Lecture Notes

Big Data in Medical Informatics

Week 2:
STRUCTURED MEDICAL DATA

Oya Beyan, PhD
Prof. Dr. Stefan Decker

RWTH AACHEN UNIVERSITY

OUTLINE

- Big Data : Data to Knowledge
- Structured – Weakly Structured- Unstructured Data
- Structured Data
  - Medical Terminologies
  - Definitions
  - Debates for Structured Medical Terminologies
  - Deutsches Institut für Medizinische Dokumentation und Information (DIMDI)
  - List of Structured Terminologies
  - Diagnostic Classifications: ICD-10, ICD-10-GM, ICD-O-3-ICD-11
  - Disability and Functioning: ICF, ICF-CY
  - Medical Procedures: ICPM, ICHI, OPS
  - Laboratory Tests: LOINC
  - Clinical Nomenclature: SNOMED and SNOMED CT
  - Drug Terminology and Classifications: ATC, INN and DDD
  - Medical Devices: UMDNS
  - MeSH and UMLS

Big Data in Medicine

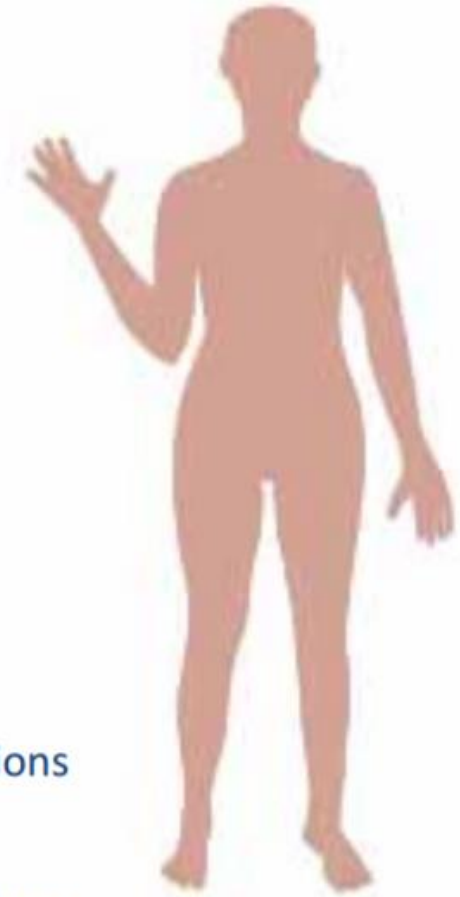
[Reference: Holzinger, 709.049 02]

Private Health vault data
Electronic health record data
Physiological data
Laboratory results

Exposome
Environmental data
Air pollution
Exposure (toxicants)

Collective data
Social data
Fitness, Wellness data
Ambient Assisted Living data
(Non-medical) personal data

Metabolomics
Chemical processes
Cellular reactions
Enzymatic reactions



Foodomics, Lipidomics
Nutrition data (Nutrigenomics)
Diet data (allergenics)

Metabolomics
Chemical processes
Cellular reactions
Enzymatic reactions

Imaging data
X-Ray, ultrasound, MR, CT, PET, cams, observation (e.g. sleep laboratory), gait (child walking)

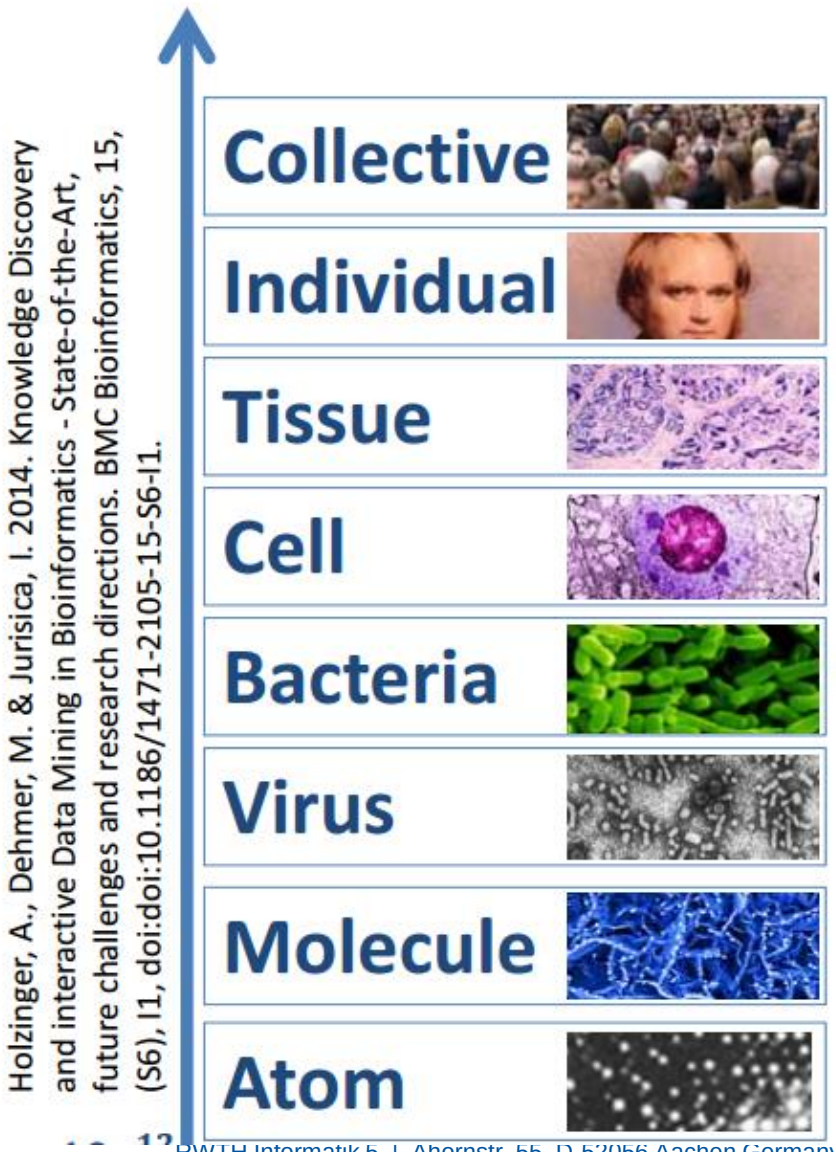
Proteomics
Protein-Protein Interactions

Epigenetics
Epigenetic modifications

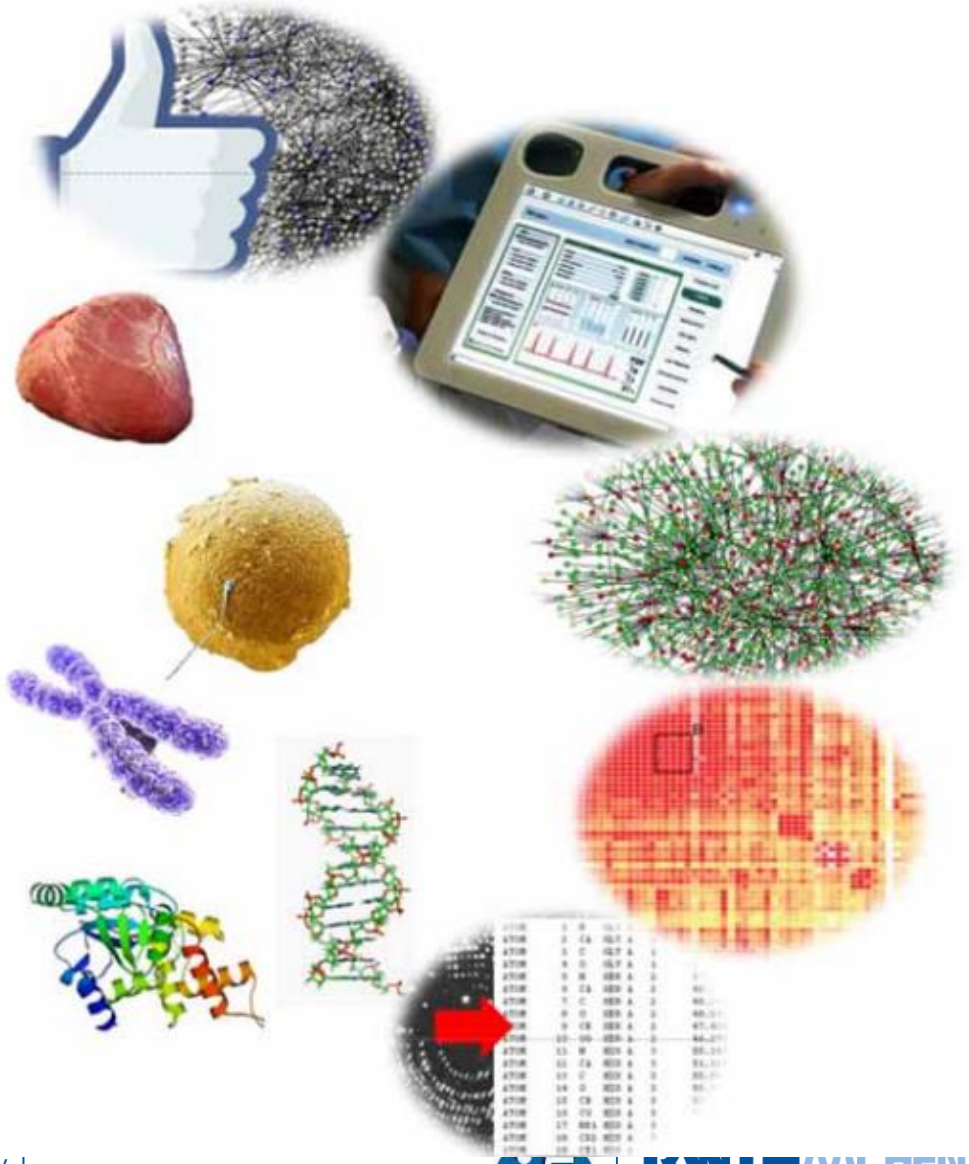
Genomics

Transcriptomics
RNA, mRNA, rRNA, tRNA

Big Data in Medicine: Levels of Abstraction



Holzinger, A., Dehmer, M. & Jurisica, I. 2014. Knowledge Discovery and interactive Data Mining in Bioinformatics - State-of-the-Art, future challenges and research directions. BMC Bioinformatics, 15, (S6), I1, doi:doi:10.1186/1471-2105-15-S6-I1.



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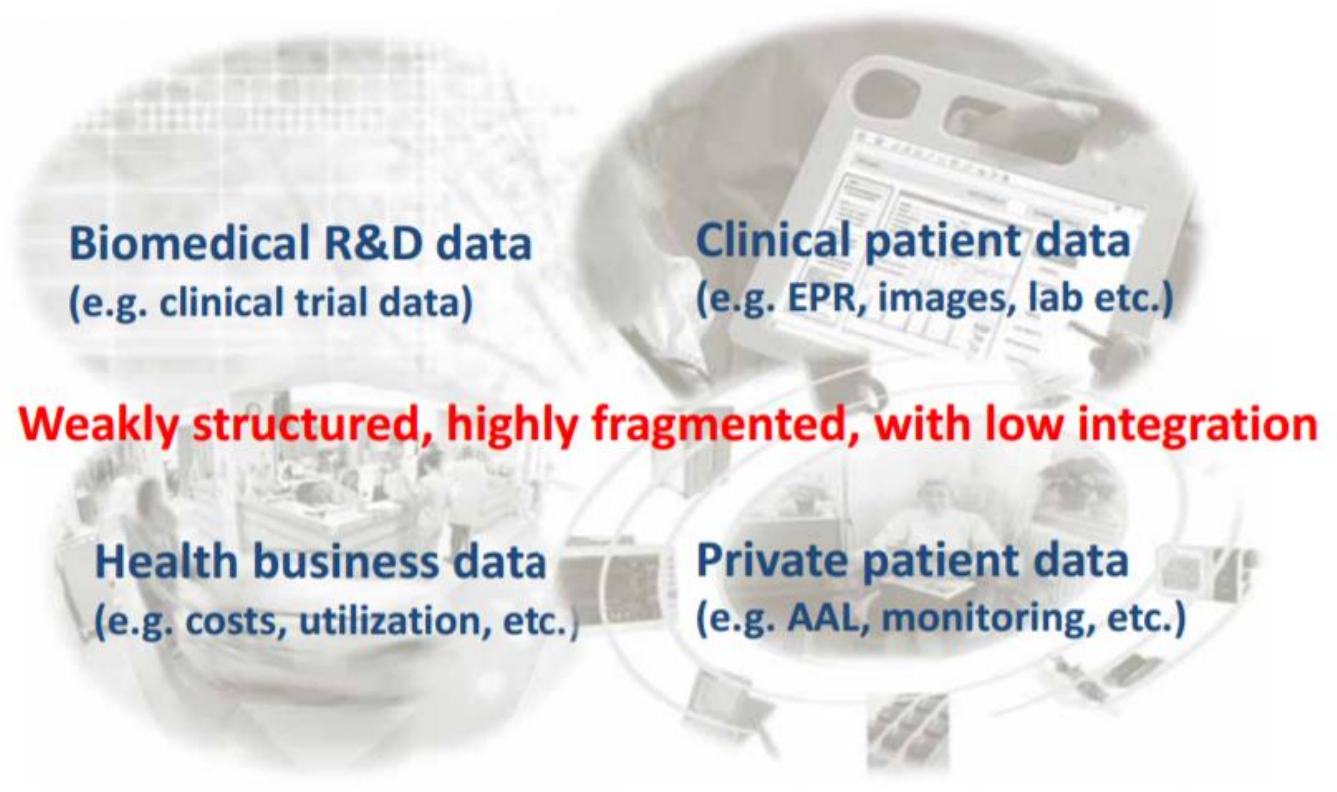
Big Data in Medicine



