Università degli Studi di Trieste

Corso di Laurea Magistrale in
INGEGNERIA CLINICA

LA CODIFICA DELL'INFORMAZIONE NELLA CARTELLA CLINICA ELETTRONICA

Corso di Informatica Medica

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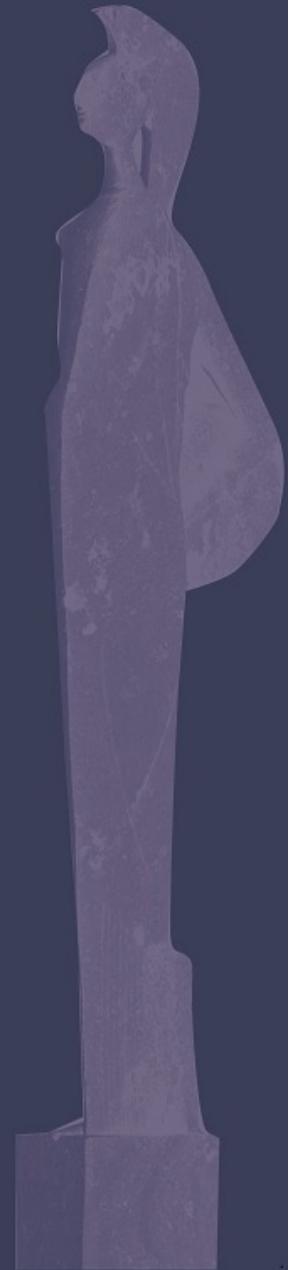
Dipartimento di Ingegneria e Architettura

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DOCUMENTO STRUTTURATO E STANDARDIZZATO

STRUTTURATO = documento organizzato secondo uno schema che può essere standard

STANDARDIZZATO = documento che utilizza una terminologia medica condivisa per garantire la compresnibilità dei contenuti anche da un calcolatore

Original **Investigations** JAMIA

MEDICAL TERMINOLOGY

Model Formulation ■

HL7 Clinical Document Architecture, Release 2

Robert H. Dolin, MD, Liora Alschuler, Sandy Boyer, BSP, Calvin Beebe, Fred M. Behlen, PhD, Paul V. Biron, Amnon Shabo (Shvo), PhD

A b s t r a c t   Clinical Document Architecture, Release One (CDA R1), became an American National Standards Institute (ANSI)–approved HL7 Standard in November 2000, representing the first specification derived from the Health Level 7 (HL7) Reference Information Model (RIM). CDA, Release Two (CDA R2), became an ANSI-approved HL7 Standard in May 2005 and is the subject of this article, where the focus is primarily on how the standard has evolved since CDA R1, particularly in the area of semantic representation of clinical events. CDA is a document markup standard that specifies the structure and semantics of a clinical document (such as a discharge summary or progress note) for the purpose of exchange. A CDA document is a defined and complete information object that can include text, images, sounds, and other multimedia content. It can be transferred within a message and can exist independently, outside the transferring message. CDA documents are encoded in Extensible Markup Language (XML), and they derive their machine processable meaning from the RIM, coupled with terminology. The CDA R2 model is richly expressive, enabling the formal representation of clinical statements (such as observations, medication administrations, and adverse events) such that they can be interpreted and acted upon by a computer. On the other hand, CDA R2 offers a low bar for adoption, providing a mechanism for simply wrapping a non-XML document with the CDA header or for creating a document with a structured header and sections containing only narrative content. The intent is to facilitate widespread adoption, while providing a mechanism for incremental semantic interoperability.

TERMINOLOGIE E BARRIERE SEMANTICHE

BARRIERA FISICA

BARRIERA SEMANTICA
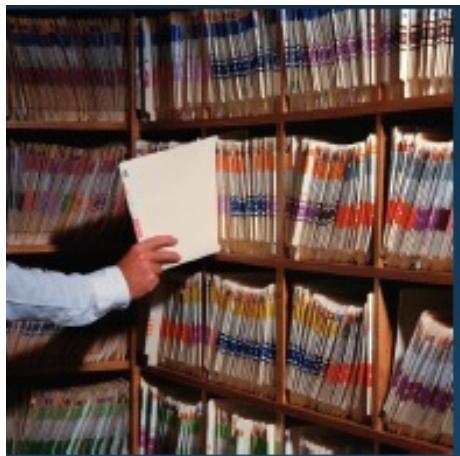
TERMINOLOGIE

Cartella clinica cartacea

Informatizzazione

Cartella clinica elettronica

SCANNERIZZAZIONE/ TRASCRIZIONE

CODIFICA

DEFINIZIONE

DIZIONARIO → RACCOLTE ORGANICHE DI TERMINI, descritti in modo tale da consentire che due interlocutori associno ad un dato termine il medesimo significato, consentono agli stessi interlocutori di comprendersi.

Se il dizionario viene implementato in un sistema informatico, esso diventa un database, cioè una **BANCA DI TERMINOLOGIA**

Nell'ambito medico-sanitario, si parla di BANCHE DI TERMINOLOGIE MEDICHE

MOTIVAZIONI

- Il testo libero, non strutturato non è comprensibile da un calcolatore
  - Presenza di sinonimi → stesso significato, parole diverse (ridondanza) → es. Orale, per via orale, per bocca, oralmente, …
  - Significato multiplo → stessa parola, diverso significato (ambiguità) → es. Spari multipli (neuroni), atrio, ventricolo (cardiaco o cerebrale), …
  - Modifiche del significato legate al contesto → storia familiare di diabete non significa che il paziente abbia il diabete
  - Incertezza → possibile presenza di reflusso valvolare
  - Errori di stampa o varianti lessicali
- Esistono le metodiche di Natural Language Processing (NLP)
  - Ancora molta ricerca da effettuare
  - I computer ragionano meglio con il testo codificato

OBIETTIVO

LE TERMONOLOGIE VENGONO UTILIZZATE NELLA CARTELLA CLINICA ELETTRONICA PER:

- **Abilitare funzionalità avanzate:**
  - Organizzazione e recupero dei dati
  - Clinical decision support
- **Facilitare il riuso del dato:**
  - Generazione di codici amministrativi
  - Misure di qualità
- **Supportare l'interoperabilità**

OBIETTIVO

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DATA RETRIEVAL AND ORGANIZATION (1)

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u Unstructured lab results (e.g. pages of lab reports in .pdf):

u Q: Show me the fasting blood glucose results of Mr. X in the past 6 months

u A: ?????

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u Structured lab results with encoded information:

Date	Lab test name	Lab test code	result	units
1/3/2013	Blood glucose (fasting)	1558-6	105	mg/dL
4/5/2013	Serum sodium	2947-0	140	mmol/L
5/6/2013	Blood glucose (spot)	2339-0	121	mg/dL
6/3/2013	Blood glucose (fasting)	1558-6	95	mg/dL

LOINC codes

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DATA PRESENTATION

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u Q: Show me the fasting blood glucose results of Mr. X in the past 6 months

u A:

Fasting blood glucose results

1/3/2013	105	mg/dL
6/3/2013	95	mg/dL
…		

Valori di glicemia a digiuno
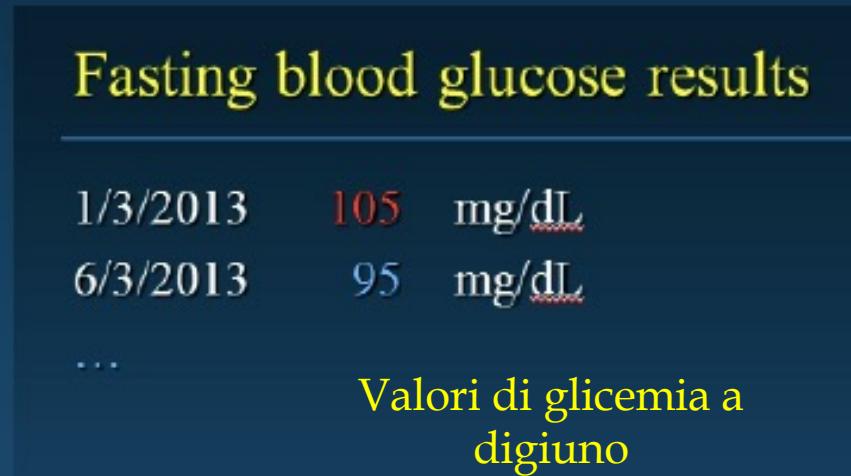
I VALORI INFORMATIZZATI E CODIFICATI POSSONO ESSERE FACILMENTE RICONOSCIUTI E INSERITI IN UN GRAFICO
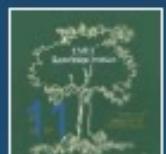
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OBIETTIVO

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CLINICAL DECISION SUPPORT (1)

- Example: "Prompt physician to adjust dosage of nephrotoxic drugs (drugs that can harm the kidneys) in patients with impaired renal function"
- Computer needs to know
  - Is the patient's kidney function normal? Look for
    - Diagnosis related to abnormal renal function e.g. acute renal failure, chronic renal failure
    - Abnormal renal function test results
  - Is the doctor prescribing a nephrotoxic drug? Look for
    - Gentamicin, tobramycin…
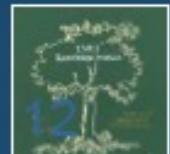
CLINICAL DECISION SUPPORT (2)

u▸ **Unstructured data:**

Nephropathy è sinonimo di "impaired renal function"

False negative

History: 68 yr old male admitted with cough and fever for 3 days. Chills and rigors. Greenish sputum…..
Co-morbidities: type 2 diabetes with **nephropathy**…
Family history: mother died of **chronic renal failure**, father has myocardial infarction at age of 45…
Lab tests: CXR, sputum for culture….
Allergy: hives after injection of **gentamicin** in childhood
Treatment: nebulizer, acetaminophen for fever, amoxicillin 250 mg tid…….

False positives

- Family history contestualizza l'insufficienza renale come patologia della madre e non del soggetto
- La gentamicina non è un farmaco prescritto ma un'allergia

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CLINICAL DECISION SUPPORT (3)

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u▸ Structured encoded data:

| EHR section	Item number	Textual entry	Code	Terminology	Test result	Ref. range
Problem list	1	Type 2 diabetes with nephropathy	420279001	SNOMED CT		
Family history (mother)	1	Chronic renal failure	90688005	SNOMED CT		
Family history (father)	2	Acute myocardial infarction	57054005	SNOMED CT		
Allergy list	1	Gentamicin	142438	RxNorm		
Lab results	1	Serum creatinine	2160-0	LOINC	1.8 mg/dL	0.7 – 1.3 mg/dL
prescriptions	1	Amoxicillin 250 mg capsule	308182	RxNorm		

OBIETTIVO

LE TERMONOLOGIE VENGONO UTILIZZATE NELLA CARTELLA CLINICA ELETTRONICA PER:

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- **Supportare l'interoperabilità**

GENERAZIONE DI CODICI AMMINISTRATIVI

Schermo di Hess-Lancaster per la quantificazione della diplopia dello strabismo.
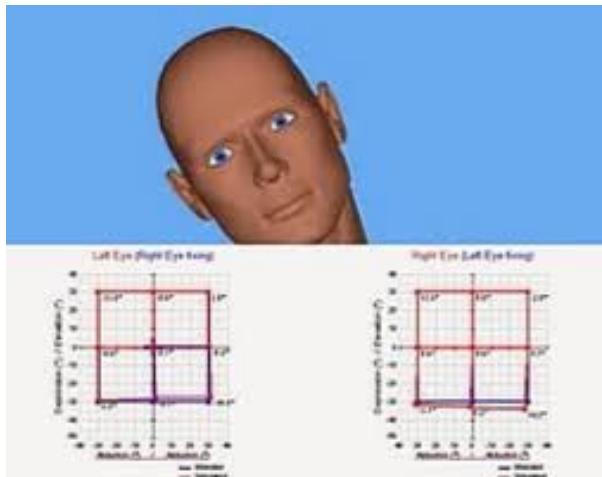
L'esaminatore proietta una mira con una torcia a luce rossa sullo schermo, mentre il paziente indossa un occhiale con lente rossa a destra e verde a sinistra e tiene in mano una torcia verde. In questo modo al paziente, che vede solo la luce rossa e l'occhio destro diventa fissatore, si chiede di sovrapporre la mira proiettata dalla sua torcia verde (l'occhio sinistro vede soltanto la luce verde) alla mira rossa. I tracciati normali della figura esemplificano un caso, solo teorico, di paralisi del muscolo grande obliquo di sinistra perfettamente compensata dall'inclinazione della testa verso la spalla controlaterale (destra)

Il medico di base scrive la ricetta per questo esame→
- Schermo di Hess
- **Test di Hess**
- Test di Hess-Lancaster
- Esame ortottico con test di Hess

Tutte queste diciture sono clinicamente corrette, ma solo una è accettata nelle prescrizioni per poter garantire il rimborso della prestazione

OBIETTIVO

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- **Supportare l'interoperabilità**

MISURE DI QUALITÀ

- Strumenti che vengono utiilizzati per tracciare la qualità dei servizi sanitari forniti da professionisti accreditati e/o strutture accreditate (es. Certificazione ISO 9001)

- Le variabili misurate dipendono dal tipo di valutazione:
  - Risultati clinici
  - Processi clinici
  - Sicurezza dle paziente
  - Efficienza di utilizzo delle risorse
  - Continuità della cura
 - Rispetto delle linee guida
  - …

CLINICAL RECOMMENDATIONS

1. American Association of Clinical Endocrinologists (2002): Recommends that a glycosylated hemoglobin be performed during an initial assessment and during follow-up assessments, which should occur at no longer than three-month intervals.

