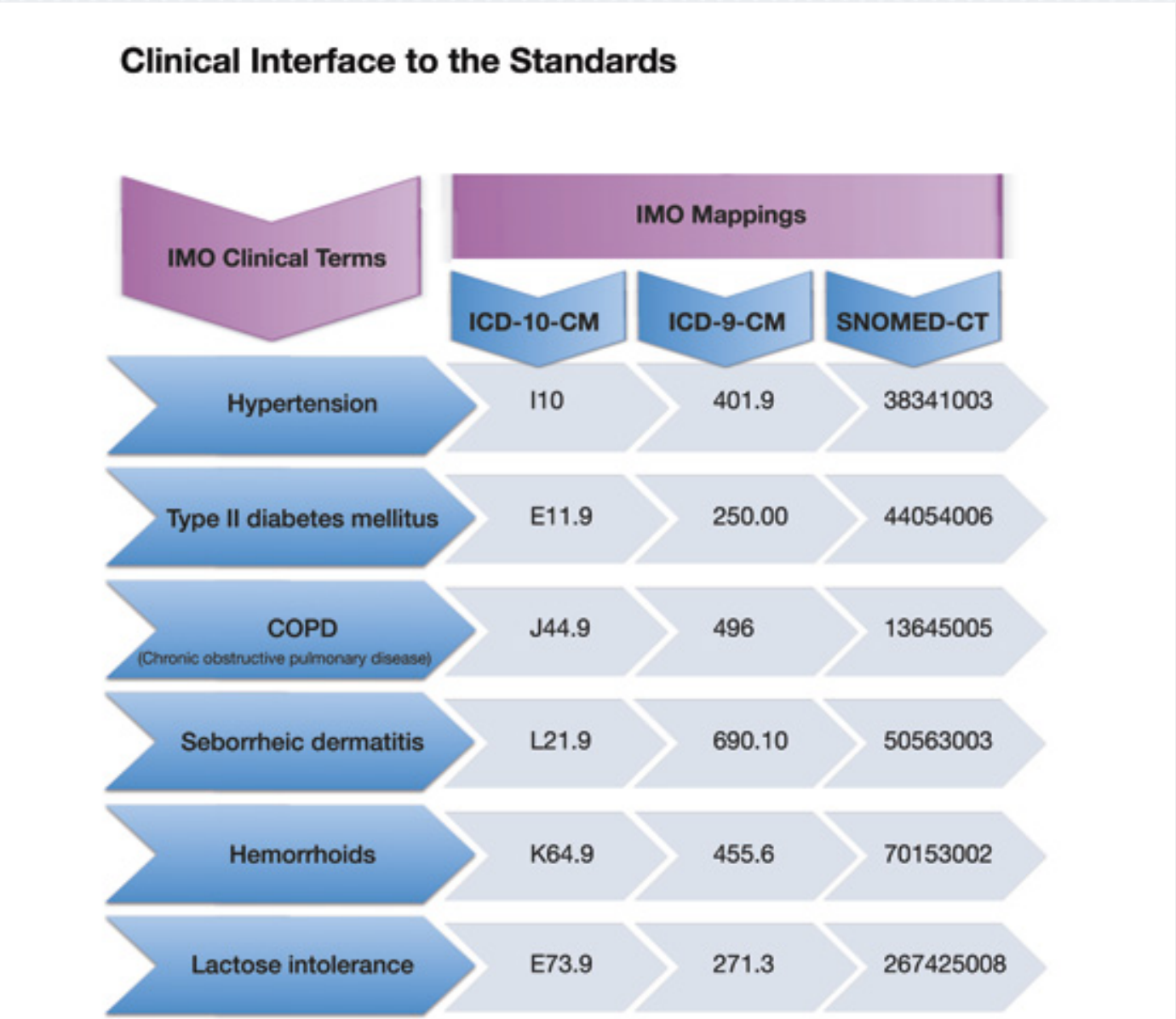
SNOMED-CT Vs ICD-9/10

- 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



Concepts/Coding Standards
SNOMED CT – Online Browser