Manyika, J., Chui, M., Brown, B., Bughin, J., Dobbs, R., Roxburgh, C. & Byers, A. H. (2011) *Big data: The next frontier for innovation, competition, and productivity. Washington (DC), McKinsey Global Institute.*

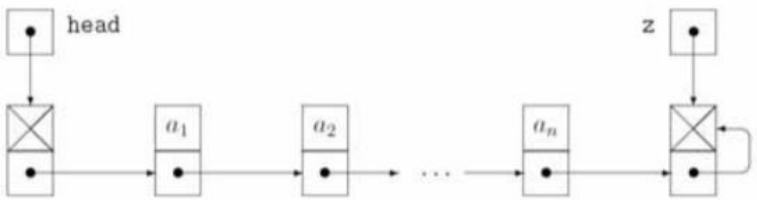
Taxonomy of data

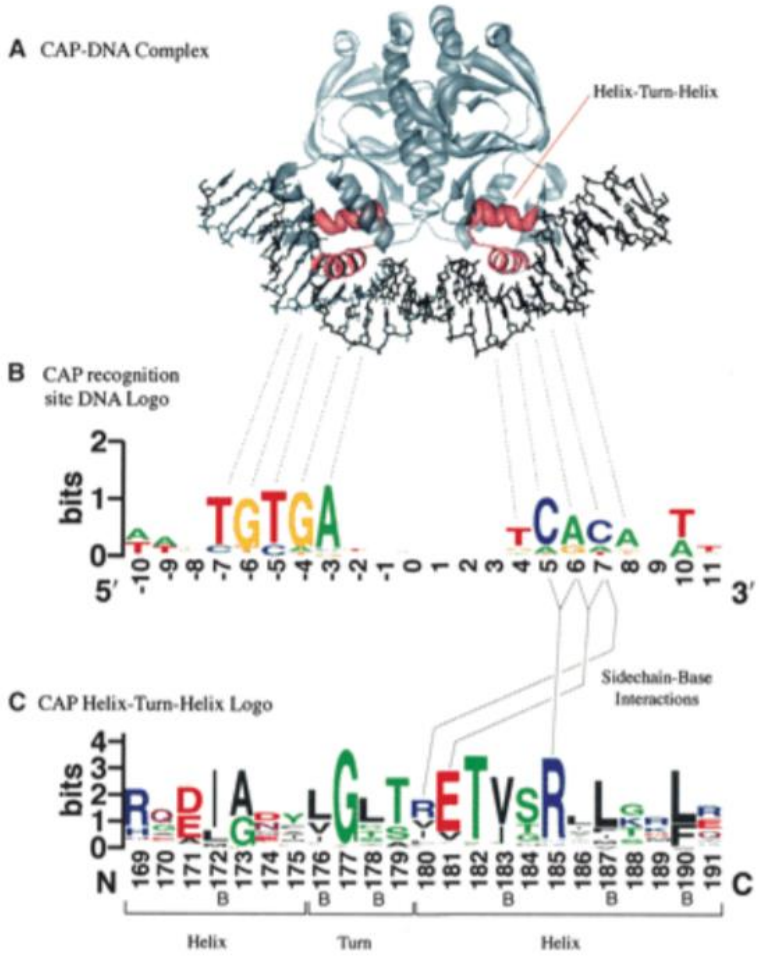
- **Physical level ->** bit = binary digit = basic indissoluble unit (= Shannon, Sh), ≠ Bit (!) in Quantum Systems -> qubit
- **Logical Level ->** integers, booleans, characters, floating-point numbers, alphanumeric strings, …
- **Conceptual (Abstract) Level ->** data-structures, e.g. lists, arrays, trees, graphs,…
- **Technical Level ->** Application data, e.g. text, graphics, images, audio, video, multimedia, …
- **“Hospital Level” ->** Narrative (textual) data, genetic data, numerical measurements (physiological data, lab results, vital signs, …), recorded signals (ECG, EEG, …), Images (cams, x-ray, MR, CT, PET, …)

Example Data Structures: List

TYPE link = REF node ;
node = RECORD
key : ItemType;
next : link;
END;
	key
	next
		class link {
		ItemType key;
		link next;
		}

VAR p, q : link ;	p q	link p,q;
p := NEW(link);	p q	p=new link();
p^.key:=x;	p q x	p.key=x;
q := NEW(link) ;	p q x	q=new link();

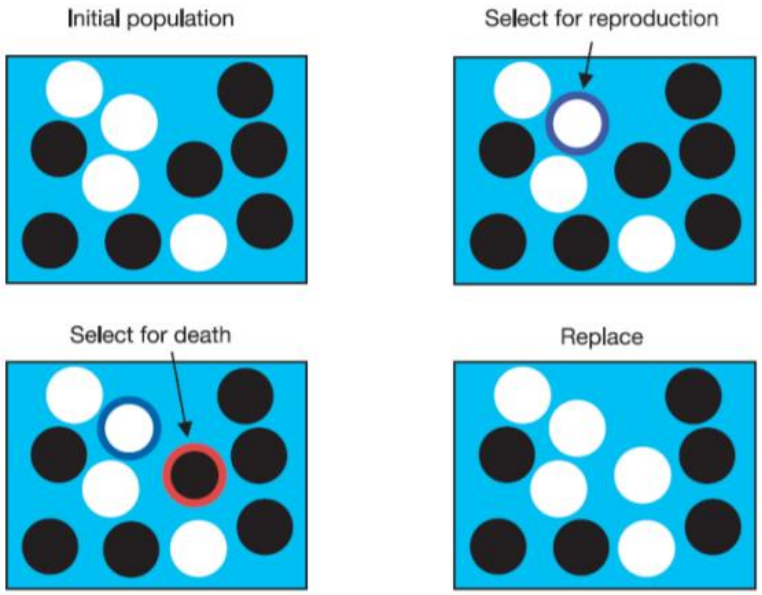




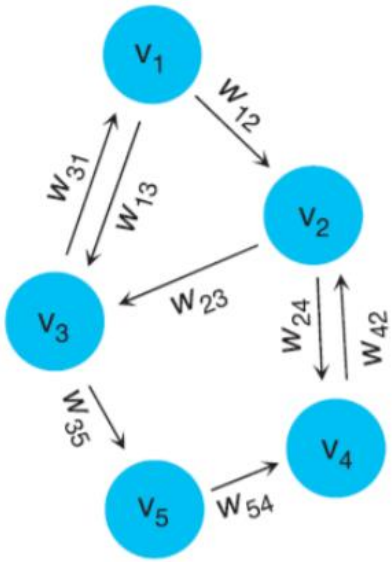
Crooks, G. E., Hon, G., Chandonia, J. M. & Brenner, S. E. (2004) WebLogo: A sequence logo generator. Genome Research, 14, 6, 1188-1190.

Example Data Structures : Graph

Evolutionary dynamics act on populations.
Neither genes, nor cells, nor individuals evolve;
only populations evolve.



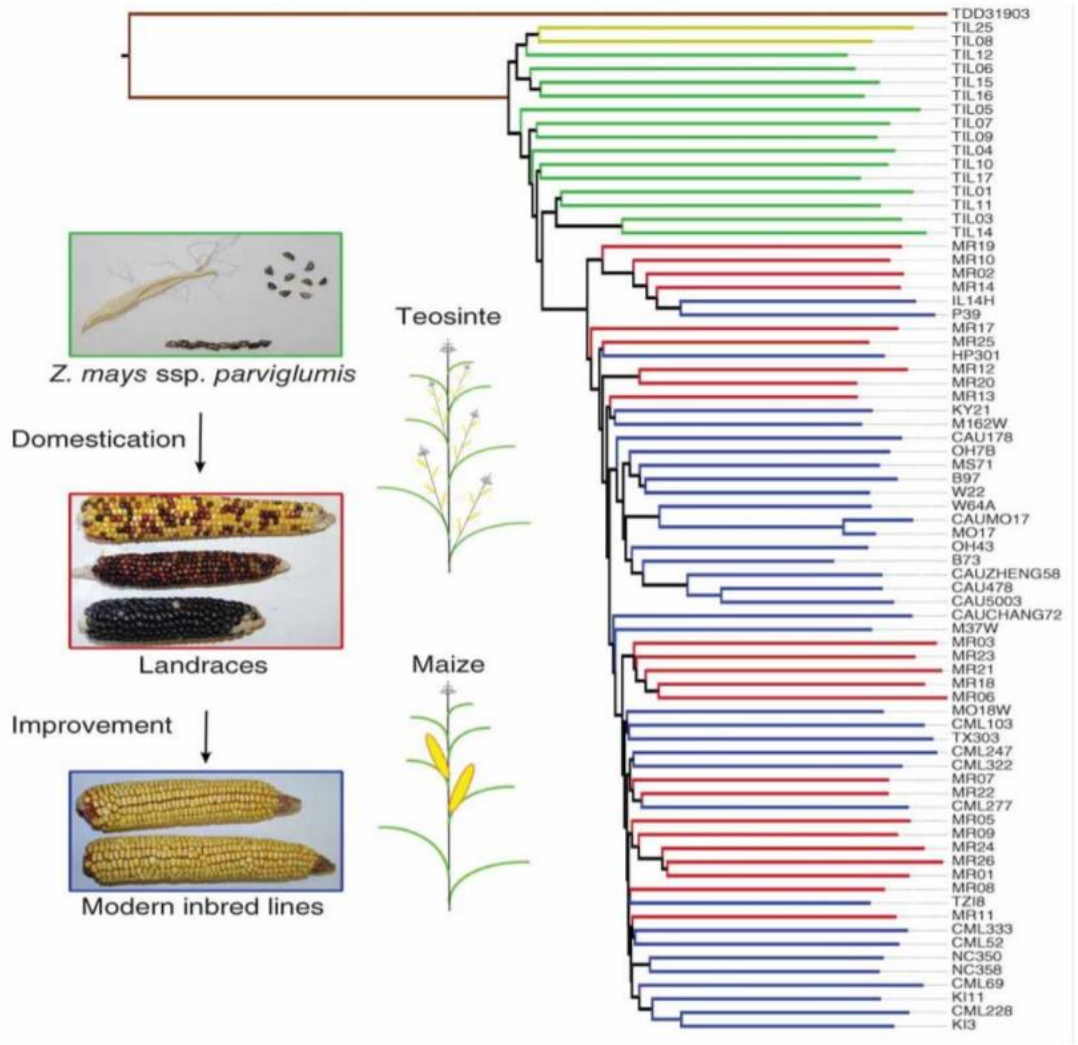
Lieberman, E., Hauert, C. & Nowak, M. A. (2005) Evolutionary dynamics on graphs. *Nature, 433, 7023, 312-316.*



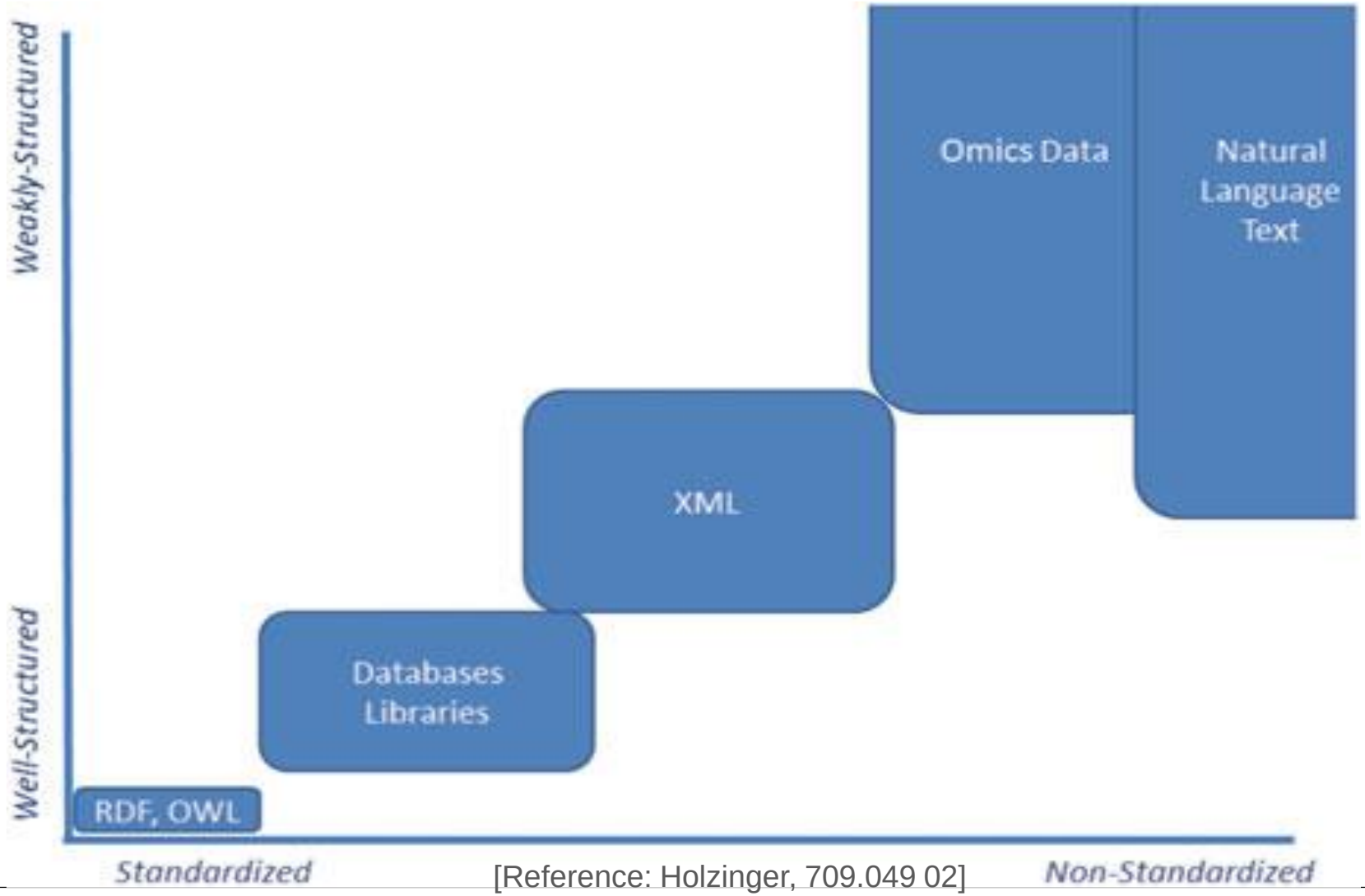
$$W = \begin{bmatrix} 0 & w_{12} & w_{13} & 0 & 0 \\ 0 & 0 & w_{23} & w_{24} & 0 \\ w_{31} & 0 & 0 & 0 & w_{35} \\ 0 & w_{42} & 0 & 0 & 0 \\ 0 & 0 & 0 & w_{54} & 0 \end{bmatrix}$$

Example Data Structures : Tree

Hufford et. al. 2012. Comparative population genomics of maize domestication and improvement. *Nature Genetics, 44, (7), 808-811.*



Standardization vs. Structurization



[Reference: Holzinger, 709.049 02]

Data - Information - Knowledge

- Big Data …. the creation and storage of large
  - to the search for information in this data.