2. American Diabetes Association (2006): Recommends obtaining a glycosylated hemoglobin during an initial assessment and then routinely as part of continuing care. In the absence of well-controlled studies that suggest a definite testing protocol, expert opinion recommends glycosylated hemoglobin be obtained at least twice a year in patients who are meeting treatment goals and who have stable glycemic control and more frequently (quarterly assessment) in patients whose therapy was changed or who are not meeting glycemic goals.
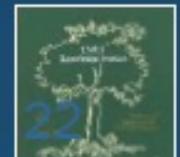
EXAMPLE (1)
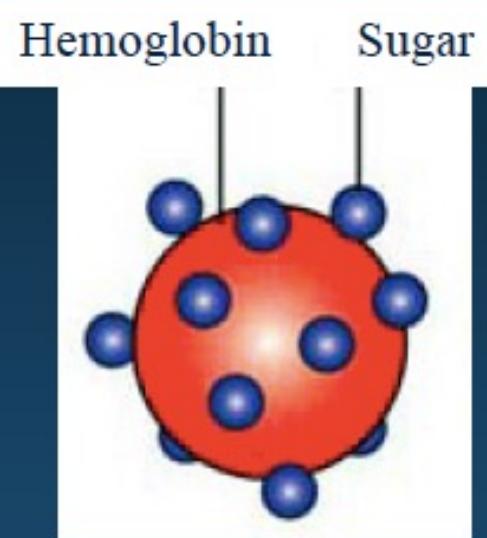
EXAMPLE (2)

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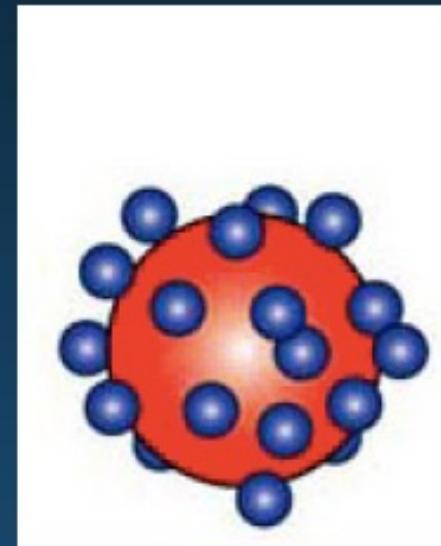
Hemoglobin A1c Test for Pediatric Patients

$$= \frac{\text{\# diabetic patients [age 5-17] } \textit{tested for HbA1c}}{\text{\# diabetic patients [age 5-17]}}$$

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EXAMPLE (3)

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Hemoglobin A1c Test for Pediatric Patients

Tests for HbA1c

$$= \frac{\# \text{ diabetic patients [age 5-17] } tested for HbA1c}{\# \text{ diabetic patients [age 5-17]}}$$

- Type 1 or Type 2 diabetes
- Excludes gestational diabetes

- Requires date of birth

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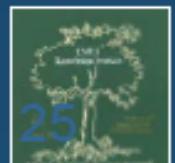
EXAMPLE (4)
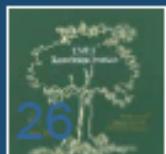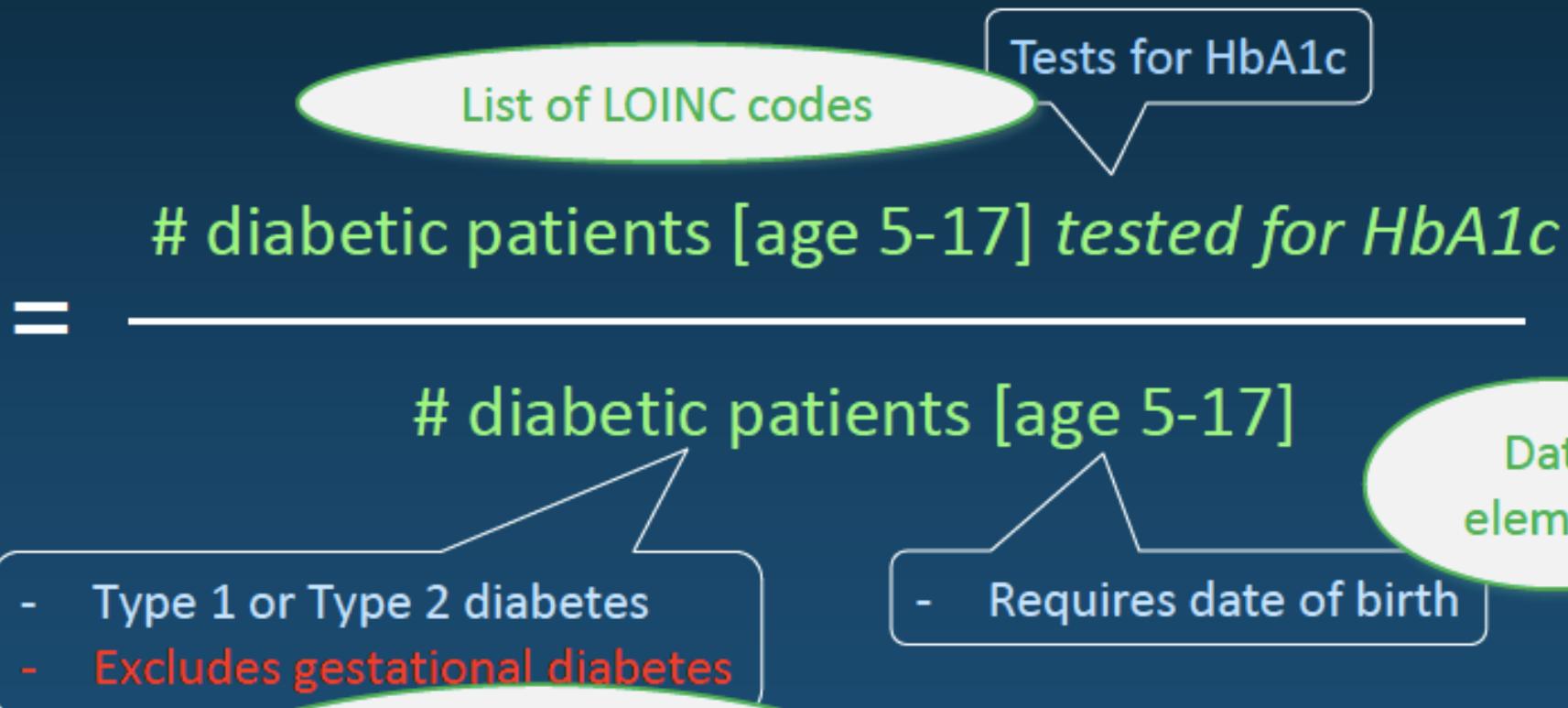
INTEROPERABILITÀ SEMANTICA

- **Comprensione senza ambiguità** tra due interlocutori (non devono essere possibili errori di interpretazione dei dati scambiati e/o delle informazioni condivise)

- **Discriminazione** di termini diversi (associazione univoca tra un termine e il suo significato)

- **Combinazione** di concetti univoca (termini diversi <u>combinati</u> tra di loro in un certo modo devono essere associati ad un unico significato)

INTEROPERABILITÀ SINTATTICA
Due computer devono essere collegati in rete e devono poter dialogare

INTEROPERABILITÀ SEMANTICA
Due computer devono poter dialogare condividere il significato dei termini → dizionario comune

I BENEFICI INTRODOTTI DALLE TERMINOLOGIE

- RECUPERO EFFICACE DELL'INFORMAZIONE
  - Indicizzata tramite codici
  - Non ambigui, veloci da trattare

- POSSIBILITÀ DI ANALISI
  - Raggruppamenti e gerarchie
  - Possibilità di rappresentare graficamente I dati

- RAGIONAMENTO CLINICO
  - Rappresentazione condivisa dei significati, utilizzo di line guida e raccomandazioni
  - Inferenza semplificata

- CONDIVISIONE
  - Rappresentazione univoca dei termini
  - Affidabilità della condivisione

COMPONENTI DI UN DIZIONARIO

DEFINIZIONE

TERMINE CONDIVISO

CODICE

DIZIONARIO
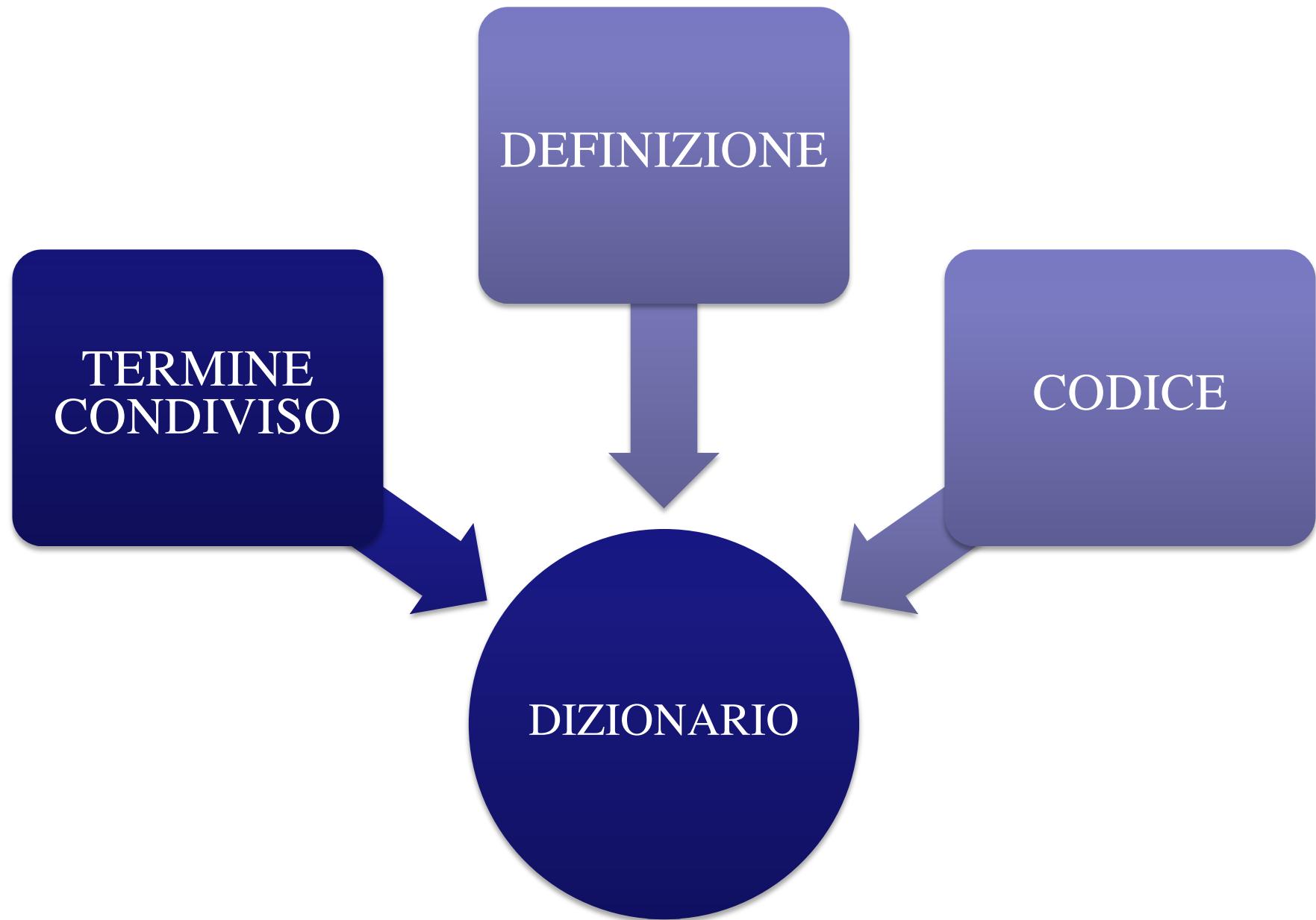
CARATTERISTICHE DELLA TERMINOLOGIA MEDICA

- I termini **variano** al variare del **contesto** in cui sono usati

- Le terminologie **evolvono:**
  - ✓ Aggiunta/Cancellazione
  - ✓ Fusione/Ristrutturazione di termini

- Sono parte di un **dominio di conoscenza ampio e complesso**

- Spesso le terminologie sono **specifiche di un certo ambito** all'interno dell'intero panorama medico-sanitario

- Di solito sono il frutto di grandi sforzi, spesso originati dalle **specifiche società scientifiche cliniche**

COMPATIBILITÀ COL PREGRESSO

- **I dizionari evolvono** insieme alla terminologia e devono essere fornite versioni aggiornate

- Le versioni aggiornate **risultare compatibili** con le versioni precedenti.

- Gli aggiornamenti devono essere fatti in modo che sia chiaro il **motivo** per cui l'aggiornamento è stato fatto e **come** questo aggiornamento **impatterà** sulla futura interpretazione delle informazioni nuove e vecchie.

- L'autore del dizionario deve fornire sia il **cambiamento formale e sintattico, sia quello semantico**, per comprendere se e come il significato del termine è variato durante l'evoluzione.

- Le nuove edizioni del dizionario devono essere **indicate e classificate** per poter sempre ricostruire il corretto significato di una parola utilizzata in un certo istante.