- Semantic meta-information provides an abstraction of the contents and helps with the search.

needle in a haystack

ICD-10: **T34.1**
Short Description: **Frostbite with tissue necrosis of neck**
Long Description: *Frostbite with tissue necrosis of neck*
This is the 2017 version of the ICD-10-CM diagnosis code T34.1

Code Classification
- Injury, poisoning and certain other consequences of external causes
  - Frostbite (T33-T34)
    - Frostbite with tissue necrosis (T34)

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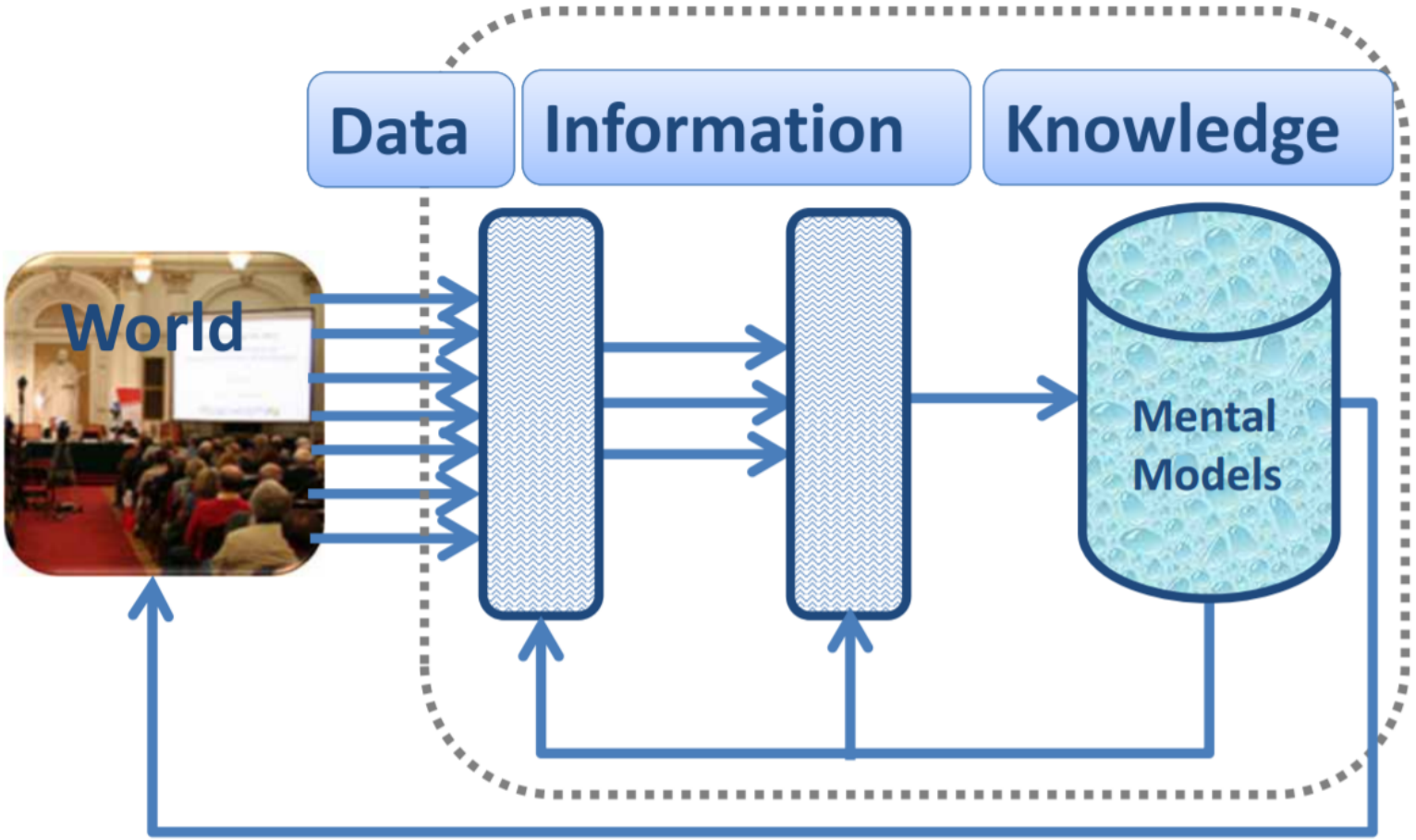
Data – Information – Knowledge



[Reference: Holzinger, 709.049 02]

Data - Information - Knowledge

DATA

- Data is signs, signals and facts.
- Data concerns the basic building blocks of informational science and characterizes the symbolic representation of facts.
- It consists of a virtually unlimited amount of available facts, statistics, pictures, etc.,
- but is still largely unstructured and context-independent.
- It can be stored for a long time on data carriers, in documents, etc., without losing its value.

63

78

Data - Information - Knowledge

INFORMATION

- **Information** is data with semantics (meaning).
- Information develops when the data is assigned a meaning with a focus on context by enriching it with “meaningful content.”
- It is subjectively perceptible and useable
- and thus able to expand, restructure and change

63 kg

78 kg

Data - Information - Knowledge

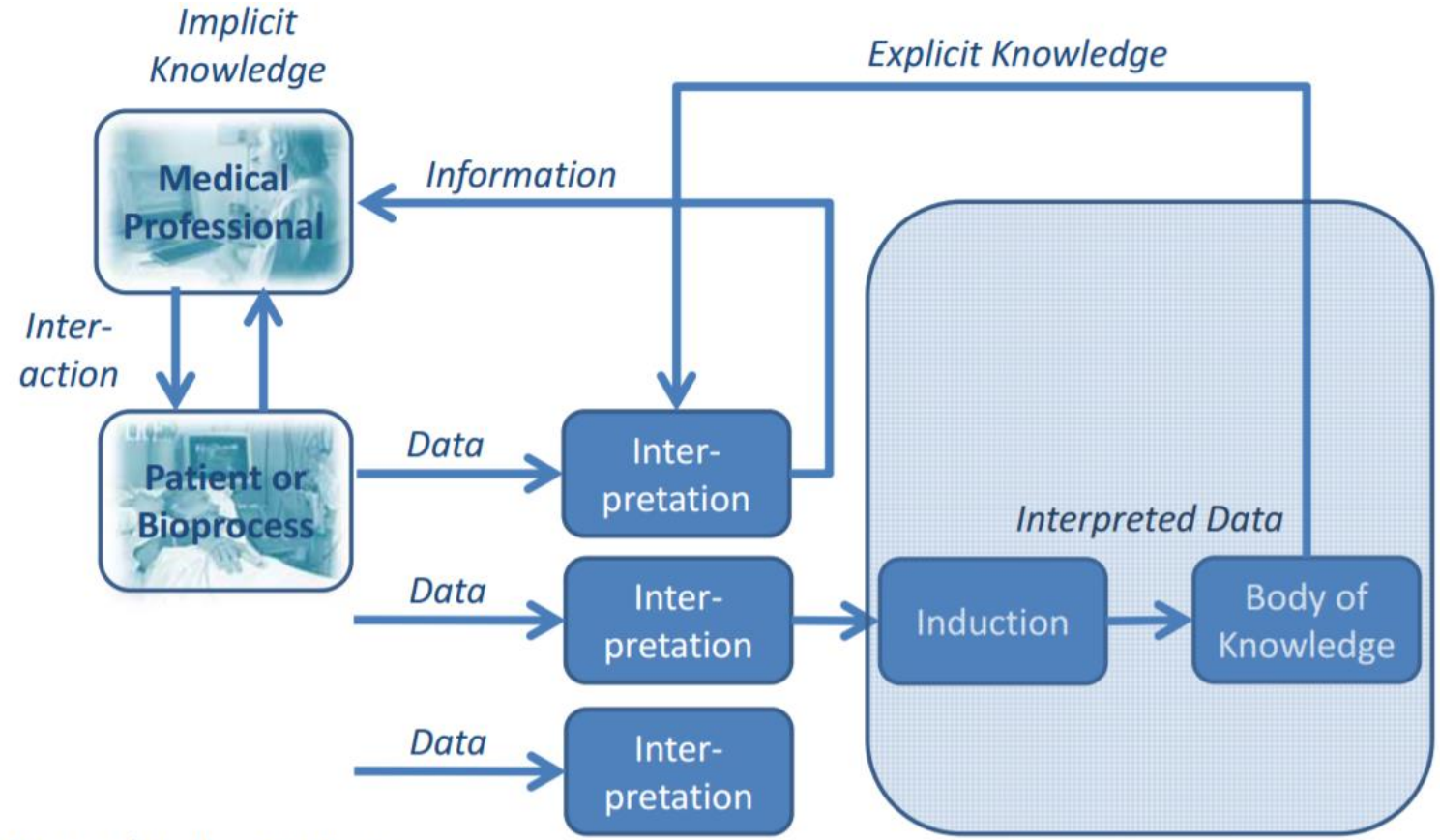
KNOWLEDGE

- **Knowledge** is information in a given context and includes much more than the mere information.
- Information only becomes knowledge if the application-oriented or situation-based meaning of information is recognized, and if the relevant information is filtered out and organized in a meaningful way.
- A knowledge-creating process always begins with expectations based on past experience.
- The context-specific linkage of information with subjective assumptions, theories, intuitions and conclusions from education, experience, experiments
- The context-forming factors are, for example, culture (shared values, behavioral norms as well as ways of thinking and acting) and time (knowledge is seen differently in different times).

63 kg

78 kg – normal ? overweight ? Obese ?

Clinical View of Data, Information, Knowledge



Bemmel, J. H. v. & Musen, M. A. (1997) *Handbook of Medical Informatics.* Heidelberg, Springer.