DEFINIZIONE DI CONCETTO

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**CONCETTO
=
Singola entità
di pensiero**

DEFINIZIONE DESCRITTIVA	DEFINIZIONE CALCOLABILE
•Definizione informale •Descrizione testuale	•Definizione formale •Descrizione tramite attributi
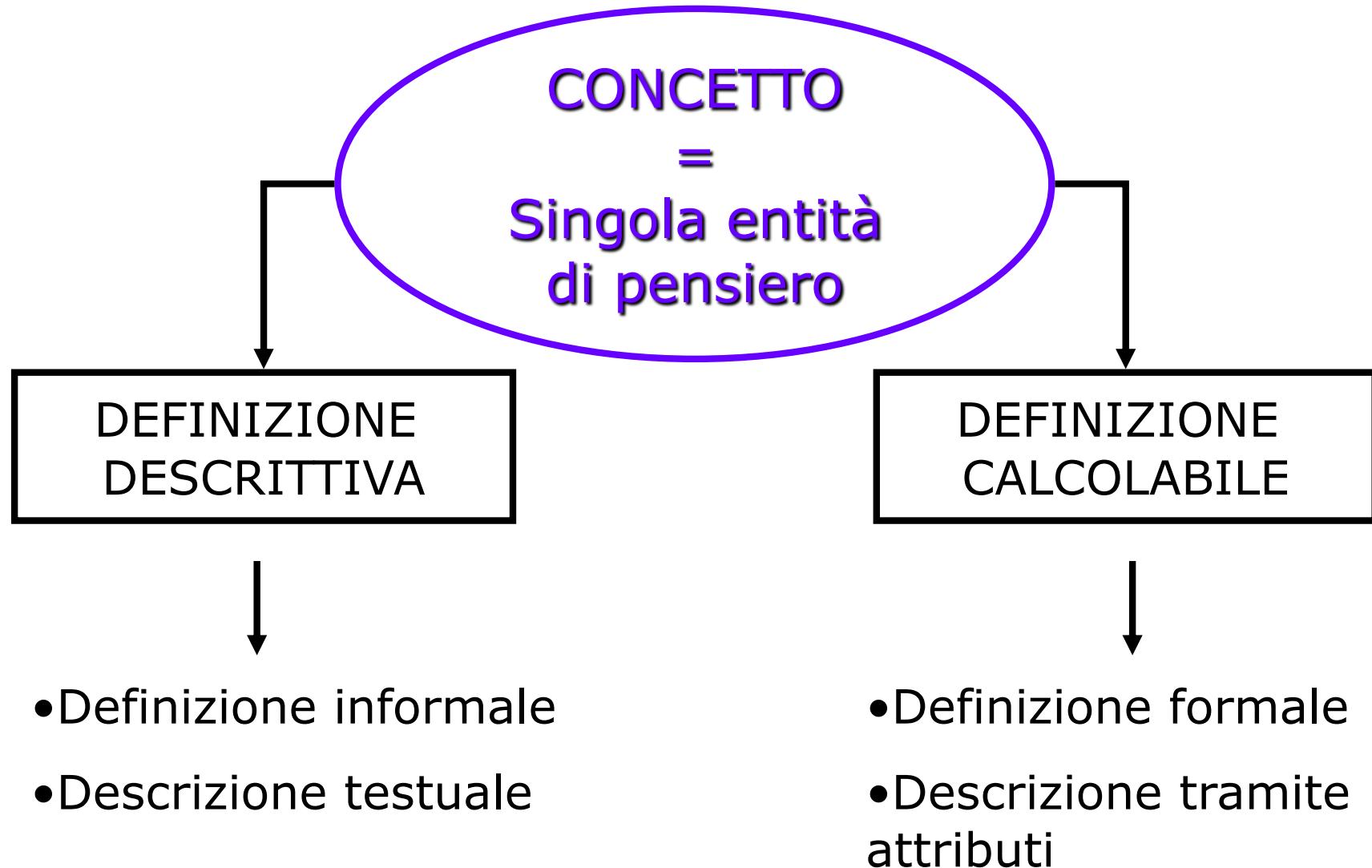
RELAZIONE TRA TERMINI E CONCETTI

TERMINE

CONCETTO SINGOLO
(atomico o individuale)

CONCETTO AGGREGATO

- Cuore
- Apparato
- Diabete
- …

- Circolazione sanguigna
- Vena cava superiore
- Malattia neurodegenerativa extrapiramidale
- …
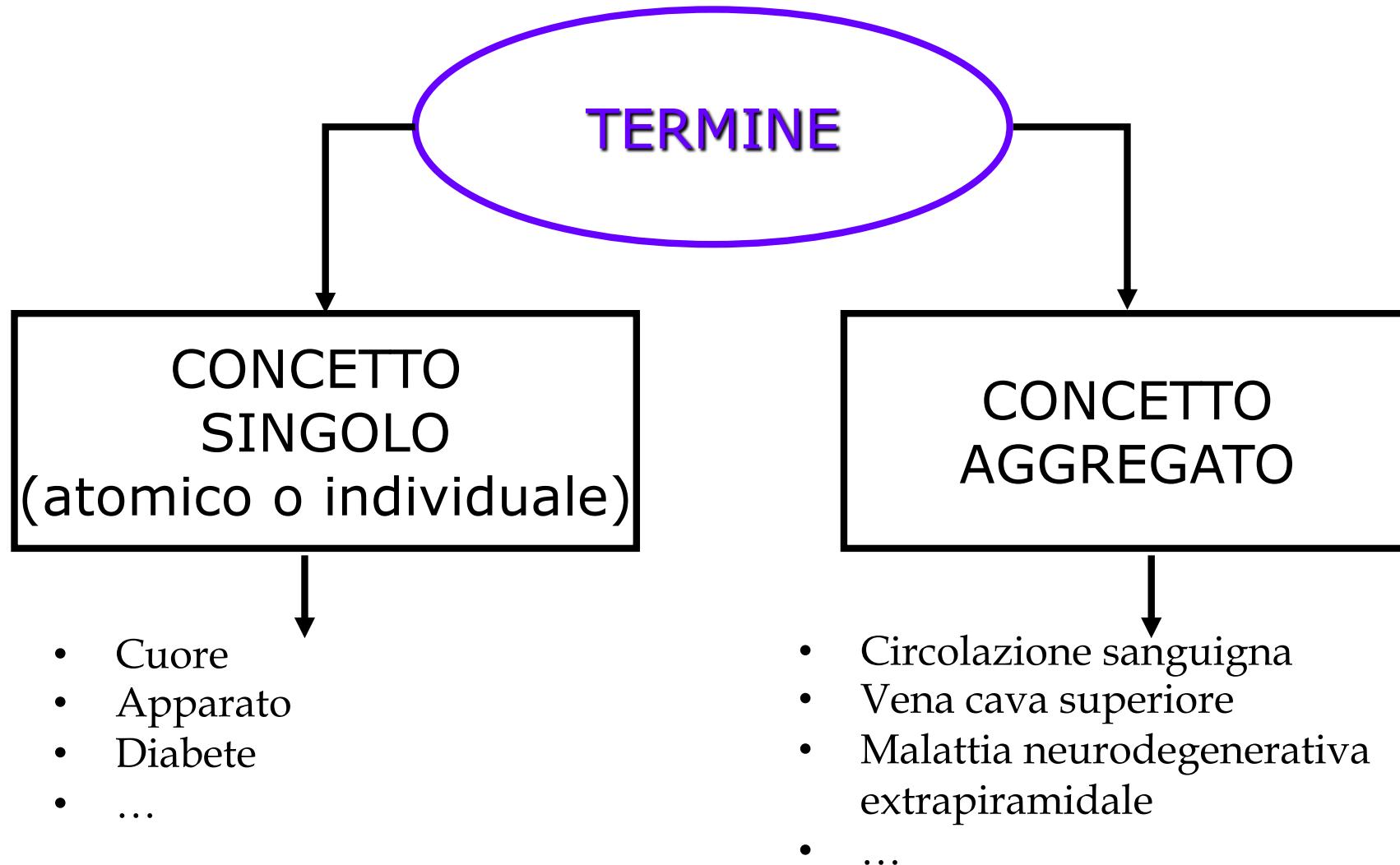
RAPPRESENTAZIONE DEI CONCETTI

- Metodo di rappresentazione → codice identificativo → Un concetto è sempre associato ad un codice identificativo.

- Se il concetto è atomico, ad esso sarà associato un identificativo.

- Se il concetto è aggregato, il metodo di rappresentazione dipende dal tipo di dizionario implementato

Dizionari precoordinati

Dizionari postcoordinati
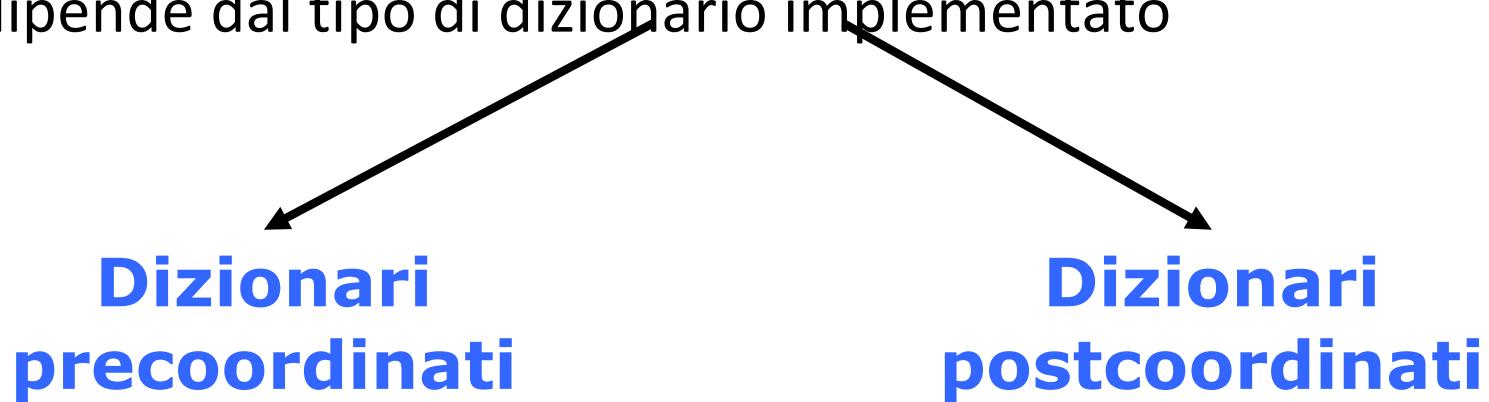
DIZIONARI PRECOORDINATI E DIZIONARI POSTCOORDINATI

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DIZIONARI PRECOORDINATI

- Assegnano un unico codice di identificazione a concetti aggregati
- I concetti aggregati devono essere già predefiniti
- ES: MALATTIA NEURODEGENRATIVA EXTRAPIRAMIDALE → cod 12345

DIZIONARI POSTCOORDINATI

- Assegnano un codice identificativo a ciascun concetto atomico
- I concetti aggregati si ottengono combinando opportunamente dei concetti atomici
- ES: MALATTIA NEURODEGENRATIVA EXTRAPIRAMIDALE → cod 12-77-73
  - Malattia: cod 12
  - Neurodegenrativa: cod 77
  - Extrapiramidale: cod 73

VANTAGGI

DIZIONARI PRECOORDINATI

- possono facilmente trasmettere informazione complessa senza ambiguità
- elimina tutte quelle combinazioni di concetti atomici che siano senza senso o non desiderabili, in quanto le uniche aggregazioni di concetti atomici permesse sono quelle predefinite

DIZIONARI POSTCOORDINATI

- non ridondante, flessibile e, potenzialmente, il numero totale di codici identificativi da assegnare è minore;
- per creare un nuovo termine aggregato, è sufficiente combinare i singoli concetti che lo compongono, senza restrizioni sulla validità del nuovo aggregato e con una maggiore facilità rispetto ai precoordinati nel risalire ai singoli elementi che lo compongono.

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SVANTAGGI

DIZIONARI PRECOORDINATI

- l'eccessiva specificità rende poco accessibile il dizionario a chi non conosce dettagliatamente il campo di applicazione dei termini descritti
- esistono versioni discordi tra esperti dello stesso settore riguardo ai processi più complessi esistenti
- richiede una sistematizzazione a priori dell'intero settore considerato e una sua strutturazione predefinita, da cui ottenere i codici per i concetti aggregati ammessi
- i concetti aggregati predefiniti sono formati da concetti singoli che vengono combinati in modo diverso e, quindi, questi concetti singoli risultano ridondanti

DIZIONARI POSTCOORDINATI

- si perde potenzialmente l'univocità della definizione, in quanto un termine può essere codificato mediante diversi concetti elementari
- è possibile creare aggregati di concetti senza senso
- è necessario definire dei vincoli in grado di evidenziare le combinazioni corrette rispetto a quelle indesiderate.

ESEMPIO

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*Test antigene-anticorpo effettuato su
un campione di liquido cerebrospinale
ottenuto in un solo prelievo e
quantificato mediante metodo di flocculazione*

DIZIONARIO PRECOORDINATO:

Concetto = codice 5289-4

DIZIONARIO POSTCOORDINATO:

Test a/a= cod 1135

Liquor = cod 3457

Un solo prelievo= cod 5503

Flocculazione= cod 3621-9

L'utilizzo dell'uno o dell'altro approccio dipende dal fine del dizionario:

• volendo privilegiare l'assoluta mancanza di ambiguità (campo sanitario amministrativo) sarà scelto un dizionario precoordinato;

• volendo privilegiare la flessibilità e la possibilità di coniare nuovi termini (campo della ricerca) sarà scelto un dizionario postcoordinato

ESEMPIO DI DIZIONARIO PRECOORDINATO

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INTERNATIONAL CODE OF DISEASE (ICD)

- Sviluppato e mantenuto dal WHO
- Nasce come classificazione delle cause di morte
- Attualmente è uno standard di classificazione dedicato all'epidemiologia e alla gestione sanitaria

The World Health Organization's
International Classification of Diseases

Evolution of ICD

First medical statistician of the General Register Office of England and Wales submitted his *Report in 1855 on nomenclature and statistical classification of diseases,* in which he included most of those fatal diseases that affect health.

William Farr (1807-1883)

| 1893 | 1909 | 1929 | 1948 | 1975 | 1990 | 2017-2018 |

ICD-1
International List of Causes of Death

ICD-2
International List of Causes of Sickness and Death

ICD-4
Categories based on etiology

ICD-6
International Classification of Diseases, Injuries and Causes of Death
Mental, Psychoneurotic and Personality Disorders

ICD-9
Narrative descriptions of Mental & Behavioral disorders

ICD-10

ICD-11
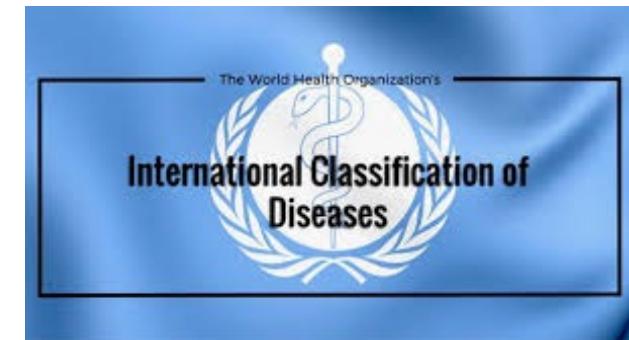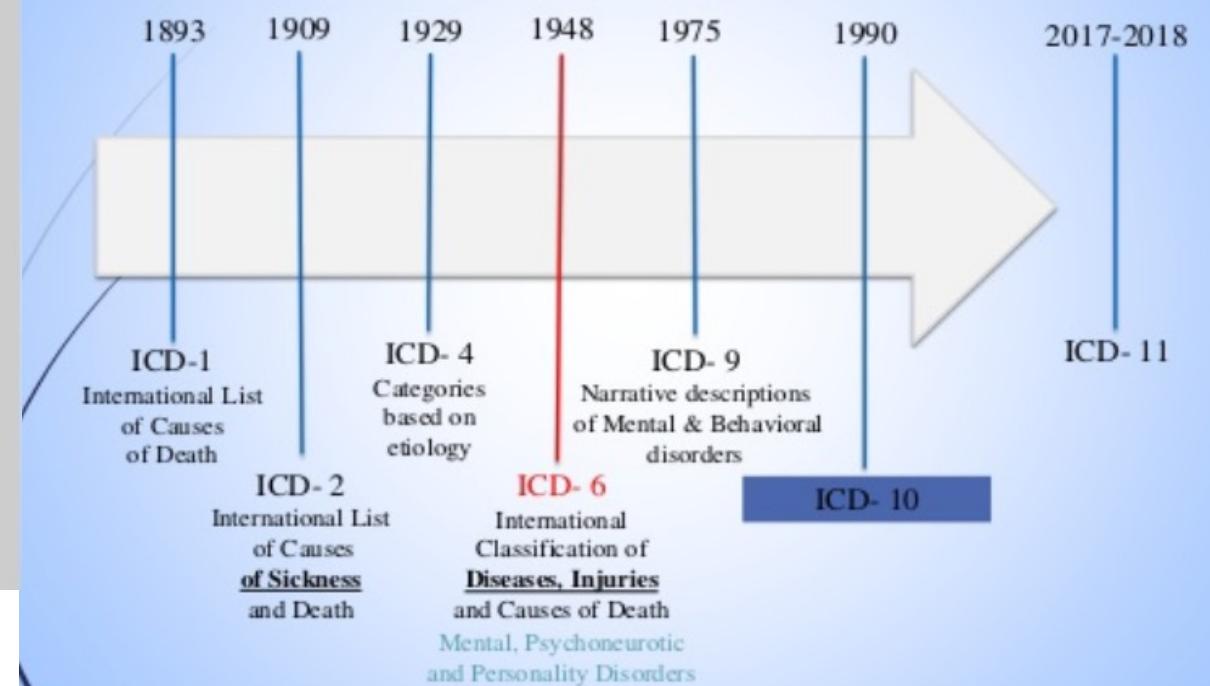
Prima "versione": 1850

ESEMPIO DI PRECOORDINAZIONE (1/2)

481   Pneumococcal Pneumonia

482   Other Bacterial Pneumonia
      482.0   Pneumonia due to Klebsiella Pneumoniae
      482.1   Pneumonia due to Pseudomonas
      482.2   Pneumonia due to Haemophilus Influenzae
      482.3   Pneumonia due to Streptococcus
      482.4   Pneumonia due to Staphylococcus
      482.8   Pneumonia due to Other Specified Bacteria
      482.9   Bacterial pneumonia unspecified

484   Pneumonia in Infectious Disease Classified Elsewhere
      484.3   Pneumonia in Whooping Cough
      484.4   Pneumonia in Tularemia
      484.5   Pneumonia in Anthrax

ESEMPIO DI PRECOORDINAZIONE (2/2)

```
003   Other Salmonella Infections
         003.0   Salmonella Gastroenteritis
         003.1   Salmonella Septicemia
         003.2   Localized Salmonella Infections
                  003.20   Localized Salmonella Infection, Unspecified
                  003.21   Salmonella Meningitis
                  003.22   Salmonella Pneumonia
                  003.23   Salmonella Arthritis
                  003.24   Salmonella Osteomyelitis
                  003.29   Other Localized Salmonella Infection
         003.8   Other specified salmonella infections
         003.9   Salmonella infection, unspecified
```

ESEMPIO DI DIZIONARIO POSTCOORDINATO

SNOMED Clinical Terms

- A controlled coded clinical terminology for use in Electronic Health Records
    - Developed in the USA and the UK as a merger of earlier versions of SNOMED with the NHS Clinical Terms (Read Codes)
        - College of American Pathologists in USA
        - National Health Service (NHS) in the UK
    - Design based on
        - Identified user requirements
        - Practical experience
        - Scientific principles established in peer reviewed publications
    - First released in 2002
- Acquired for the public good by IHTSDO in 2007
- In 2017 IHTSDO adopted the trading name
SNOMED International

ESEMPIO DI POSTCOORDINAZIONE

UNIVERSITÀ
DEGLI STUDI DI TRIESTE

DE-10000	Bacterial infectious disease, NOS	(L-10000)
DE-10100	Bacterial pneumonia, NOS	(T-28000)(M-40000)(L-10000)
DE-11205	Pneumonia in anthrax	(T-28000)(M-40000)
DE-13212	Pneumonia in pertussis	(T-28000)(M-40000)
DE-13430	Pneumonic plague, NOS	(T-28000)(L-1E401)(DE-01750)
DE-13431	Primary pneumonic plague	(T-28000)(L-1E401)(DE-01750)
DE-13432	Secondary pneumonic plague	(T-28000)(L-1E401)(DE-01750)
DE-13510	Pneumococcal pneumonia	(T-28000)(M-40000)(L-25116)
DE-13934	Salmonella pneumonia	(T-28000)(L-17100)
DE-14120	Staphylococcal pneumonia	(T-28000)(L-24800)
DE-14213	Pneumonia due to Streptococcus	(T-28000)(M-40000)(L-25100)
DE-14817	Tuberculous pneumonia	(T-28000)(M-40000)(L-21801)
DE-15104	Pneumonia in typhoid fever	(T-28000)(M-40000)
DE-15613	Haemophilus influenzae pneumonia	(T-28000)(L-1F701)
DE-15710	Legionella pneumonia, NOS	(L-20401)
DE-15716	Pittsburg pneumonia	(L-20402)
DE-15810	Mycoplasma pneumonia	(T-28000)(L-22018)
DE-19110	Bacterial infection due to Klebsiella pneumoniae	(L-16001)
DE-19111	Pneumonia due to Klebsiella pneumoniae	(T-28000)(M-40000)(L-16001)
DE-19134	Achromobacter pneumonia	
DE-19151	Pneumonia due to Pseudomonas	(T-28000)(M-40000)(L-23400)
DE-19162	Pneumonia due to Proteus mirabilis	(T-28000)(M-40000)(L-16802)
DE-19204	Pneumonia due to E. coli	(T-28000)(M-40000)(L-15602)
DE-21611	Ornithosis with pneumonia	(T-28000)(M-40000)(L-2A902)
DE-21704	Pneumonia in Q fever	(T-28000)(M-40000)
DE-3632A	AIDS with bacterial pneumonia	(T-28000)(L-34800)(L-10000)
DE-3632B	AIDS with pneumococcal pneumonia	(T-28000)(L-34800)(L-25100)
DE-36333	AIDS with pneumonia, NOS	(T-28000)(M-40000)(L-34800)

Not otherwise specified

Lung

Inflammation

Pneumococcus

DEFINIZIONE DEI CODICI IDENTIFICATIVI

UNIVERSITÀ
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IDENTIFICATORI

GERARCHICI

•L'assegnazione dell'identificatore dipende dalla appartenenza di un termine ad una certa classe

•Esempio:
  Eschirichia coli=cod L15601
      L=organismo vivente
      L1=batteri
      L15=enetrobacteria
      L156=famiglia eschirichia

•Numero limitato di termini per classe

CONTEXT-FREE

•L'assegnazione dell'identificatore avviene senza una precisa regola gerarchica

•Flessibili

•Illimitati

•Esempio:

  Eschirichia coli = cod 12345

ESEMPIO DI CODICE GERARCHICO - DIZIONARIO PRECOORDINATO

UNIVERSITÀ DEGLI STUDI DI TRIESTE

INTERNATIONAL CODE OF DISEASE, 9th edition ICD - 9

📖 ICD9-CM

    📖 01 --05 - INTERVENTI SUL SISTEMA NERVOSO

        📖 01 -- - Incisioni ed asportazioni di patologia del cranio, del cervello e delle meningi cerebrali

            📖 01.0--Puntura transcranica (trapanazione del cranio)

            📖 01.1--Procedure diagnostiche sul cranio, sul cervello e sulle meningi cerebrali

            📖 01.2--Craniotomia e craniectomia

            📖 01.3--Incisione cerebrale e delle meningi

            📖 01.4--Interventi sul talamo e sul globo pallido

            📖 01.5--Altre asportazioni o altri interventi di demolizione sul cervello e sulle meningi cerebrali

            01.6 -- Asportazione di lesioni del cranio

http://www.salute.gov.it/portale/temi/ric_codice/default.jsp

ESEMPIO DI CODICE GERARCHICO - DIZIONARIO PRECOORDINATO

UNIVERSITÀ
DEGLI STUDI DI TRIESTE

INTERNATIONAL CODE OF DISEASE, 9th edition ICD - 9

ICD9-CM

01 --05 - INTERVENTI SUL SISTEMA NERVOSO

01 - Incisioni ed asportazioni di patologia del cranio, del cervello e delle meningi cerebrali

01.0 - Puntura transcranica (trapanazione del cranio)

01.01--Puntura delle cisterne

01.02--Puntura ventricolare mediante catetere già impiantato

01.09--Altra puntura del cranio

http://www.salute.gov.it/portale/temi/ric_codice/default.jsp

ESEMPIO DI CODICI GERARCHICI - DIZIONARIO POSTCOORDINATO

SYSTEMIZED NOMENCLATURE OF MEDICINE- SNOMED

- **T (Topography) – Termini anatomici**
  - (T-28000) Polmone
  - (T-32000) Cuore
  - (T-51000) Bocca
  - (T-D2500)
  - (T-D9600)

- **M (Morphology) – Cambiamenti reperiti in cellule, tessuti e organi**
  - (M-40000) Infiammazione
  - (M-44000) Granuloma
  - (M-54700) Infartuato
  - (M-54701) Infarto microscopico

I concetti sono organizzati in assi (ciascuno inizia con una lettera) da cui poi discendono le ulteriori gerarchie

QUALI DIZIONARI?

u There are so many of them:

- Diagnosis and findings - ICD9CM, ICD10, ICD10CM, ICD10AM, ICD-O, ICPC, ICF, SNOMED CT, Read Codes, MedDRA, CTCAE, WHOART, MEDCIN, DSM

- Procedures - CPT, CDT, HCPCS, OCPS, SNOMED CT, ICD9CM, ICD10-PCS

- Nursing - NANDA, NIC, NOC, OMS, HHC

- Diagnostic tests - LOINC, UltraSTAR

- Drugs - VANDF, NDC, RXNORM, NDDF

- Medical devices - UMDNS, GMDN, SPN

- Genomics - GO, HUGO, NCBI Taxonomy

- …

PERCHÈ?

- La frammentazione (elevati numero di dizionari) porta a maggiore frammentazione → è difficile trocvare ciò di cui ho bisogno → lo creo ex-novo

- Non tutta la terminlogia medica è coperta

- Le terminologie esistenti pososono essere complicate e difficili da capire

- Problema dell'aggiornamneto

- Dislocazione geopolitica e storica

- Si detremina uno spreco di risorse e una minore interoperabilità

SNOMED CT vs.
ICD 9/10/11

SNOMED CT

UNIVERSITÀ DEGLI STUDI DI TRIESTE

SNOMED Clinical Terms

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        - Identified user requirements
        - Practical experience
        - Scientific principles established in peer reviewed publications
    - First released in 2002
- Acquired for the public good by IHTSDO in 2007
- In 2017 IHTSDO adopted the trading name
    SNOMED International

SNOMED International

- ## Is a not-for-profit company
  - Owned by its Members
  - Governed by General Assembly of its Members
  - Funded by its members based on national wealth
- ## Maintains and delivers SNOMED CT
  - Licensed to registered Affiliates
  - SNOMED International does not charge for use in Member territories
  - Low-cost licenses for institutions in other territories
    - Free in lowest income countries
    - Fee waivers for approved research and 'Public Good' uses

SNOMED International Members (April 2019)

Argentina	Denmark	Lithuania	Singapore
Austria	Estonia	Luxembourg	Slovak Republic
Australia	Finland	Malaysia	Slovenia
Belgium	Hong Kong	Malta	Spain
Brazil	Iceland	The Netherlands	Sweden
Brunei	India	New Zealand	Switzerland
Canada	Ireland	Norway	United Kingdom
Chile	Israel	Poland	USA
Cyprus	Jordan	Portugal	Uruguay
Czech Republic	Kazakhstan	Saudi Arabia	

Meaningful Use

- CMS 'Meaningful Use' incentive program for EHR, Stage 2 Certification criteria:
  - SNOMED CT to be used in
    - Problems
    - Procedures
    - Smoking status
    - Some laboratory tests results
    - Family health history
    - Cancer registry

ICD

UNIVERSITÀ DEGLI STUDI DI TRIESTE

INTERNATIONAL CODE OF DISEASE (ICD)

- Sviluppato e mantenuto dal WHO
- Nasce come classificazione delle cause di morte
- Attualmente è uno standard di classificazione dedicato all'epidemiologia e alla gestione sanitaria

The World Health Organization's
International Classification of Diseases

Evolution of ICD

First medical statistician of the General Register Office of England and Wales submitted his *Report in 1855 on nomenclature and statistical classification of diseases,* in which he included most of those fatal diseases that affect health.