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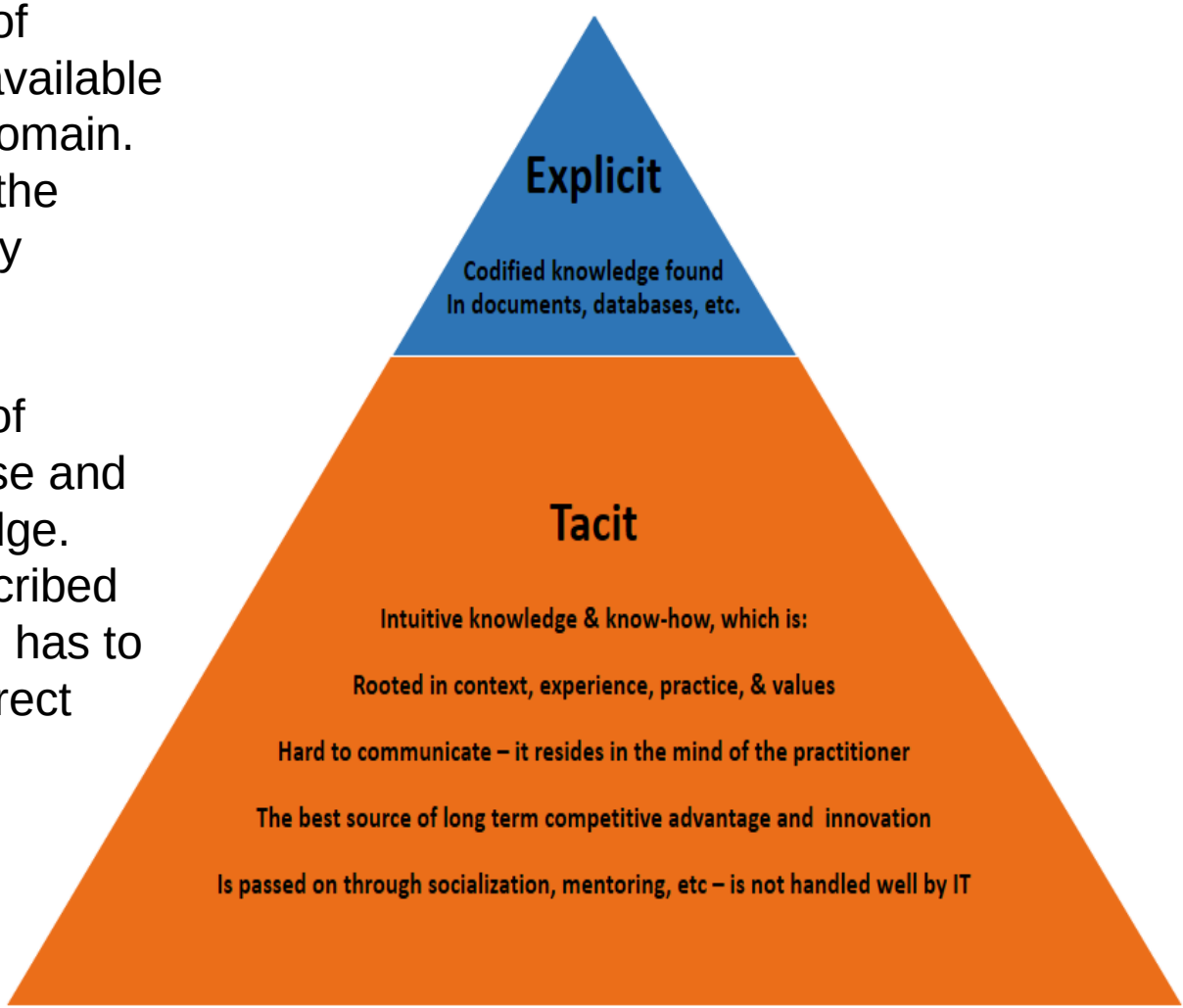
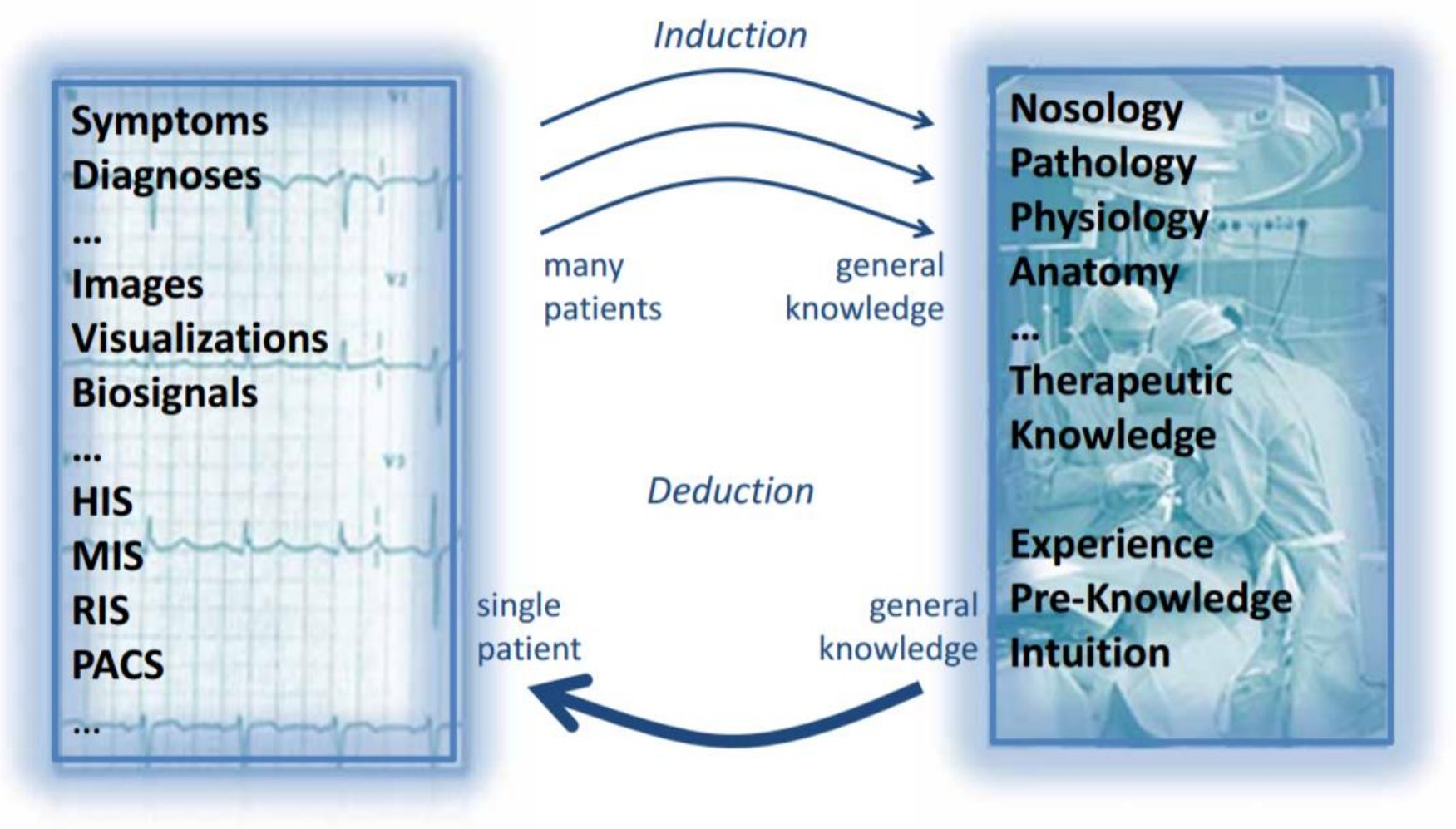
Types of Knowledge

- Explicit knowledge consists of theoretical expertise that is available in the respective specialist domain.
  - It is explicitly described in the sources and can be directly extracted from it.
- Implicit knowledge consists of practical knowledge, expertise and general or everyday knowledge.
  - This knowledge is not described explicitly in the source and has to be accessed via other indirect methods.



From Patient Data to Medical Knowledge



[Reference: Holzinger, 709.049 02]

Knowledge Acquisition

- The acquisition of knowledge in only slightly structured or unstructured data follows a process chain with different stages

  - the extraction of data,
  - the identification of the context,
  - the enrichment with metadata with the aid of dictionaries, nomenclatures and thesauri.

- The example process:
  - Data extraction (83, 3.14, kg, Miller, 2010, ...)
  - Information generation (63 kg → weight)
  - Knowledge generation (Walter Miller, current weight 63 kg, overweight)

Structured Biomedical Data

Coding and Classification

Semantic Interoperability: Coding and Classification Systems

- **Clinical vocabularies, terminologies, taxonomies, nomenclatures**
- Healthcare message exchanges: HL7, DICOM, FHIR
- Ontologies

STRUCTURED MEDICAL TERMINOLOGIES

- Clinical vocabularies, terminologies, coding and classification systems
- Designed to describe unambiguously the care and treatment of patients.
- Diseases, diagnoses, findings, operations, treatments, drugs, administrative items etc.
- Support recording and reporting a patient's care at varying levels of detail, whether on paper or, an electronic medical record.

DEFINITIONS

- *Nomenclature:* A list of all the approved terms for describing and recording observations, or an agreed-upon naming convention.
- *Controlled Clinical Vocabulary or Controlled Clinical Terminology (CCT):* A structured and limited dictionary of clinical terms used at the point-of-service.
- *Classification system:* A means of giving order to a group of disconnected facts by assignment to predetermined classes on the basis of perceived common characteristics.
- *Thesaurus:* A type of controlled vocabulary arranged so that relationships among terms are displayed clearly and identified by standardized relationship indicators. (e.g. UMLS)

DEFINITIONS

- Controlled clinical vocabularies, nomenclatures, and classification systems standardize the terms to describe health and health service-related concepts.
- The purpose is to create a shared “language of health”and exchange of basic clinical data among different individuals, agencies, and institutions.
- Fundamental difference is the types of concepts being represented and categorized. The distinction can be conceptualized as points along a continuum of increasing aggregation and decreasing richness.

natural language→nomenclature →controlled clinical vocabularies → classification

DEBATES FOR STRUCTURED MEDICAL TERMINOLOGIES

- A very large number of coding and classification systems have been developed for healthcare.
- Widespread adoption has been slow.
- Current standards tend to compete.
- Existing medical vocabularies vary in their coverage and completeness (content, structure, completeness, detail, cross-mapping, taxonomy, definitions, clarity etc.).
- Many classifications overlap.
- Historically, vocabulary and classification systems have been designed to meet different and specific goals.

DEBATES FOR STRUCTURED MEDICAL TERMINOLOGIES

- Widely-used but essentially administration-oriented systems, have been mandated by government agencies and/or payor organizations but they capture clinical data at an insufficient level of detail to support clinical needs.
- Systems designed to cover clinical information have tended to cover a relatively narrow subset of healthcare (such as nursing procedures or problem lists).
- Some systems concentrate on coding primarily clinical data, but they are difficult to use for clinicians and have lower user acceptance.

DEBATES FOR STRUCTURED MEDICAL TERMINOLOGIES

- Interoperability is a significant problem.
- Many of established medical coding systems lack a precise semantic underpinning and can lose clinical information.
- A single, comprehensive standard medical terminology which would improve the automated flow of clinical information does not exist.
- Comprehensive clinical terminology systems are needed to help integrate patient data with health information technologies.
- Integration of electronic patient records and medical terminologies with decision support systems is being researched.

DEUTSCHES INSTITUT FÜR MEDIZINISCHE DOKUMENTATION UND INFORMATION (DIMDI)

- DIMDI founded in 1969 and works as a subordinate authority of the Federal Ministry of Health.
- This organization publishes the German versions of medical nomenclatures and classifications such as ICD-10, ICF, OPS, ATC, MeSH, and UMDNS.
- The institute also operates special information systems for health technology assessment researches about drugs, medical devices and medical care .
- DIMDI also offers around 30 online databases with more than 140 million information in the domains of medicine, pharmacy and psychology.

Startseite
Das DIMDI
Arzneimittel
Datenbankrecherche
HTA
Klassifikationen, Terminologien, Standards
Aktuelles
Downloadcenter
Alpha-ID
ATC/DDD
EDMA IVD Classification
ICD-10-GM
ICD-10-WHO
ICD-11
ICD-O-3
ICF
LOINC/RELMA
MeSH, UMLS
OID
OPS
UCUM
UMDNS
Kooperationen
Iris-Institut
FAQ
Medizinprodukte

Ihre Position: Startseite » Klassifikationen, Terminologien, Standards

Klassifikationen, Terminologien und Standards im Gesundheitswesen

Das DIMDI gibt im Auftrag des Bundesministeriums für Gesundheit amtliche medizinische Klassifikationen heraus und stellt weitere Terminologien und Standards für das Gesundheitswesen bereit.

Basisinformation Klassifikationen (PDF, 850 kB)

Alpha-ID

Diagnosen für medizinische Zwecke

Die Alpha-ID ist eine nichtklassierende Diagnosenverschlüsselung. Sie kann auch zur medizinischen Dokumentation genutzt werden, da bei der Kodierung keinerlei Information verloren geht. mehr »

ATC/DDD

Arzneimittel

Die Anatomisch-Therapeutisch-Chemische Klassifikation (ATC) gruppiert Wirkstoffe nach Wirkort und -eigenschaften und enthält für jeden Wirkstoff eine definierte Tagesdosis (DDD). mehr »

EDMA IVD Classification

In-vitro-Diagnostika

Zur Verschlüsselung von In-vitro-Diagnostika dient im deutschen Medizinprodukte-Informationssystem die IVD Classification der EDMA (European Diagnostic Manufacturers Association). mehr »

ICD-10-GM

Diagnosen für Gesundheitsverwaltung

Die Internationale statistische Klassifikation der Krankheiten, German Modification (ICD-10-GM) ist die amtliche Klassifikation für Diagnosen in der ambulanten und stationären Versorgung in Deutschland. mehr »

ICD-10-WHO

Todesursachen

Die Internationale statistische Klassifikation der Krankheiten der WHO (ICD-10-WHO) ist eine amtliche Klassifikation für Diagnosen, in Deutschland vor allem für die

ICD-11

Parallel zur Weiterentwicklung der ICD-10 der WHO wird international seit einigen Jahren an einer grundlegenden 11. Revision gearbeitet. mehr »

Servicelinks

- Aktuelles
- Newsletter abonnieren
- Downloadcenter
- DIMDI Webshop
- FAQ
- Ansprechpartner/-innen

Quicklinks

- ICD-10-GM 2016
- ICD-10-GM 2017
- OPS 2016
- OPS 2017
- ICD-10-WHO 2016
- ICD-O-3 Erste Revision
- ICD und OPS: alle Versionen
- ICF
- Basiswissen Kodieren (PDF, 530 kB)
- Todesursachen-Flyer (PDF, 145 kB)

THE LIST OF STRUCTURED TERMINOLOGIES (DIMDI)

- ICD-10-WHO and ICD-10-GM (German Modification), ICD-O-3
- Operationen und Prozedurenschlüssel (OPS)
- International Classification of Functioning, Disability and Health (ICF)
- Universal Medical Device Nomenclature System (UMDNS)
- Medical Subject Headings (MeSH) and Unified Medical Language System (UMLS)
- Alpha-ID (a nomenclature for diagnosis)
- Logical Observation Identifiers Names and Codes (LOINC)
- Unified Codes for Units of Measure (UCUM)
- EDMA (European Diagnostic Manufacturers Association) IVD Classification
- Anatomical Therapeutic Chemical (ATC) Classification System with Defined Daily Dose (DDD)

SOME OTHERS ….