William Farr (1807-1883)

| 1893 | 1909 | 1929 | 1948 | 1975 | 1990 | 2017-2018 |

ICD-1
International List of Causes of Death

ICD-2
International List of Causes **of Sickness** and Death

ICD-4
Categories based on etiology

ICD-6
International Classification of **Diseases, Injuries** and Causes of Death
Mental, Psychoneurotic and Personality Disorders

ICD-9
Narrative descriptions of Mental & Behavioral disorders

ICD-10

ICD-11
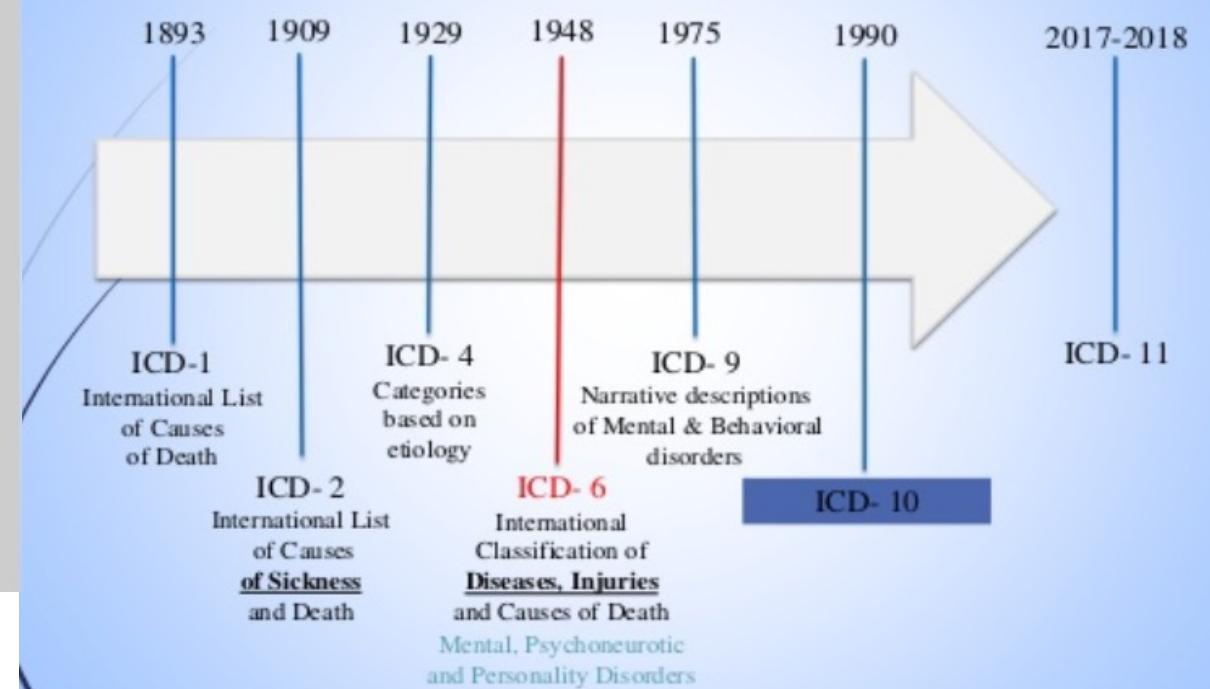
Prima "versione": 1850

SNOMED CT vs. ICD for the EHR

- ICD-9-CM is accepted as an alternative for problem list in MU1, but not MU2, despite the ubiquity of ICD-9-CM codes in the EHR

- Rationale: SNOMED CT (a clinical terminology) is inherently more suitable than ICD (a medical classification) for capturing clinical information
  - Content coverage
  - Clinical orientation
  - Flexible data entry and retrieval

ICD STRUCTURE

- Originally conceived by William Farr as a classification of death causes

- Lists only those causes that are statistically/epidemiologically relevant

- 5 groups
  - Epidemic diseases
  - Constitutional or general diseases
  - Local diseases arranged by site
  - Developmental diseases
  - Injuries.

Volumes of ICD-10

Volume 1: Tabular list

Volume 2: Instruction manual

Volume 3: Alphabetical Index

Records&QAEasy Services Consulting

ICD-10
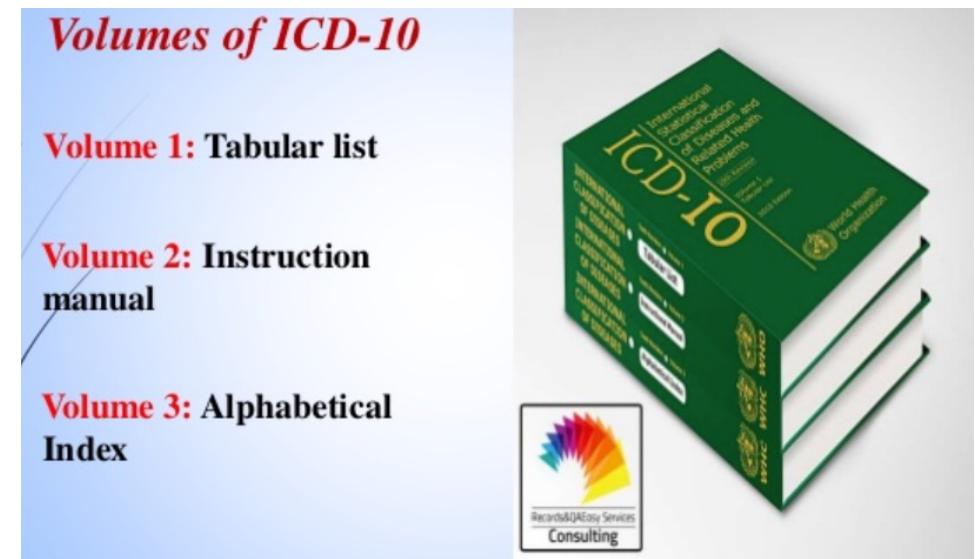
ICD ALPHABETICAL INDEX: CHAPTERS

XXI CHAPTERS

Chapter	Chapter Title	Codes
I	Infectious and parasitic diseases	A00-B99
II	Neoplasms	C00-D49
III	Diseases of the blood & blood-forming organs & disorders of the immune mechanism	D50-D59
IV	Endocrine, nutritional and metabolic diseases	E00-E99
V	Mental and behavioral disorders	F00-F99
VI	Diseases of the nervous system	G00-G99
VII	Diseases of the eye and adnexa	H00-H59
VIII	Diseases of the ear and mastoid process	H60-H99
IX	Diseases of the circulatory system	I00-I99
X	Diseases of the respiratory system	J00-J99
XI	Diseases of the digestive system	K00-K99
XII	Diseases of the skin and subcutaneous tissue	L00-L99

ICD ALPHABETICAL INDEX: CHAPTERS

Chapter	Chapter Title	Codes
XIII	Diseases of the musculoskeletal system & connective tissue	M00-M99
XIV	Diseases of the genitourinary system	N00-N99
XV	Pregnancy, childbirth and the puerperium	O00-O99
XVI	Certain conditions originating in the perinatal period	P00-P99
XVII	Congenital malformations, deformations, and chromosomal abnormalities	Q00-Q99
XVIII	Symptoms & abnormal clinical & lab findings, not elsewhere classified	R00-R99
XIX	Injury, poisoning and certain other consequences of external causes	S00-T99
XX	External causes of morbidity and mortality	V00-Y99
XXI	Factors influencing health status & contact with health services	Z00-Z99

ICD CODING RULES

- Basic coding guideline:

LETTER	NUMBER	NUMBER	.	NUMBER
A	0	0	.	0
…				
Z	9	9	.	9

Three-character category   **Sub-category**

- Three-character categories is mandatory level of coding for international reporting to the WHO mortality database and for general international comparisons.

- Some three-character categories have been left vacant for future expansion / Revision
  - Codes U00–U49 are to be used by WHO for the provisional assignment of new diseases of uncertain etiology.
  - Codes U50–U99 may be used in research, e.g. when testing an alternative sub-classification for a special project. Basic coding guidelines

SPECIAL CHARACTERS: DAGGER AND ASTERISKS

Amoebiasis (A060 to A069)

A06.0	Acute amoebic dysentery
A06.1	Chronic intestinal dysentery
A06.2	Amoebic nondysenteric colitis
A06.3	Amoeboma of intestine
A06.4	Amoebic liver abscese
A06.5†	Amoebic lung abscess (J99.8*)
A06.6†	Amoebic brain abscess (G07*)
A06.7	Cutaneous amoebiasis
A06.8	Amoebic infection of other parts
A06.9	Amoebiais unspecified

Intracranial & intraspinal abscess (G07*)
Abscess of Brain

- Amoebic brain abscess (A06.6 †)
- Gonococcal abscess (A54.8 †)
- Tuberculous abscess (A17.8 †)

Asterisk (*) – Used for the secondary cause

Dagger (†) - Used for the root cause

➡ **Tuberculosis (A15-A19)**

- ➤ Incl.: Infections due to Mycobacterium tuberculosis and

    Mycobacterium bovis

- ➤ Excl.: congenital tuberculosis (P37.0)

    human immunodeficieny [HIV] disease resulting in

    tuberculosis (B20.0)

    pneumoconiosis associated with tuberculosis (J65)

    sequelae of tuberculosis (B90.-)

    silicotuberculosis (J65)

PARKINSON'S DISEASE

UNIVERSITÀ DEGLI STUDI DI TRIESTE

ICD-10 Version:2016

Search: Parkinson [Advanced Search]

ICD-10 | Versions - Languages | Info

ICD-10 Version:2016
- ▶ I Certain infectious and parasitic diseases
- ▶ II Neoplasms
- ▶ III Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism
- ▶ IV Endocrine, nutritional and metabolic diseases
- ▶ V Mental and behavioural disorders
- ▼ VI Diseases of the nervous system
  - ▶ G00-G09 Inflammatory diseases of the central nervous system
  - ▶ G10-G14 Systemic atrophies primarily affecting the central nervous system
  - ▼ G20-G26 Extrapyramidal and movement disorders
    - G20 Parkinson disease
    - ▶ G21 Secondary parkinsonism
    - G22 Parkinsonism in diseases classified elsewhere
    - ▶ G23 Other degenerative diseases of basal ganglia
    - ▶ G24 Dystonia
    - ▶ G25 Other extrapyramidal and movement disorders
    - G26 Extrapyramidal and movement disorders in diseases classified elsewhere
  - ▶ G30-G32 Other degenerative diseases of the nervous system
  - ▶ G35-G37 Demyelinating diseases of the central nervous system
  - ▶ G40-G47 Episodic and paroxysmal disorders
  - ▶ G50-G59 Nerve, nerve root and plexus disorders
  - ▶ G60-G64 Polyneuropathies and other disorders of the peripheral nervous system
  - ▶ G70-G73 Diseases of myoneural junction and muscle
  - ▶ G80-G83 Cerebral palsy and other paralytic syndromes

Extrapyramidal and movement disorders (G20-G26)

G20 **Parkinson disease**

Incl.: Hemiparkinsonism
Paralysis agitans
Parkinsonism or Parkinson disease:
- NOS
- idiopathic
- primary

G21 **Secondary parkinsonism**

G21.0 **Malignant neuroleptic syndrome**
Use additional external cause code (Chapter XX), if desired, to identify drug.

G21.1 **Other drug-induced secondary parkinsonism**
Use additional external cause code (Chapter XX), if desired, to identify drug.

G21.2 **Secondary parkinsonism due to other external agents**
Use additional external cause code (Chapter XX), if desired, to identify external agent.

G21.3 **Postencephalitic parkinsonism**

G21.4 **Vascular parkinsonism**

G21.8 **Other secondary parkinsonism**

G21.9 **Secondary parkinsonism, unspecified**

G22* **Parkinsonism in diseases classified elsewhere**
Incl.: Syphilitic parkinsonism (A52.1†)

G23 **Other degenerative diseases of basal ganglia**

G23.0 **Hallervorden-Spatz disease**
Pigmentary pallidal degeneration

G23.1 **Progressive supranuclear ophthalmoplegia [Steele-Richardson-Olszewski]**
Progressive supranuclear palsy

ICD-11

What is ICD-11?

ICD-11 is the international standard for systematic recording, reporting, analysis, interpretation and comparison of mortality and morbidity data. This 11th revision is the result of an unprecedented collaboration with clinicians, statisticians, classification and IT experts from around the world, making it useable by these groups, as well as by coders.

ICD-11 allows countries to count and identify their most pressing health issues by using an up-to-date and clinically relevant classification system. Health conditions and accidents are assigned ICD-11 codes, resulting in data that can be used by governments to design effective public health policies, and measure their impact, or used for clinical recording.

For the first time, ICD is fully electronic, currently providing access to 17 000 diagnostic categories, with over 100 000 medical diagnostic index terms. The index-based search algorithm interprets more than 1.6 million terms. ICD-11 is easy to install and use online or offline, using free 'container' software.

ICD-11 INNOVATION

1.A significant feature of ICD–11 is the improved ease and accuracy of coding requiring less user training than ever before, together with the availability of online and offline functioning. ICD–11 is digital health ready, for use in multiple IT-environments, with a new API. It is presented together with a suite of web services, including multilingual support and in-built user guidance.

2.New core chapters include 'Diseases of the immune system', 'Sleep-wake disorders', and 'Conditions related to sexual health'. New supplementary chapters and sections permit the assessment of functioning, and the optional recording of traditional medicine diagnoses.

3.The creation of extension codes allows flexible addition of detail relevant for clinical documentation, and device or substance safety. Extension codes provide for the recording of medicaments with WHO INN3 and WHO Medical Device nomenclature, as well as documenting the severity of conditions, anatomy or histopathology.

ICD-11

UNIVERSITÀ DEGLI STUDI DI TRIESTE

ICD-11 for Mortality and Morbidity Statistics (Version : 02/2022)

Search: Parkinson's disease   [Advanced Search]

Browse | Coding Tool | Special Views | Info

ICD-11 for Mortality and Morbidity Statistics
- 01 Certain infectious or parasitic diseases
- 02 Neoplasms
  - Neoplasms of brain or central nervous system
    - **2A00** Primary neoplasms of brain
    - **2A01** Primary neoplasms of meninges
    - **2A02** Primary neoplasm of spinal cord, cranial nerves or remaining parts of central nervous system
    - **2A0Z** Other and unspecified neoplasms of brain or central nervous system
  - Neoplasms of haematopoietic or lymphoid tissues
    - Myeloproliferative neoplasms
    - Myelodysplastic syndromes
    - Myelodysplastic and myeloproliferative neoplasms
    - Myeloid and lymphoid neoplasms with eosinophilia and abnormalities of PDGFRA, PDGFRB or FGFR1
    - **2A60** Acute myeloid leukaemias and related precursor neoplasms
    - **2A61** Acute leukaemias of ambiguous lineage
    - Precursor lymphoid neoplasms
    - Mature B-cell neoplasms
    - Mature T-cell or NK-cell neoplasms
    - **2B30** Hodgkin lymphoma
    - **2B31** Histiocytic or dendritic cell neoplasms

Foundation URI : http://id.who.int/icd/entity/296066191

8A00.0 Parkinson disease

All ancestors up to top
- 08 Diseases of the nervous system
  - Movement disorders
    - 8A00 Parkinsonism
      - 8A00.0 Parkinson disease

Hide ancestors

Description

Parkinson Disease is a gradual onset progressive degenerative disease whose cardinal manifestations include bradykinesia plus one of the following-tremor, rigidity or postural instability. Nonmotor manifestations include autonomic dysfunction and neuropsychiatric features.

Postcoordination ?