- Nursing interventions: International Classification for Nursing Practice (ICNP), NANDA International (NANDA-I), Nursing Interventions Classification (NIC), Nursing Outcomes Classification (NOC), Home Health Care Classification (HHCC)
- Surgical Procedures: Current Procedural Terminology (CPT), Office of Population Censuses and Surveys, Fourth Revision (OPCS-4)
- Clinical Imaging Procedures: National Interim Clinical Imaging Procedure (NICIP)
- Impairment, Disability and Handicap: ICIDH: International Classification of Impairments, Disabilities, and Handicaps (ICIDH)
- Medical care: International Classification of Primary Care (ICPC), Read Codes, SNOMED Clinical Terms
- ….

Standards setting organizations

عربي 中文 English Français Русский Español

World Health Organization

Health topics | Data | Media centre | Publications | Countries | Programmes | Governance | About WHO

Global Health Observatory (GHO) data

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WHO FAMILY OF INTERNATIONAL CLASSIFICATIONS (WHO-FIC)

- International Statistical Classification of Diseases (ICD)
- International Classification of Functioning, Disability and Health (ICF)
- International Classification of Health Interventions (ICHI)
- Related classifications
  - International Classification of Primary Care (ICPC)
  - International Classification of External Causes of Injury (ICECI)
  - Assistive products for persons with disabilities - Classification and terminology (ISO9999)
  - The Anatomical Therapeutic Chemical Classification System with Defined Daily Doses (ATC/DDD)
  - International Classification for Nursing Practice (ICNP)
- Derived classifications
  - ICD for Oncology, Third Edition (ICD-O-3)
  - The ICD-10 Classification of Mental and Behavioural Disorders
  - ICF Children and Youth Version
  - Application of the ICD to Dentistry and Stomatology, Third Edition (ICD-DA)
  - Application of the International Classification of Diseases to Neurology (ICD-10-NA)

WHO FAMILY OF INTERNATIONAL CLASSIFICATIONS (WHO-FIC)

RELATED Classifications	REFERENCE Classifications	DERIVED Classifications
International Classification of **Primary Care-2** (ICPC)*	**I** nternational **C** lassification of **D** iseases*	International Classification of Diseases for **Oncology**, Third Edition (ICD-O-3)*
*International Classification of External Causes of **Injury** (ICECI)*	**I** nternational **C** lassification of **F** unctioning, Disability & Health*	The ICD-10 Classification of **Mental and Behavioural Disorders***
*International Classification for **Nursing Practice** (ICNP)*		ICF, **Children & Youth Version** (ICF -CY)*
ISO 9999 **Assistive products** for persons with disabilities – Classification and Terminology – *	**I** nternational **C** lassification of **H** ealth **I** nterventions *(under exploration)*	Application of the International Classification of Diseases to **Dentistry** and Stomatology, Third Edition (ICD-DA)
*The Anatomical, Therapeutic, Chemical (**ATC**) classification system with Defined Daily Doses (**DDD**)*		Application of the International Classification of Diseases to **Neurology** (ICD-10-NA)

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INTERNATIONAL CLASSIFICATION OF DISEASES (ICD)

- International Statistical Classification of Diseases and Related Health Problems or (shortly) International Classification of Diseases
- An international standard diagnostic tool for epidemiology, health management, outcome monitoring, resource allocation, clinical care and research purposes.
- The ICD is maintained by the World Health Organization (WHO).
- ICD has been translated into 43 languages.
- More than 100 countries use the system to report mortality data, a primary indicator of health status.

HISTORY OF ICD

- The first edition (as the International List of Causes of Death) was adopted by the International Statistical Institute in 1893.
- WHO was entrusted with the ICD at its creation in 1948 and published the 6th version, ICD-6, that incorporated morbidity for the first time.
- The ICD has been revised and published in a series of editions to reflect advances in health and medical science over time.
- ICD-10 was endorsed in May 1990 by the Forty-third World Health Assembly. It is cited in more than 20,000 scientific articles and used by more than 100 countries around the world.

International List of Causes of Death

II. CANCERS AND OTHER TUMORS

48. Cancer and malignant tumors of the buccal cavity 43
49. Cancer and malignant tumors of the esophagus, stomach and duodenum 44
50. Cancer and malignant tumors of the peritoneum, of the intestines and of the rectum 45
51. Cancer and malignant tumors of the female genital organs 46
    a. Of the uterus
    b. Of other organs
52. Cancer and malignant tumors of the breast. 47
53. Cancer and malignant tumors of the skin.. 48
54. Cancer and malignant tumors of other or unspecified organs . . . . . 49 and 44
55. Benign tumors and tumors not returned as malignant (excluding those of the ovary and of the uterus) 50, 137, 139

III. DISEASES OF NUTRITION AND OF THE ENDOCRINE GLANDS

56. Diabetes 57
57. Gout . . . . . 52—part
58. Scurvy 53
    a. Barlow's Disease
    b. Scurvy
59. Pellagra 54
60. Beriberi 55
61. Rickets . . . . . 56—part

    a. Of the middle ear
    b. Of the internal ear
    c. Of the mastoid

VII. DISEASES OF THE CIRCULATORY SYSTEM

90. Pericarditis 87
    a. Acute
    b. Chronic
91. Acute endocarditis . . . . . 88 in part
92. Chronic endocarditis and valvular diseases of the heart . . . . . 88 in part
93. Myocarditis . . . . . 88 in part
    a. Acute
    b. Chronic
94. Angina pectoris 89
95. Other diseases of the heart. 90
96. Aneurysm 91a
97. Arteriosclerosis 91b
98. Other diseases of the arteries. 91c
99. Embolism and thrombosis (cerebral and pulmonary excepted). . . . . 92—part
100. Diseases of the veins (varices, hemorrhoids, phlebitis, etc.). 93
101. Diseases of the lymphatic system (lymphangitis, etc.). 94
102. Hemorrhages with unspecified causes. 95
103. Others under this title. 96

VIII. DISEASES OF THE RESPIRATORY SYSTEM

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International Classification of Causes of Sickness and Death (1910)

DEPARTMENT OF COMMERCE AND LABOR

BUREAU OF THE CENSUS

E. DANA DURAND, DIRECTOR

INTERNATIONAL CLASSIFICATION

OF

CAUSES OF SICKNESS AND DEATH

REVISED BY THE INTERNATIONAL COMMISSION
AT THE SESSION OF PARIS, JULY 1 TO 3, 1909,
FOR USE BEGINNING JANUARY 1, 1910,
AND UNTIL DECEMBER 31, 1919

I.—GENERAL DISEASES—Continued.

*4. Malaria.
*4a. —*Including:* Malarial cachexia.
*5. Smallpox.
*6. Measles.
*7. Scarlet fever.
*8. Whooping cough.
*9. Diphtheria and croup.
*9a. —*Including:* Croup.
*10. Influenza.

I.—GENERAL DISEASES—Continued.

*4. Malaria.
*4a. —*Including:* Malarial cachexia.
*5. Smallpox.
*6. Measles.
*7. Scarlet fever.
*8. Whooping cough.
*9. Diphtheria and croup.
*9a. —*Including:* Croup.
*10. Influenza.

IV.—DISEASES OF THE RESPIRATORY SYSTEM.

86. Diseases of the nasal fossæ. —*This title includes:* (*a*) Polypus, *or* fibroma: of the nasal fossæ, *or* nasopharyngeal.—(*b*) Coryza.—Rheum.—Rhinitis.—Ozæna.—Rhinoscleroma.—Adenoid vegetations of the nasal fossæ.—(*c*) Abscess of the nasal fossæ.

This title does not include: Epistaxis (85).—Syphilitic coryza (37).

In 1909 the following were added: *Rhinitis.—Rhinoscleroma.*

87. Diseases of the larynx.—*This title includes:* (*a*) Laryngitis: acute, *or* chronic, *or* erysipelatous, *or* œdematous, *or* phlegmonous, etc.—(*b*) Aphonia.—Loss of voice.—(*c*) False croup.—Spasmodic croup.—Stridulous croup.—Stridulous laryngitis.—Spasm, *or* paralysis: of the glottis.—(*d*) Œdema of the glottis.—(*e*) Polypus of the larynx.—(*f*) Stricture of the larynx.—(*g*) Laryngotomy.

International Classification of Causes of Sickness and Death (1910)

1 Enteric fever
2 Typhus
3
3A Relapsing fever
3B Mediterranean fever
4 Malaria
5 Small-pox
6 Measles
7 Scarlet fever
8 Whooping cough
9
9A Diphtheria
9B Membranous laryngitis
9C Croup
10 Influenza
11 Miliary fever
12 Asiatic cholera
13 Cholera nostras
14 Dysentery
15 Plague
16 Yellow fever
17 Leprosy
18 Erysipelas
19
19A Mumps
19B German measles
19C Varicella
19D Other epidemic diseas
20
20A Pyaemia
20B Septicaemia
20C Vaceinia
21 Glanders
22 Anthrax (Splenic fever)
23 Rabies
24 Tetanus
25
25A Actinomycosis
25B Other mycoses
26 Pellagra
27 Beri-beri
28
28A Pulmonary tuberculosis
28B Phthisis (not defined as tuberculous)
29
29A Acute phthisis
29B Acute miliary tuberculosis
30 Tuberculous meningitis
31
31A Tabes mesenterica
31B Other peritoneal and intestinal tuber
32 Tuberculosis of spinal column
33 Tuberculosis of joints
34
34A Lupus
34B Scrofula
34C Tuberculosis of other organs
35 Disseminated tuberculosis
36
36A Rickets
36B Other forms of bone softening
37 Syphilis
38
38A Soft chancre
38B Gonococcus infection
38C Purulent ophthalmia
39 Cancer of the buccal cavity
40 Cancer of the stomach, liver, etc.
41 Cancer of the peritoneum, intestines, and r
42 Cancer of the female genital organs
43 Cancer of the breast
44 Cancer of the skin
45 Cancer of the other or unspecified organs
46
46A Angioma
46B Adenoma
46C Other tumours (situation undefined)
47 Rheumatic fever
48
48A Chronic rheumatism
48B Osteo-arthritis
151A Premature birth
151B Infantile atrophy, debility, and
151C Icterus neonatorum
151D Sclerema and oedema neonatorum
151E Want of breast milk
152
152A Diseases of umbilicus, etc.
152B Atelectasis
152C Injuries at birth
152D Cyanosis neonatorum
153 Lack of care
154
154A Senile dementia
154B Senile decay
155 Suicide by poison
156 Suicide by asphyxia
157 Suicide by hanging or strangulation
158 Suicide by drowning
159 Suicide by firearms
160 Suicide by cutting or piercing instrume
161 Suicide by jumping from high place
162 Suicide by crushing
163 Other suicides
164 Poisoning by food
165 Other acute poisonings
166 Conflagration
167 Burns (conflagration excepted)
168 Absorption of deleterious gases (confla
169 Accidental drowning
170 Injury by firearms
171 Injury by cutting or piercing instrumen
172 Injury by fall
173 Injury by in mines and quarries
174 Injury by machines
175 Injury by other crushing (vehicles, rai
176 Injury by animals
177 Starvation
178 Excessive cold
179 Effects of heat
180 Lightning
181 Electricity (lightning excepted)

ICD-10 Version:2010

http://apps.who.int/classifications/icd10/browse/2010/en

Search [Advanced Search] ICD-10 | Versions - Languages | Info

- ICD-10 Version:2010
  - 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
  - VII Diseases of the eye and adnexa
    - H00-H06 Disorders of eyelid, lacrimal system and orbit
    - H10-H13 Disorders of conjunctiva
      - H10 Conjunctivitis
      - H11 Other disorders of conjunctiva
        - H11.0 Pterygium
        - H11.1 Conjunctival degenerations and deposits
        - H11.2 Conjunctival scars
        - H11.3 Conjunctival haemorrhage
        - H11.4 Other conjunctival vascular disorders and cysts
        - H11.8 Other specified disorders of conjunctiva
        - H11.9 Disorder of conjunctiva, unspecified
      - H13 Disorders of conjunctiva in diseases classified elsewhere
    - H15-H22 Disorders of sclera, cornea, iris and ciliary body
    - H25-H28 Disorders of lens
    - H30-H36 Disorders of choroid and retina
    - H40-H42 Glaucoma
    - H43-H45 Disorders of vitreous body and globe
    - H46-H48 Disorders of optic nerve and visual pathways
    - H49-H52 Disorders of ocular muscles, binocular movement, accommodation and refraction

H11 **Other disorders of conjunctiva**

Excl.: keratoconjunctivitis (H16.2)

H11.0 **Pterygium**

Excl.: pseudopterygium (H11.8)

H11.1 **Conjunctival degenerations and deposits**

Conjunctival:
- argyrosis [argyria]
- concretions
- pigmentation
- xerosis NOS

H11.2 **Conjunctival scars**

Symblepharon

H11.3 **Conjunctival haemorrhage**

Subconjunctival haemorrhage

H11.4 **Other conjunctival vascular disorders and cysts**

Conjunctival:
- aneurysm
- hyperaemia
- oedema

H11.8 **Other specified disorders of conjunctiva**

Pseudopterygium

H11.9 **Disorder of conjunctiva, unspecified**

H13* **Disorders of conjunctiva in diseases classified elsewhere**

H13.0* **Filarial infection of conjunctiva (B74.-+)**

H13.1* **Conjunctivitis in infectious and parasitic diseases classified elsewhere**

Conjunctivitis (due to):
- Acanthamoeba (B60.1+)
- adenoviral follicular (acute) (B30.1+)
- chlamydial (A74.0+)
- diphtheritic (A36.8+)
- gonococcal (A54.3+)
- haemorrhagic (acute)(epidemic) (B30.3+)

PURPOSE AND USES

- ICD is the foundation for the identification of health trends and statistics globally, and the international standard for reporting diseases and health conditions.
- It is the diagnostic classification standard for all clinical and research purposes.
- ICD defines the universe of diseases, disorders, injuries and other related health conditions that 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 AND ICD-10-GM

- In Germany, there are two main official application areas for ICD-10;
  - Death registration for cause of death statistics (unchanged translation of ICD -10)
  - Diagnostic coding for the outpatient and inpatient treatment and reimbursement. ICD -10- GM is the basis of the G-DRG (German Diagnosis Related Groups) and EBM (Einheitlicher Bewertungsmaßstab) systems.

H11.- **Sonstige Affektionen der Konjunktiva**

Exkl.: Keratokonjunktivitis (H16.2)

H11.0 **Pterygium**

Exkl.: Pseudopterygium (H11.8)

H11.1 **Konjunktivadegeneration und -einlagerungen**

Konjunktivale:

- Argyrose [Argyrie]
- Konkremente
- Pigmentierung

Xerosis conjunctivae o.n.A.

H11.2 **Narben der Konjunktiva**

Symblepharon

H11.3 **Blutung der Konjunktiva**

Hyposphagma

Subkonjunktivale Blutung

H11.4 **Sonstige Gefäßkrankheiten und Zysten der Konjunktiva**

Konjunktivale(s):

- Aneurysma
- Hyperämie
- Ödem

H11.8 **Sonstige näher bezeichnete Affektionen der Konjunktiva**

Pseudopterygium

H11.9 **Affektion der Konjunktiva, nicht näher bezeichnet**

https://www.dimdi.de/static/de/klassi/icd-10-gm/kodesuche/onlinefassungen/htmlgm2017/block-h10-h13.htm

H13.-* **Affektionen der Konjunktiva bei anderenorts klassifizierten Krankheiten**

H13.0* **Filarienbefall der Konjunktiva (B74.-†)**

H13.1* **Konjunktivitis bei anderenorts klassifizierten infektiösen und parasitären Krankheiten**

Konjunktivitis (durch):

- Adenoviren, follikulär (akut) (B30.1†)
- Akanthamöben (B60.1†)
- bei Zoster (B02.3†)
- Chlamydien (A74.0†)

ICD-O-3

- ICD-O is used by cancer registries throughout the world to record incidence of malignancy and survival rates, and the data produced are used to inform cancer control, research activity, treatment planning and health economics.
- ICD-O first published in 1976 and the third edition of ICD-O (ICD-O-3) has been available since 2000.
- In September 2011, the classification was updated with a number of new or modified codes and terms (ICD-O-3 First Revision, or ICD-O-3.1)
- In Germany, German-language ICD-O-3.1 is used for cancer registries.

ICD-O-3

- ICD-O consists of two axes (or coding systems), which together describe the tumour:
  - the topographical code (C) describes the anatomical site of origin (or organ system) of the tumour and uses the ICD-10 classification of malignant neoplasms
  - the morphological code (M) has three parts:
    - First four digits: Cell type (or histology) of the tumour (from 8000 to 9992)
    - Fifth digit: Behaviour (malignant, benign, in situ, or uncertain)
    - Sixth digit: Histological grading and differentiation (well differentiated, moderately differentiated, poorly differentiated, undifferentiated, not applicable)

ICD-O-3

Figure 7. Structure of a Topography Code

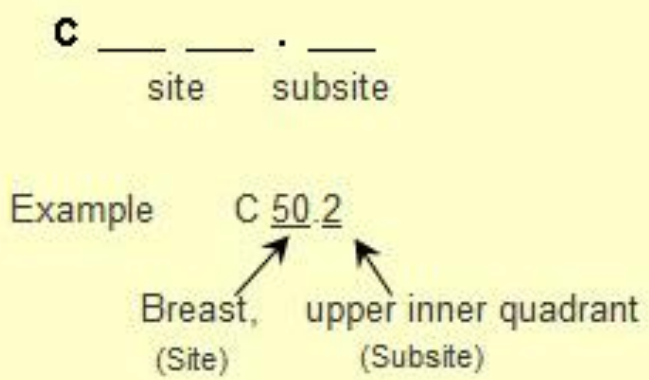


Figure 8. Structure of a Morphology Code

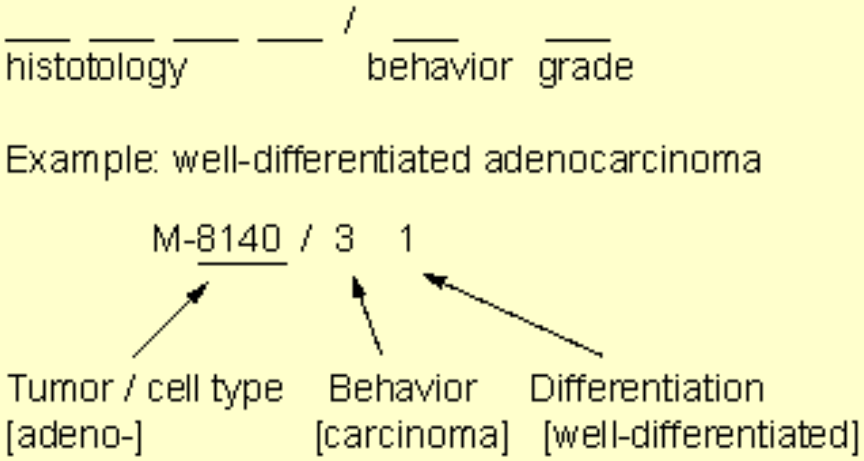


Figure 9. Structure of a Complete Code

Diagnostic term:
Poorly differentiated squamous cell carcinoma, upper lobe of lung

C34.1M-8070/33

Topographical code (C)	Morphological code (M)	
Site.Subsite	Cell type / Behavior	Differentiation
Lung.Upper Lobe	Squamose cell / Carcinoma	Poorly differentiated

Reference: https://training.seer.cancer.gov/coding/structure/

WHO ICD-11 REVISION

- The 11th version, ICD-11, is now being developed through a continuous revision process. It is anticipated that the final ICD-11 will be approved for release in 2018.
- When finalized, ICD-11 will be ready to use with electronic health records and information systems.
- This new revision is more comprehensive for use in broader clinical settings (e.g., it has a subset of conditions for use in primary care).
- It enables greater international comparability, with no country-specific versions.
- It has linkages to other data standards, such as the International Classification of Functioning and Disability (ICF), International Classification of Health Interventions (ICHI) and SNOMED-CT.

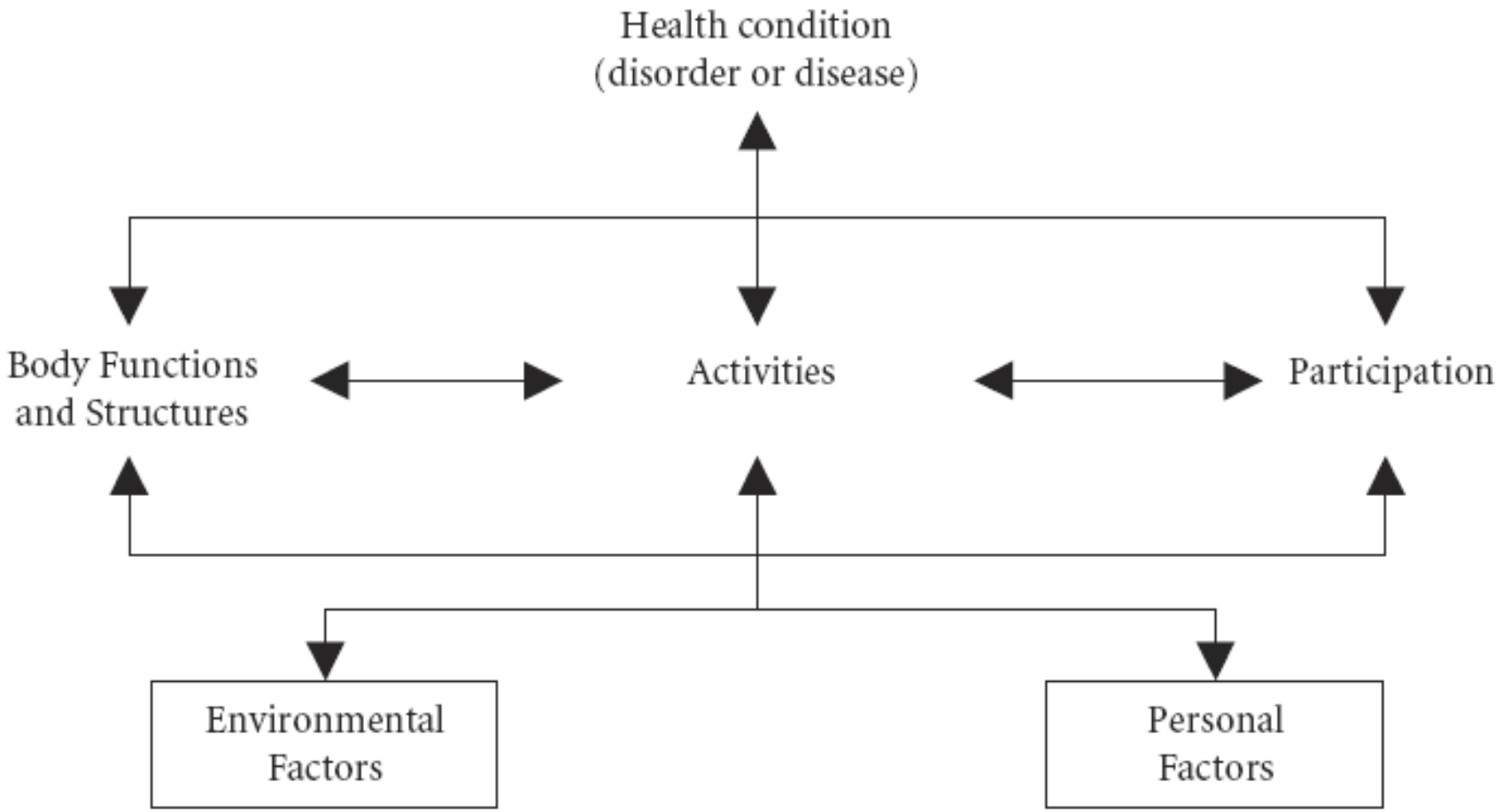
INTERNATIONAL CLASSIFICATION OF FUNCTIONING, DISABILITY AND HEALTH (ICF)

- ICF is a classification of human functioning and disability.
- Functioning: An umbrella term for body function, body structures, activities and participation. (positive or neutral aspects of the interaction between a person's health condition(s) and contextual factors)
- Disability: An umbrella term for impairments, activity limitations and participation restrictions. (Negative aspects of the interaction between a person's health condition(s) and contextual factors)
- ICF provides us a multidisciplinary and transnational framework to understand and describe the functional health status, disability, social impairment and relevant environmental factors of a human.

THE ICF MODEL

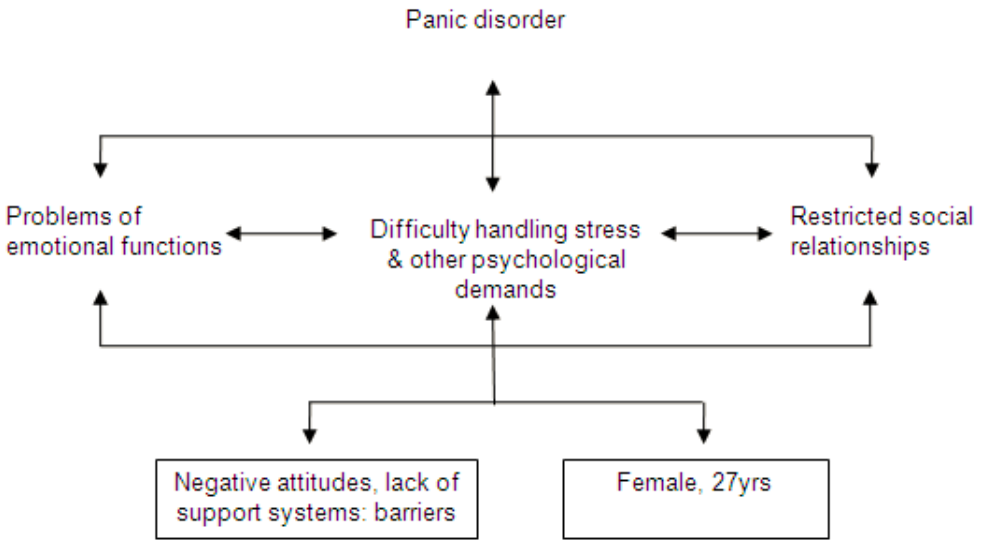
- In the ICF, functioning and disability are multi-dimensional concepts, relating to:
  - the body functions and structures of people, and impairments thereof (functioning at the level of the body);
  - the activities of people (functioning at the level of the individual) and the activity limitations they experience;
  - the participation or involvement of people in all areas of life, and the participation restrictions they experience (functioning of a person as a member of society); and
  - the environmental factors which affect these experiences (and whether these factors are facilitators or barriers).