Add detail to **Parkinson disease**

Has manifestation *(use additional code, if desired .)*

| 6D85.0 | Dementia due to Parkinson disease |
| MG30.32 | Chronic secondary musculoskeletal pain due to disease of the nervous system |

Has severity *(use additional code, if desired .)*

XS5W	Mild
XS0T	Moderate
XS25	Severe

https://icd.who.int/browse11/l-m/en

SNOMED CT LOGICAL MODEL
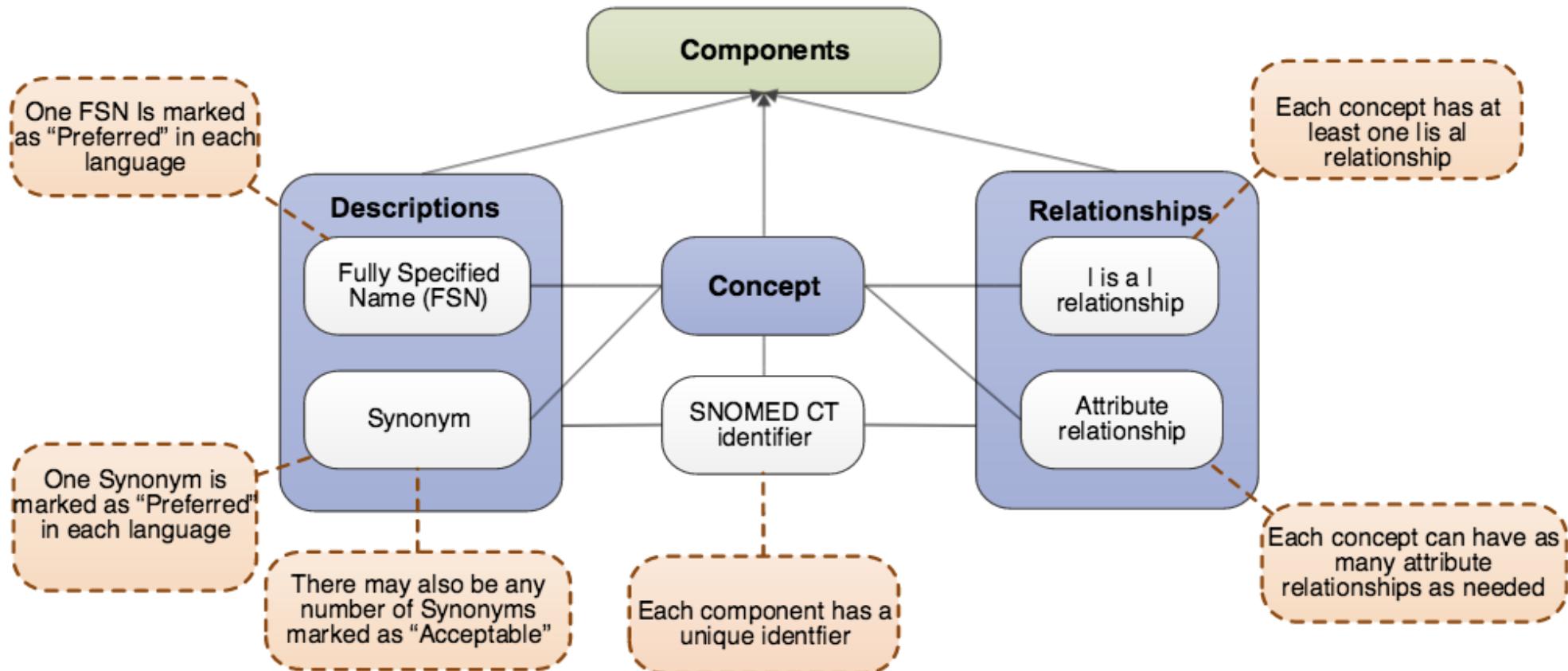
Concept = unique clinical meaning, which is referenced using a unique, numeric and machine-readable SNOMED CT identifier (pre-coordinated). The identifier provides an unambiguous unique reference to each concept and does not have any ascribed human interpretable meaning

Description = set of textual descriptions assigned to every concept. These provide the human readable form of a concept. Two types of description are used to represent every concept - Fully Specified Name (FSN) and Synonym.

Relationship = association between two concepts. Relationships are used to logically define the meaning of a concept in a way that can be processed by a computer. A third concept, called a relationship type (or attribute), is used to represent the meaning of the association between the source and destination concepts.

EXAMPLE - RELATIONSHIPS

Concept (source)	Relationship type	Concept (destination)
44054006 diabetes mellitus type 2 (disorder)	116680003 Is a (attribute)	73211009 diabetes mellitus (disorder)
44054006 diabetes mellitus type 2 (disorder)	363698007 Finding site (attribute)	113331007 structure of endocrine system (body structure)
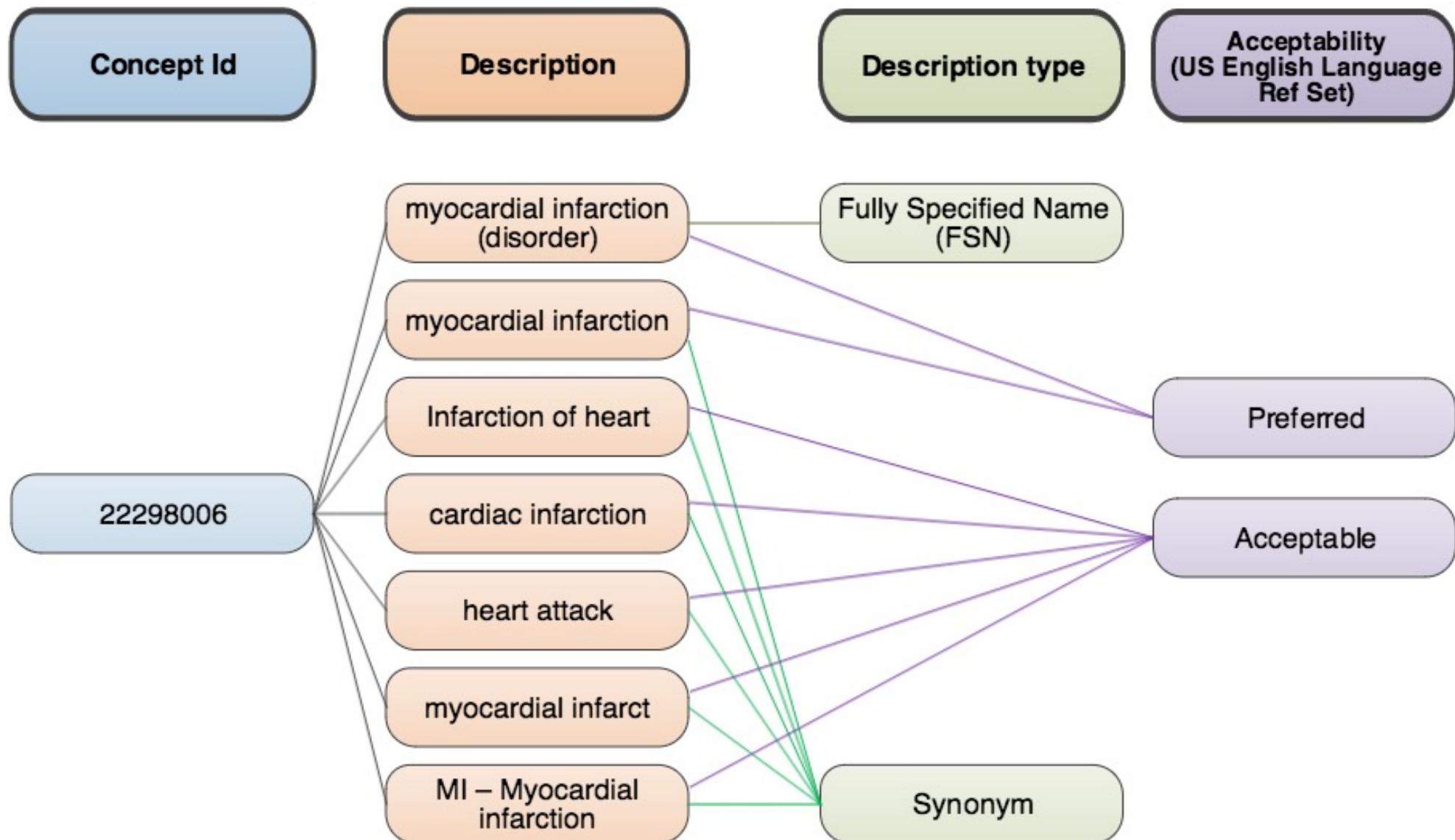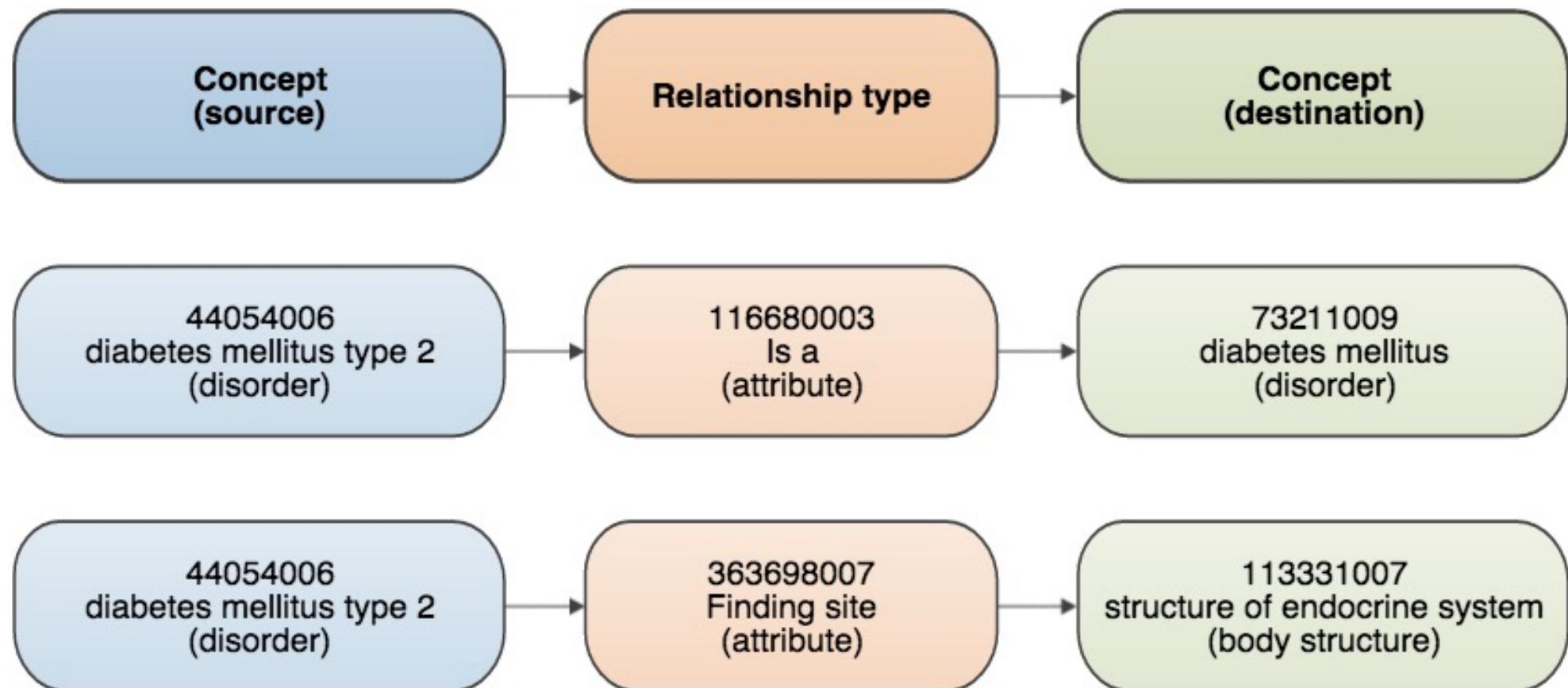
PARKINSON'S DISEASE

SNOMED CT LOGICAL DESIGN
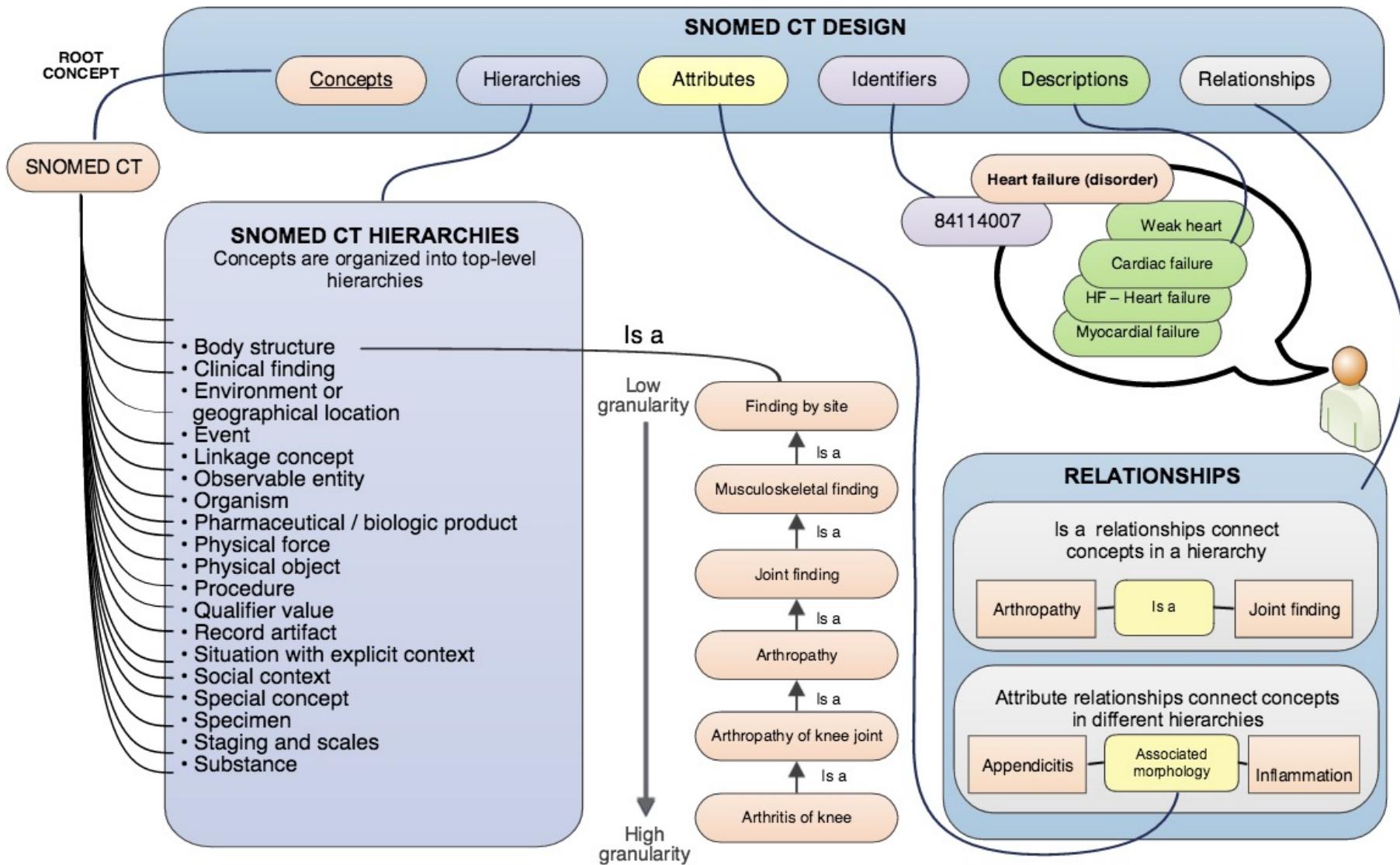
HIERARCHIES

- SNOMED CT concepts are organized in hierarchies.
- Within a hierarchy concepts range from the more general to the more detailed.
- Related concepts in the hierarchy are linked using the **|is a|** relationship.
- Examples of some of the hierarchies include:
    - | clinical finding|
    - |procedure|
    - |observable entity|
    - |body structure|
    - |organism|