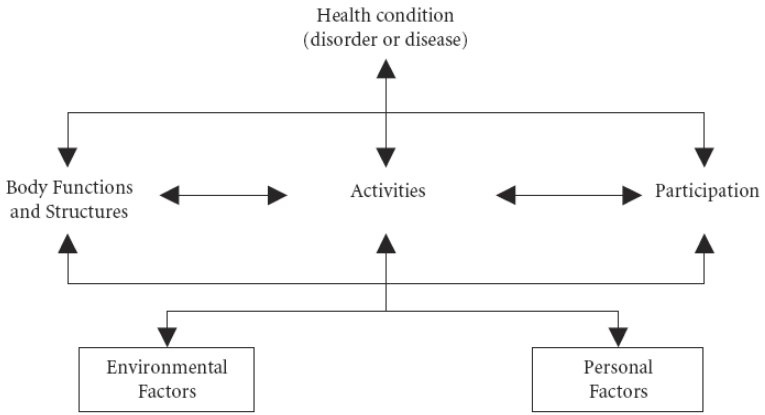
THE ICF MODEL

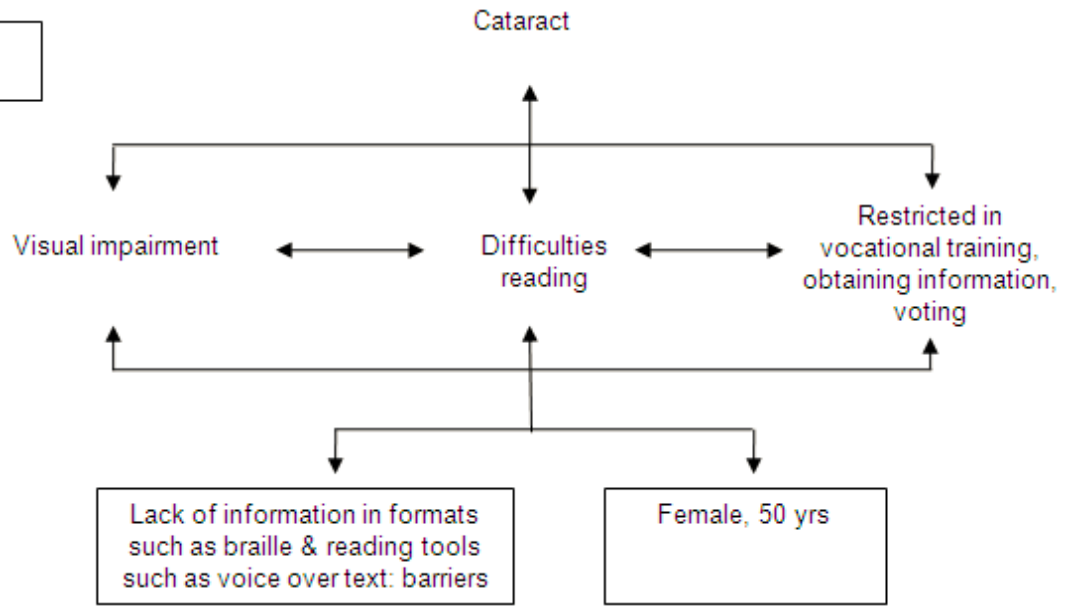


Although personal factors are recognised in the interactive model shown in Figure , they are not classified in the ICF at this time.

EXAMPLES OF ICF USE WITH INDIVIDUALS







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THE ICF CHECKLIST

- A practical tool allowing simple, time efficient identification and qualification of the functioning profile of an individual.
- The ICF codes require the use of one or more qualifiers.

PART 1a: IMPAIRMENTS of BODY FUNCTIONS

- Body functions are the physiological functions of body systems (including psychological functions).
- Impairments are problems in body function as a significant deviation or loss.

First Qualifier: *Extent of impairments*
0 No impairment means the person has no problem ***1 Mild impairment*** means a problem that is present less than 25% of the time, with an intensity a person can tolerate and which happens rarely over the last 30 days. ***2 Moderate impairment*** means that a problem that is present less than 50% of the time, with an intensity, which is interfering in the persons day to day life and which happens occasionally over the last 30 days. ***3 Severe impairment*** means that a problem that is present more than 50% of the time, with an intensity, which is partially disrupting the persons day to day life and which happens frequently over the last 30 days. ***4 Complete impairment*** means that a problem that is present more than 95% of the time, with an intensity, which is totally disrupting the persons day to day life and which happens every day over the last 30 days. ***8 Not specified*** means there is insufficient information to specify the severity of the impairment. ***9 Not applicable*** means it is inappropriate to apply a particular code (e.g. b650 Menstruation functions for woman in pre-menarche or post-menopause age).

Short List of Body Functions	***Qualifier***
b1. MENTAL FUNCTIONS	
b110 Consciousness	
b114 Orientation *(time, place, person)*	
b117 Intellectual *(incl. Retardation, dementia)*	
b130 Energy and drive functions	
b134 Sleep	
b140 Attention	
b144 Memory	
b152 Emotional functions	
b156 Perceptual functions	
b164 Higher level cognitive functions	

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THE ICF CHECKLIST

Short List of Body Structures	**First Qualifier:** ***Extent of impairment***	**Second Qualifier:** ***Nature of the change***
s1. STRUCTURE OF THE NERVOUS SYSTEM		
s110 Brain		
s120 Spinal cord and peripheral nerves		
s2. THE EYE, EAR AND RELATED STRUCTURES		
s3. STRUCTURES INVOLVED IN VOICE AND SPEECH		
s4. STRUCTURE OF THE CARDIOVASCULAR, IMMUNOLOGICAL AND RESPIRATORY SYSTEMS		
s410 Cardiovascular system		
s430 Respiratory system		
s5. STRUCTURES RELATED TO THE DIGESTIVE, METABOLISM AND ENDOCRINE SYSTEMS		

Short List of A&P domains	***Performance Qualifier***	***Capacity Qualifier***
d1. LEARNING AND APPLYING KNOWLEDGE		
d110 Watching		
d115 Listening		
d140 Learning to read		
d145 Learning to write		
d150 Learning to calculate *(arithmetic)*		
d175 Solving problems		
d2. GENERAL TASKS AND DEMANDS		
d210 Undertaking a single task		

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BENEFITS OF ICF

- The use of the ICD-10 and the ICF together provides a meaningful and complete picture of the health needs of people and populations.
- When population data use the same concepts and frameworks as administrative and service data, a strong, integrated national information array can be developed.
- People use the ICF across broad sectors including health, disability, rehabilitation, community care, insurance, social security, employment, education, economics, social policy, legislation and environmental design and modification.

EXAMPLES OF ICF APPLICATIONS

- The ICF and its model have been introduced into legislation and social policy in some countries. The ICF also can be used to underpin reforms in education, employment or social welfare and ensure coherent implementation across different levels and sectors.
- In clinical settings the ICF can be used to support case planning, monitoring of progress, and outcomes evaluation. ICF core sets have been developed to achive this.
- The ICF model is valuable as a unifying model in rehabilitation medicine practice, research and education.
- In Germany, ICF have influenced the social legislation. The application of the ICF is mandated by law on the rehabilitation policy. Many research projects are focused on the application and development of ICF in the German-speaking countries.

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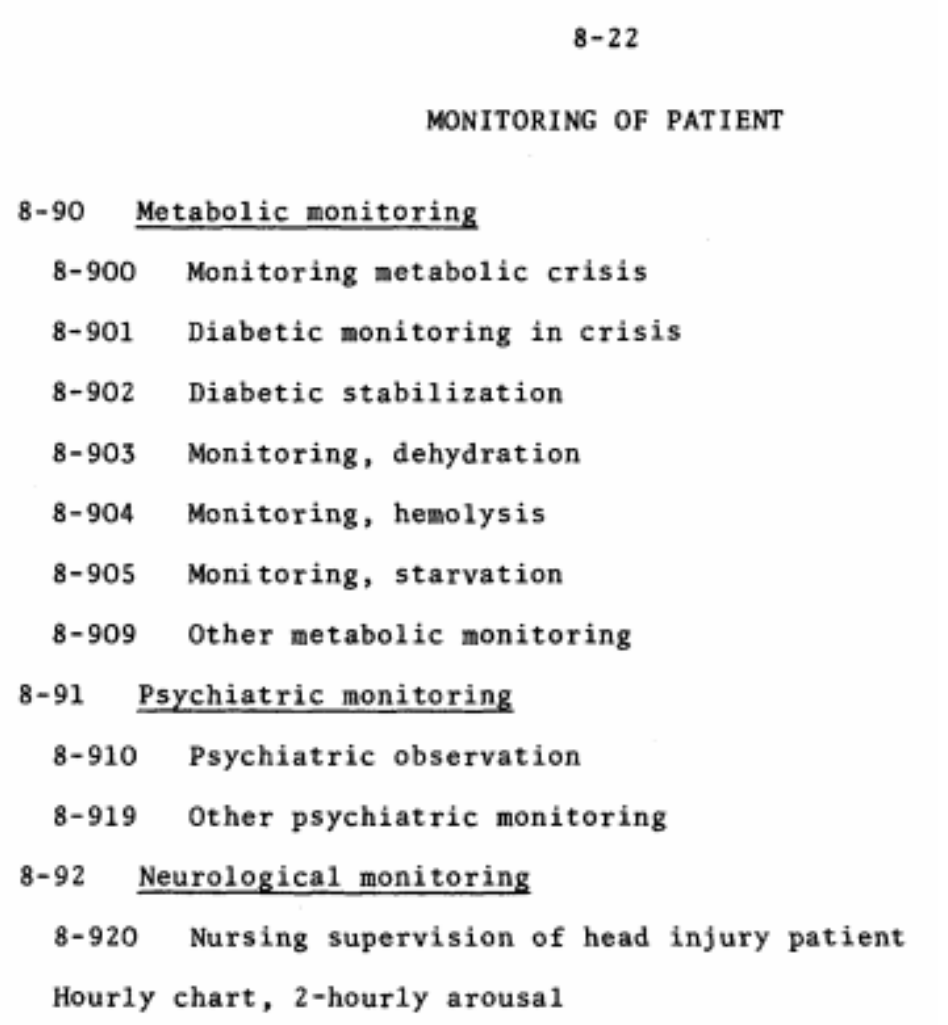
ICF FOR CHILDREN AND YOUTH

- The International Classification of Functioning, Disability and Health for Children and Youth (ICF-CY) is a WHO approved “derived” classification based on the ICF.
- ICF-CY includes further detailed information on the application of the ICF when documenting the relevant aspects of functioning and health in children and youth.
- The stakeholders have agreed to merge the two classifications.
- German version of ICF-CY is available.

INTERNATIONAL CLASSIFICATION OF PROCEDURES IN MEDICINE (ICPM) AND ICHI

- ICPM was a system of classifying procedure codes published by the WHO from 1978. International development it stopped in 1989.
- In the last few years, the WHO began to develop a new procedural classification - International Classification of Health Interventions (ICHI)- as replacement for ICPM.



8-22

MONITORING OF PATIENT

8-90 Metabolic monitoring

8-900 Monitoring metabolic crisis

8-901 Diabetic monitoring in crisis

8-902 Diabetic stabilization

8-903 Monitoring, dehydration

8-904 Monitoring, hemolysis

8-905 Monitoring, starvation

8-909 Other metabolic monitoring

8-91 Psychiatric monitoring

8-910 Psychiatric observation

8-919 Other psychiatric monitoring

8-92 Neurological monitoring

8-920 Nursing supervision of head injury patient

Hourly chart, 2-hourly arousal

OPERATIONEN UND PROZEDURENSCHLÜSSEL (OPS)

- OPS is the German modification of the ICPM. The German version of the ICPM was based on a translation of the ICPM DE (Dutch Extension).
- OPS is the basis of G-DRG, Einheitliche Bewertungsmaßstab (EBM) and quality reports for German healthcare providers.
- DRG-type hospital payment systems have become the main method of hospital payment in the majority of OECD countries. In Germany, a national German- DRG (G-DGR) system was gradually introduced following a legislative decision in 2000. Since 2004, it is mandatory for all hospitals.

OPS Version 2017

Kode-Suche in OPS Version 2017

Drei- oder Viersteller:

OK!