MULTIPLE INHERITANCE IS ALLOWED (polyhierarchy)
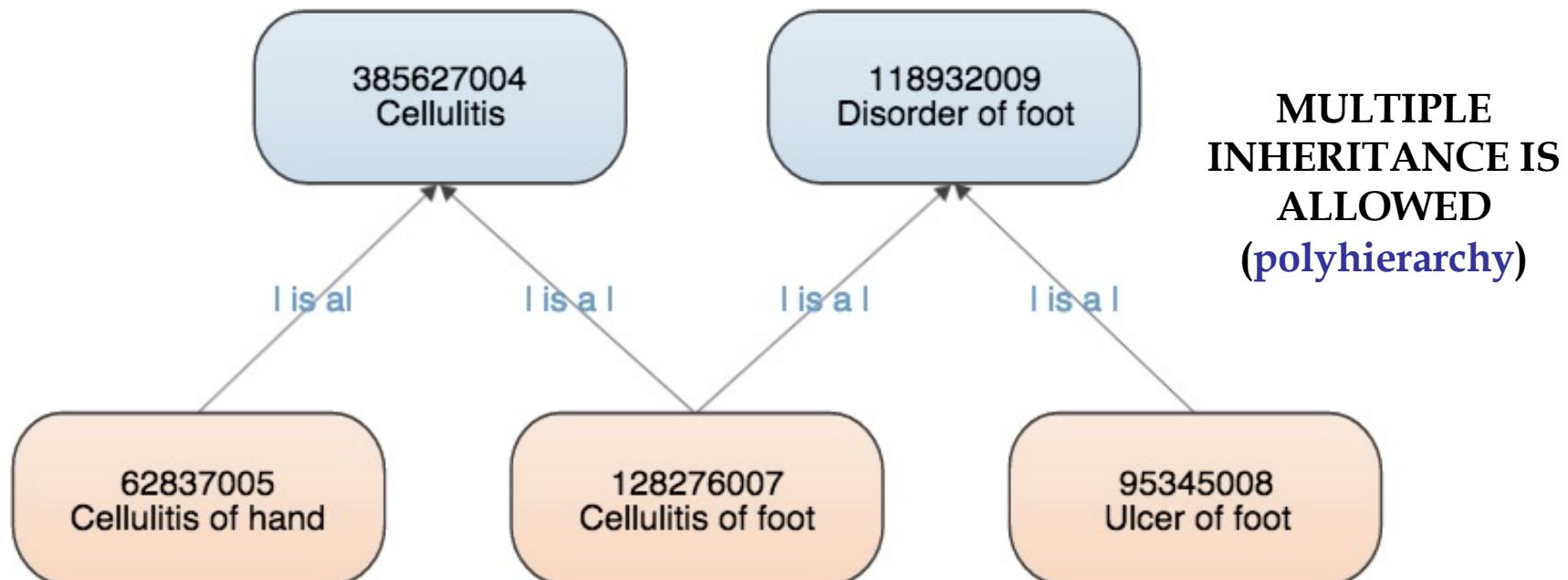
PRE-COORDINATED EXPRESSIONS

- Precoordinated expressions represent the meaning of individual **concepts** which **are predefined in SNOMED CT**.
- Each concept also has a formal logic definition represented by a set of defining relationships to other concepts.
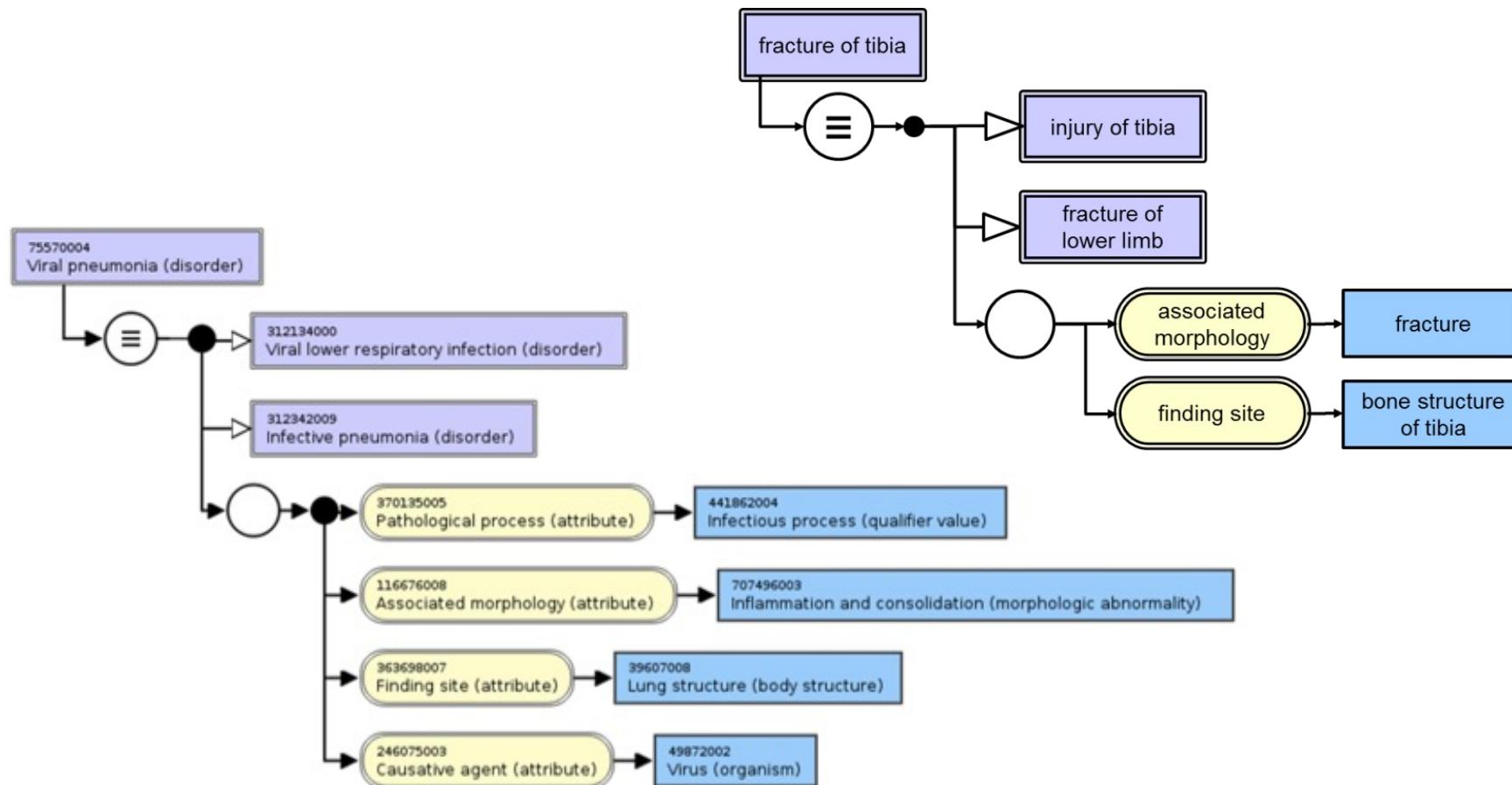
POST-COORDINATED EXPRESSIONS

- Expressions that contain **two or more concept identifiers**.
- Postcoordination **combines concepts** and allows more detail to be added to the meaning represented by a single concept.
- A postcoordinated expression is not just a list of concept identifiers, **it follows a set of rules** that mimic the way attributes and values are used to define SNOMED CT concepts.
- Postcoordinated expressions **may be created at run-time** by selection of individual facets of a concept.

Example: Postcoordinated representation of "Laparoscopic removal of device from abdomen"

SNOMED CT does not contain a concept that represents this clinical idea. However, it is possible to represent it using the following postcoordinated expression.

68526006|removal of device from abdomen| :425391005|using access device| = 6174004|laparoscope|

CONCEPT   RELATIONSHIP   CONCEPT

PRE- vs POST-COORDINATION

Example: Precoordinated representation of "Laparoscopic emergency appendectomy"

SNOMED CT contains the concept 174041007|laparoscopic emergency appendectomy|. The identifier of this concept (174041007) can be used (with or without the associated term) as a precoordinated expression to record an instance of this procedure.

The procedure 'laparoscopic emergency appendectomy' has at least three distinct facets: 'removal of appendix', 'using a laparoscope' as 'emergency procedure'. The SNOMED CT concept 174041007|laparoscopic emergency appendectomy| precoordinates these facets as its definition includes the following defining relationships:

- 116680003|is a| = 80146002|appendectomy|
- 260870009|priority|=25876001|emergency|
- 425391005|using access device| = 86174004|laparoscope|

Example: Postcoordinated representation of "Laparoscopic emergency appendectomy"

Although SNOMED CT contains the concept |laparoscopic emergency appendectomy|, it is also possible to represent this clinical phrase using the following postcoordinated expression.

- 80146002|appendectomy|:260870009|priority|=25876001|emergency|, 425391005|using access device|=86174004|laparoscope|

  This postcoordinated expression has exactly the same meaning as the precoordinated expression
- 174041007|laparoscopic emergency appendectomy|

  The fact that the two expressions have the same meaning can be computed because
- 174041007|laparoscopic emergency appendectomy| is a fully-defined subtype descendant of 80146002|appendectomy| ; and
- the only differences between the defining attributes of these concepts are the addition of
  - 260870009|priority|=25876001|emergency|
  - 425391005|using access device| = 86174004|laparoscope|

1- COMBINATION OF CONCEPTS USING "+"

Two or more concepts may be combined to form a new concept by joining them with the "+" symbol. This is particularly useful where both concepts are primitive. The resultant expression is the child of each of the concepts in the expression. The resultant expression below represents a drug dose form that is both a spray and a suspension.

> 421720008 |Spray dose form| + 7946007 |Drug suspension|

2- CONCEPT REFINEMENT USING ":"

One or more refinements may be added to a concept to qualify it. This is done by putting the concept to be qualified before a colon and the qualifying expression after. The qualifying expression is of the form "attribute = value". The example below describes an operation to remove an ovary (i.e. an 'oophorectomy') using a laser.

> 83152002 |Oophorectomy| : 405815000 |Procedure device| = 122456005 |Laser device|

The next example, shown below, describes the right hip joint.

> 182201002 |Hip joint| : 272741003 |Laterality| = 24028007 |Right|

3- CONCEPT REFINEMENT WITH MORE ATTRIBUTES USING ","

Where more than one qualifying attribute is required, these can be separated using a comma. The example below describes the removal of an ovarian structure using a laser device.

```
71388002 |Procedure| :
  405815000 |Procedure device| = 122456005 |Laser device| ,
  260686004 |Method| = 129304002 |Excision - action| ,
  405813007 |Procedure site - direct| = 15497006 |Ovarian structure|
```

4- GROUPING ATTRIBUTES WITH {…}

Where a SNOMED CT concept definition comprises a number of qualifying attributes, it may be necessary to group these to avoid ambiguity as to how they apply. An example of a SNOMED CT concept whose definition comprises multiple attribute groups is: 116028008 |Salpingo-oophorectomy|This procedure comprises two sub-procedures: the excision of part or all of the ovarian structure and the excision of part or all of the fallopian tube structure. This is demonstrated by the SNOMED CT expression for salpingo-oophorectomy, as shown below:

```
71388002 |Procedure| :
{ 260686004 |Method| = 129304002 |Excision - action| ,
  405813007 |Procedure site - direct| = 15497006 |Ovarian structure| }
{ 260686004 |Method| = 129304002 |Excision - action| ,
  405813007 |Procedure site - direct| = 31435000 |Fallopian tube structure| }
```

5- NESTED EXPRESSIONS USING (…)

It is also possible to nest expressions, one inside the other. Any valid expression may be enclosed in a pair of brackets, and included as the value of an attribute in another expression. For example, the following expression describes a medication product that has a single dose form, which is both a spray and a suspension:

```
373873005 |Pharmaceutical / biologic product| :
   411116001 |Has dose form| = ( 421720008 |Spray dose form| + 7946007 |Drug suspension| )
```

In the example above, note the use of round brackets (i.e. "( )") to identify a nested expression, as opposed to braces (i.e. "{ }"), which is used to identify attribute groups.

6- EXPRESSIONS WITH NUMERIC VALUES USING

```
774586009 |Amoxicillin only product| :
   411116001 |Has manufactured dose form| = 420692007 |Oral capsule| ,
 { 127489000 |Has active ingredient| = 372687004 |Amoxicillin| ,
   179999999100 |Has basis of strength| = 372687004 |Amoxicillin| ,
   189999999103 |Has strength value| = #500, 199999999101 |Has strength unit| = 258684004 |mg| }
```

New attributes that are added to the SNOMED CT concept model (or to a SNOMED CT extension) may require their value to be concrete. Concrete values include integers (e.g. 500), decimals (e.g. 2.75), strings (e.g. "PANADOL"), and booleans (e.g. TRUE). The numeric value is indicated in the expression by the preceding '#' symbol (e.g. #500).

Content coverage

- SNOMED CT has much better clinical coverage than ICD
- Number of codes:
  - SNOMED CT (Clinical finding): 100,000
  - ICD-9-CM: 14,000
  - ICD-10-CM: 68,000
- ICD's focus is statistical – less common diseases get lumped together in "catch-all" categories e.g. *J15.8 Pneumonia due to other specified bacteria*, which could result in loss of information
- SNOMED CT is clinically-based – document whatever is important for patient care

	SNOMED CT	ICD-9-CM	ICD-10-CM
Congenital skin anomalies	205573006 Focal dermal hypoplasia 79468000 Familial benign pemphigus 5132005 Keratosis pilaris ... (total 21 codes)	757.39 Other specified congenital anomalies of skin	Q82.8 Other specified congenital malformations of skin
Acidosis	59455009 Metabolic acidosis 12326000 Respiratory acidosis 91273001 Lactic acidosis ... (total 60 codes)	276.2 Acidosis	E87.2 Acidosis
Brachial plexus disorders	72893007 Brachial neuritis 278065000 Pancoast's syndrome 78141002 Erb-Duchenne paralysis ... (total 33 codes)	353.0 Brachial plexus lesions	G54.0 Brachial plexus disorders

SNOMED CT is extensible

- Coverage of SNOMED CT is not limited to existing codes
- ICD
  - no reproducible method for adding codes
  - Local extension codes are not shareable
- SNOMED CT – well-defined rules to extend coverage by modifying or refining existing concepts (post-coordination) e.g.
  - New concept "Left kidney stone" can be created by adding the laterality attribute "*Left*" to "*Kidney stone*"
- Advantages:
  - Can compute equivalence of new concepts to existing concepts
  - The new concept (left kidney stone) will be recognized as a sub-type of existing concepts (kidney stone)
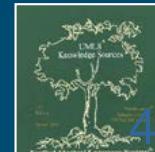
Clinical orientation

- SNOMED CT terms are words that clinicians use in clinical discourse, but some ICD names are not
  - SNOMED CT: *281430007 Failure of tendon graft*
  - ICD-9-CM: *E878.2 Surgical operation with anastomosis, bypass, or graft, with natural or artificial tissues used as implant causing abnormal patient reaction, or later complication, without mention of misadventure at time of operation*
- Excessive detail in some areas (e.g. external causes of injury)
  - ICD-10-CM
    - *V30.2xxD Person on outside of three-wheeled motor vehicle injured in collision with pedestrian or animal in nontraffic accident, subsequent encounter* (ICD-10-CM)
  - More bizarre examples: burning water-skis, turtle bite
  - public health perspective vs. patient perspective

Data entry

- In ICD, 2 kinds of special codes are needed because it is a statistical classification
  - NOS (Not otherwise specified) or Unspecified codes - cases with some missing information and cannot be classified to more specific codes e.g. *Viral pneumonia, unspecified*
  - NEC (Not elsewhere classified) codes - cases with more specific information not covered by available codes e.g. Pneumonia caused by Human metapneumovirus is codes as *Viral pneumonia, NEC*
- NOS and NEC codes can be confusing for clinical users
- SNOMED CT
  - no need for NOS or NEC codes
  - Can use codes at any level of specificity as warranted by the clinical situation

Semantic drift of NEC terms

ICD-9-CM in 2003

480 Viral pneumonia

- 480.0 Pneumonia due to adenovirus
- 480.1 Pneumonia due to respiratory syncytial virus
- 480.2 Pneumonia due to parainfluenza virus
- 480.8 Pneumonia due to other virus not elsewhere classified
- 480.9 Viral pneumonia, unspecified

ICD-9-CM in 2004

480 Viral pneumonia

- 480.0 Pneumonia due to adenovirus
- 480.1 Pneumonia due to respiratory syncytial virus
- 480.2 Pneumonia due to parainfluenza virus
- 480.3 Pneumonia due to SARS-associated coronavirus
- 480.8 Pneumonia due to other virus not elsewhere classified
- 480.9 Viral pneumonia, unspecified

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Semantic drift of NEC terms

ICD-9-CM in 2003

480 Viral pneumonia

    480.0 Pneumonia due to adenovirus

    480.1 Pneumonia due to respiratory syncytial virus

    480.2 Pneumonia due to parainfluenza virus

    480.8 Pneumonia due to other virus not elsewhere classified

    480.9 Viral pneumonia, unspecified

ICD-9-CM in 2010

480 Viral pneumonia

    480.0 Pneumonia due to adenovirus

    480.1 Pneumonia due to respiratory syncytial virus

    480.2 Pneumonia due to parainfluenza virus

    480.3 Pneumonia due to SARS-associated coronavirus

    480.8 Pneumonia due to other virus not elsewhere classified

   480.9 Viral pneumonia, unspecified

?
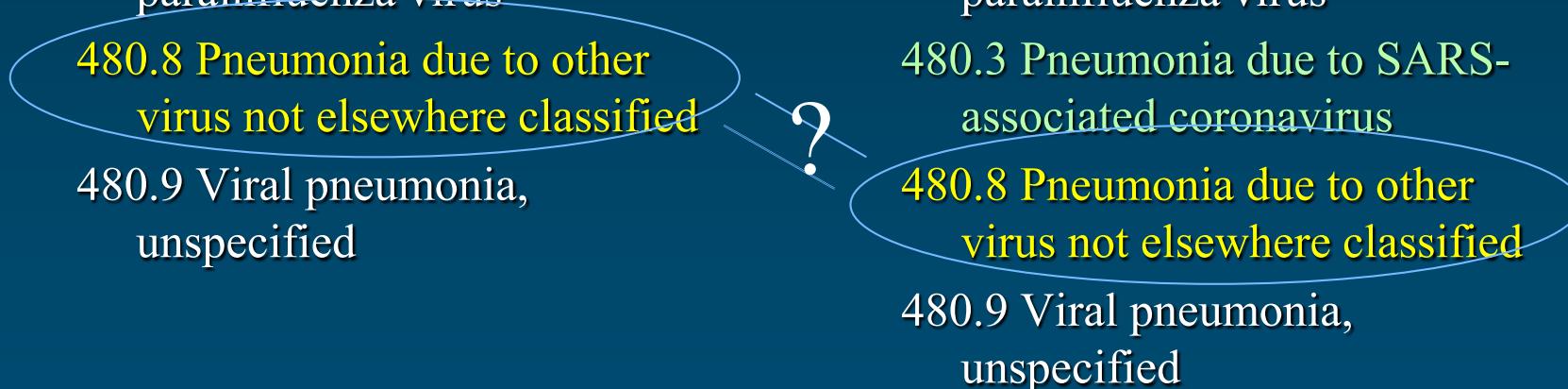
Data retrieval

- Data retrieval is easier in SNOMED CT
  - Poly-hierarchy
  - Logical definition

Poly- vs. Strict hierarchy

SNOMED CT   (poly-hierarchy)
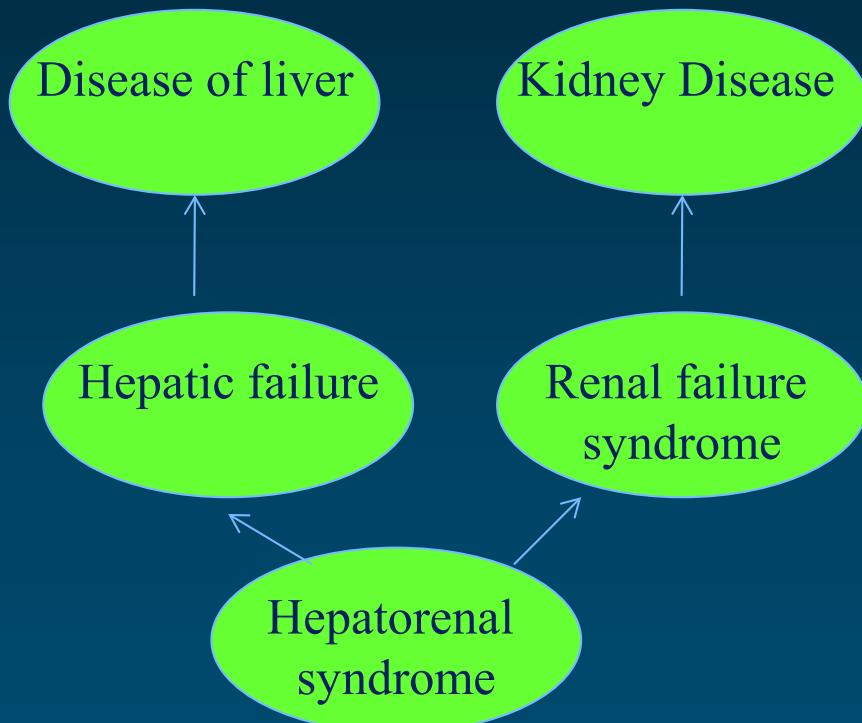
ICD-9-CM (strict hierarchy to avoid double-counting)

Disease of liver

Kidney Disease

Hepatic failure

Renal failure syndrome

Hepatorenal syndrome

DISEASES OF THE DIGESTIVE SYSTEM (520-579)

572 Liver abscess and sequelae of chronic liver disease

572.4 Hepatorenal syndrome

Easier to find codes in polyhierarchy

- Task: identify all patients suffering from hypertension
- ICD-9-CM
  - One may be tempted to restrict to *HYPERTENSIVE DISEASE (401-405)*
  - But will be missing
    - *410.9 Myocardial infarction with hypertension*
    - *642 Hypertension complicating pregnancy, childbirth, and the puerperium*
- SNOMED CT
  - Simple query to get all descendants of *38341003 Hypertensive disorder*

Code retrieval using attributes

u Research interest: diseases caused by arterial occlusion but not those affecting intestinal or renal arteries

u SNOMED CT

  l Get all descendants of *2929001 Occlusion of artery (183 concepts)*

  l Exclude those with 'Finding site' = 'Structure of mesenteric artery' and descendants; or 'Structure of renal artery' and descendants (11 concepts)

u ICD-9-CM

  l *440 Atherosclerosis and descendants (except 440.1 Of renal artery)*

  l *437.0 Cerebral atherosclerosis*

  l *414.0 Coronary atherosclerosis*

  l *362.3 Retinal vascular occlusion descendants*

  l *747.22 Atresia and stenosis of aorta*

  l *...*

u When source terminologies are updated

  l SNOMED CT – re-run query

  l ICD-9-CM – manually review all codes

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Inter-terminology mapping

- The CORE concepts are among the priority list of concepts for mapping in two mapping projects
    - SNOMED CT to ICD-10 map – collaborative project between IHTSDO and WHO
    - SNOMED CT to ICD-10-CM map – NLM project to support the transition to ICD-10-CM in the US in 2014
- MedlinePlus Connect – NLM service to connect patient portals and EHRs to patient education information
    - Accepts CORE concepts as input, which are mapped in the backend to terms used to index MedlinePlus pages

NLM tool for conversion:
https://imagic.nlm.nih.gov/imagic/code/map

Terminology research

- Comparison of SNOMED CT to ICD
  - Nadkarni PM et al. Migrating existing clinical content from ICD-9 to SNOMED. J Am Med Inform Assoc 2010;17:602-7.
  - Steindel SJ. A comparison between a SNOMED CT problem list and the ICD-10-CM/PCS HIPAA code sets. Perspect Health Inf Manag 2012;9:1b.
  - Hogan WR et al. Measuring the Information Gain of Diagnosis vs. Diagnosis Category Coding. AMIA Annu Symp Proc 2010;2010:306-10.

- Ontology modularization, translation and graphical representation
  - Lopez-Garcia P et al. Usability-driven pruning of large ontologies: the case of SNOMED CT. J Am Med Inform Assoc 2012;19:e102-9.
  - Abdoune H et al. Assisting the translation of the CORE subset of SNOMED CT into French. Stud Health Technol Inform 2011;169:819-23.
  - Lamy JB et al. A Semi-automatic Semantic Method for Mapping SNOMED CT Concepts to VCM Icons. Stud Health Technol Inform 2013;192:42-6.

- Essential to the big picture view of healthcare
  - Group ideas for aggregation and analysis
  - Add statistical value to data
- Limited value in an individual patient record
  - Represent one dimension of meaning
    - For example 'viral pneumonia' (J12 or J12.9)
    - Classified as a 'respiratory disease'
    - But not classified as a 'viral disease'
  - No links to body sites, causes, etc.
    - For example, 'viral pneumonia' (J12 or J12.9)
    - Not linked to site 'lung'
    - Not linked to causative agent 'virus'

- SNOMED CT
  - Rich semantic structure adds meaning to the EHR
  - Adequate detail for clinical recording
  - Broad scope of coverage
- SNOMED CT maps to Classifications
  - Existing maps to ICD-9-CM and ICD-10
  - Enhanced rule-based mapping to ICD-10
  - Maps to ICD-10 are used by NLM for mapping to ICD-10-CM
- SNOMED International and WHO
  - Cooperate on approaches to shared challenges
  - As a common terminology SNOMED CT eases transition to future versions of classifications

NLM SNOMED CT resources

- NLM Tools for EHR Certification and Meaningful Use
  http://www.nlm.nih.gov/healthit/meaningful_use.html
- CORE Problem List Subset
  http://www.nlm.nih.gov/research/umls/Snomed/core_subset.html
- Convergent Medical Terminology Subsets
  http://www.nlm.nih.gov/research/umls/Snomed/cmt.html
- SNOMED CT to ICD-10-CM Map
  http://www.nlm.nih.gov/research/umls/mapping_projects/snomedct_to_icd10cm.html
- ICD-9-CM Diagnostic Codes to SNOMED CT Map
  http://www.nlm.nih.gov/research/umls/mapping_projects/icd9cm_to_snomedct.html
- ICD-9-CM Procedure Codes to SNOMED CT Map
  http://www.nlm.nih.gov/research/umls/mapping_projects/icd9cmv3_to_snomedct.html
- US Edition of SNOMED CT
  http://www.nlm.nih.gov/research/umls/Snomed/us_edition.html
- US SNOMED CT Content Request System
  https://uscrs.nlm.nih.gov/
- UMLS-enhanced SNOMED CT browser
  https://uts.nlm.nih.gov/snomedctBrowser.html
- NLM Value Set Authority Center (VSAC)
  https://vsac.nlm.nih.gov/