Übersicht über die Kapitel

Kapitelgliederung

Gruppengliederung

Vorige Gruppe

Nächste Gruppe

Ergänzende Informationen

Kapitel 8
NICHT OPERATIVE THERAPEUTISCHE MASSNAHMEN (8-01...8-99)

Patientenmonitoring (8-92...8-93)

Diese Gruppe gliedert sich in folgende Kategorien:

8-92 Neurologisches Monitoring

Inkl.: Auswertung und klinische Beurteilung

Hinw.: Ein Kode aus diesem Bereich ist jeweils nur einmal pro stationären Aufenthalt anzugeben

8-920 EEG-Monitoring (mindestens 2 Kanäle) für mehr als 24 h

Inkl.: Bispektral-Index-Monitoring [BIS-Monitoring]

Hinw.: Dieser Kode ist nur für intensivmedizinische Patienten anzugeben

8-921 Monitoring mittels evozierter Potentiale

Hinw.: Dieser Kode ist nur für intensivmedizinische Patienten anzugeben

8-923 Monitoring der hirnvenösen Sauerstoffsättigung

Hinw.: Dieser Kode ist nur für intensivmedizinische Patienten anzugeben

8-924 Invasives neurologisches Monitoring

Inkl.: Monitoring des intrakraniellen Druckes
Monitoring der Sauerstoffsättigung im Hirngewebe

Hinw.: Dieser Kode ist nur für intensivmedizinische Patienten anzugeben

8-925 Intraoperatives neurophysiologisches Monitoring

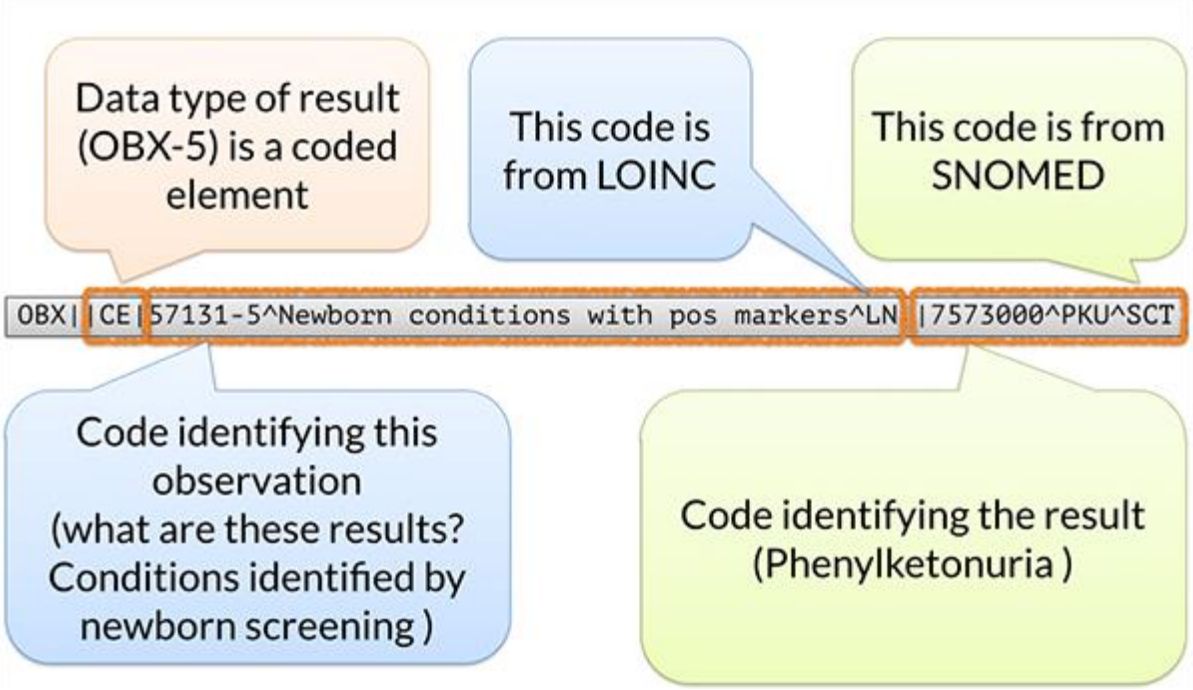
Inkl.: Elektrophysiologisches Monitoring
Sprachmonitoring bei Wacheingriffen

LOGICAL OBSERVATION IDENTIFIERS NAMES AND CODES (LOINC)

- We want to share, exchange, or aggregate health data such as labs, vitals signs, or clinical documents.
- But local systems have different ways of identifying the same test or measurement.
- This is a semantic interoperability problem.
- LOINC is a universal standard (set of identifiers, names, and codes) for clinical and laboratory observations that solve this problem.
- Also we can map our local test codes to LOINC codes.

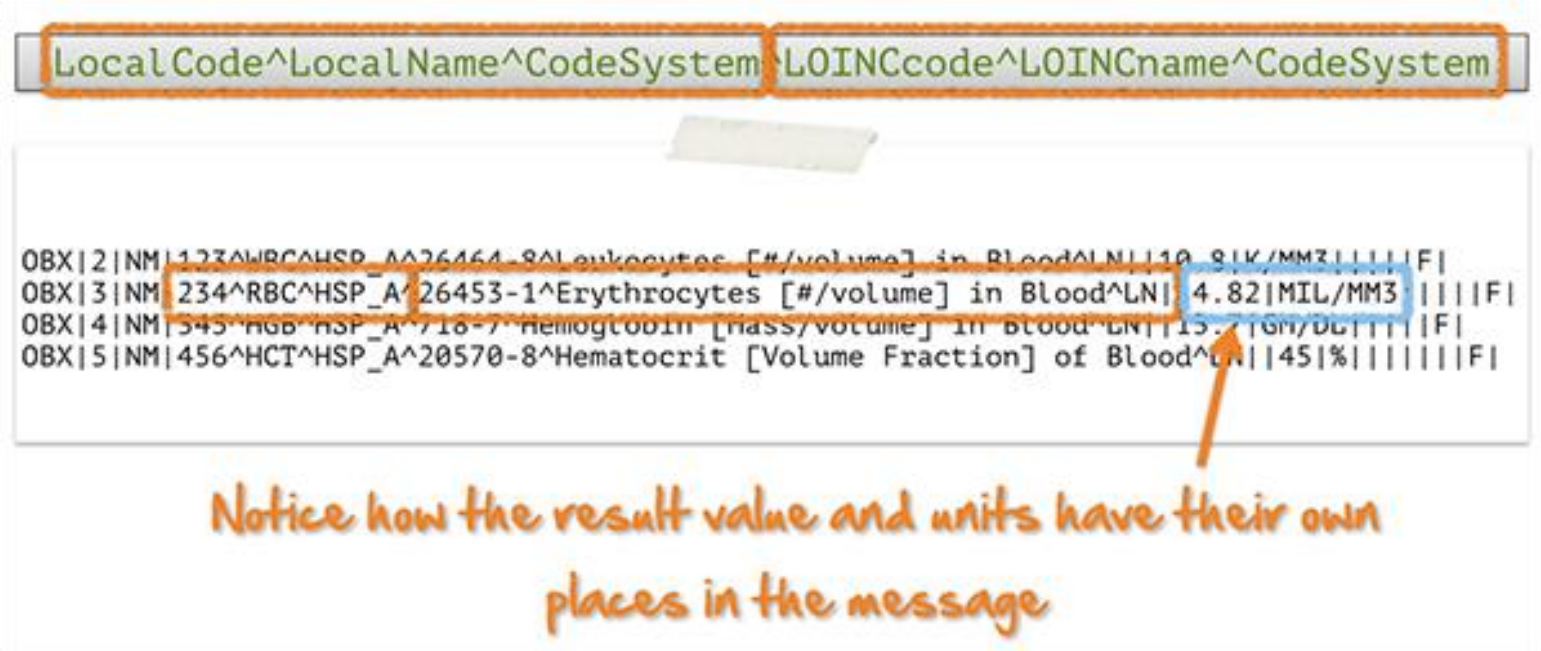
LOINC AND HL7

- Currently, most laboratories and diagnostic services are sending data out using the HL7 v.2 messaging standard. In this example, you can see how a LOINC code identifies the question and a SNOMED CT code represents the answer in an HL7 v.2 message:



LOINC AND HL7

- We can send our local concept identifier and name along with codes from a vocabulary standard. With the HL7 v.2 message standard, the OBX-3 slot allows 2 sets of triplets, one for our local concept and one for the concept from the vocabulary standard:



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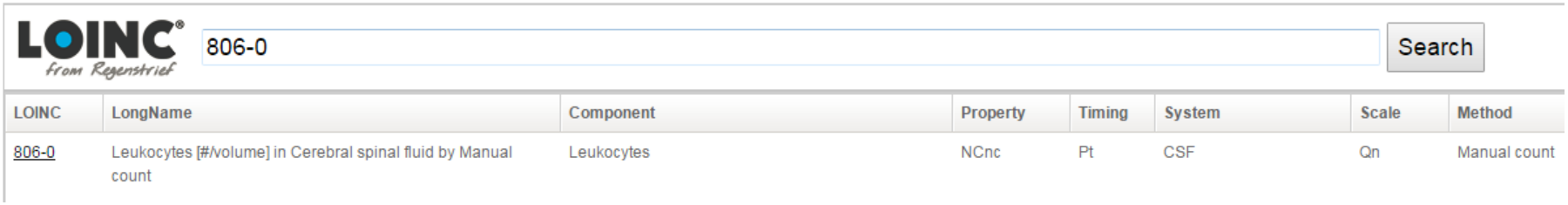
LOINC TERM BASICS

- To do that LOINC codes distinguish a given observation across six dimensions (parts):
  - 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. How the observation was made. Only needed when the technique affects the clinical interpretation of the results [OPTIONAL].

LOINC TERM BASICS

- LOINC name for a manual count of white blood cells in cerebral spinal fluid specimen (LOINC code 806-0):
  - Component (Analyte). Leukocytes (white blood cells)
  - Property. NCnc (Number concentration)
  - Time. Pt (Point in time)
  - System (Specimen). CSF (Cerebral spinal fluid)
  - Scale. Qn (Quantitative)
  - Method. Manual Count



LOINC	LongName	Component	Property	Timing	System	Scale	Method
806-0	Leukocytes [#/volume] in Cerebral spinal fluid by Manual count	Leukocytes	NCnc	Pt	CSF	Qn	Manual count

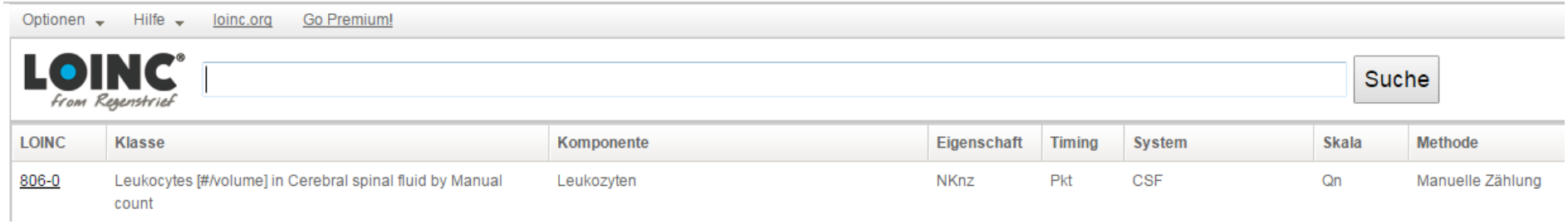
http://search.loinc.org/

SCOPE OF LOINC

- The overall scope of LOINC is anything you can test, measure, or observe about a patient. We generally talk about two major divisions of the content in LOINC: Laboratory and Clinical.
- The laboratory portion of the LOINC: Usual categories of chemistry, hematology, serology, microbiology (including parasitology and virology), and toxicology; as well as categories for cell counts, antibiotic susceptibilities, and more.
- The clinical portion of the LOINC: Vital signs, hemodynamics, intake/output, ECG, obstetric ultrasound, cardiac echo, urologic imaging, gastroendoscopic procedures, pulmonary ventilator management, radiology studies, clinical documents,selected survey instruments, and other clinical observations.

TOOLS FOR LOINC

- Regenstrief Institute maintains the LOINC database and its supporting documentation. To facilitate searches through the LOINC database and to assist efforts to map local codes to LOINC codes, Regenstrief Institute provides;
  - a Windows-based mapping utility called the Regenstrief LOINC Mapping Assistant (RELMA®),
  - a web application (**http://search.loinc.org**).
- DIMDI actively supports the LOINC. Since 2010, German translations are integrated to LOINC.



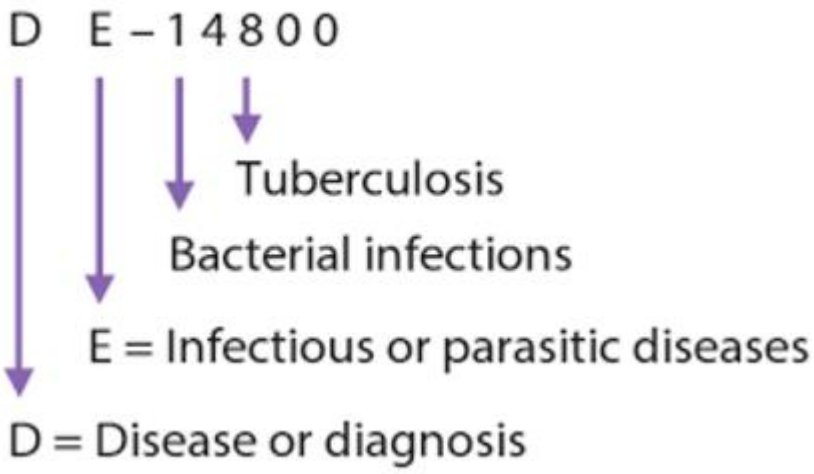
The Systematized Nomenclature of Medicine (SNOMED)

- SNOMED is a systematic, computer-processable collection of medical terms, in human and veterinary medicine. It provides codes, terms, synonyms and definitions which cover anatomy, diseases, findings, procedures, microorganisms, substances, etc.
- Systematized Nomenclature of Pathology (SNOP) was a predecessor of SNOMED and started in 1965.
- In 1973, SNOMED was developed by the U.S. College of American Pathologists (CAP) and revised into the 1990s.
- In 2002 CAP's SNOMED Reference Terminology (SNOMED RT) was merged with the National Health Service's Clinical Terms Version 3 (previously known as the Read codes) to produce SNOMED Clinical Terms (SNOMED CT).
- SNOMED CT is owned and distributed around the world by The International Health Terminology Standards Development Organisation (IHTSDO).

SNOMED's Nomenclature and Classification

- Versions of SNOMED released prior to 2001 were based on a multiaxial, hierarchical classification system. SNOMED codes are hierarchically structured.

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)



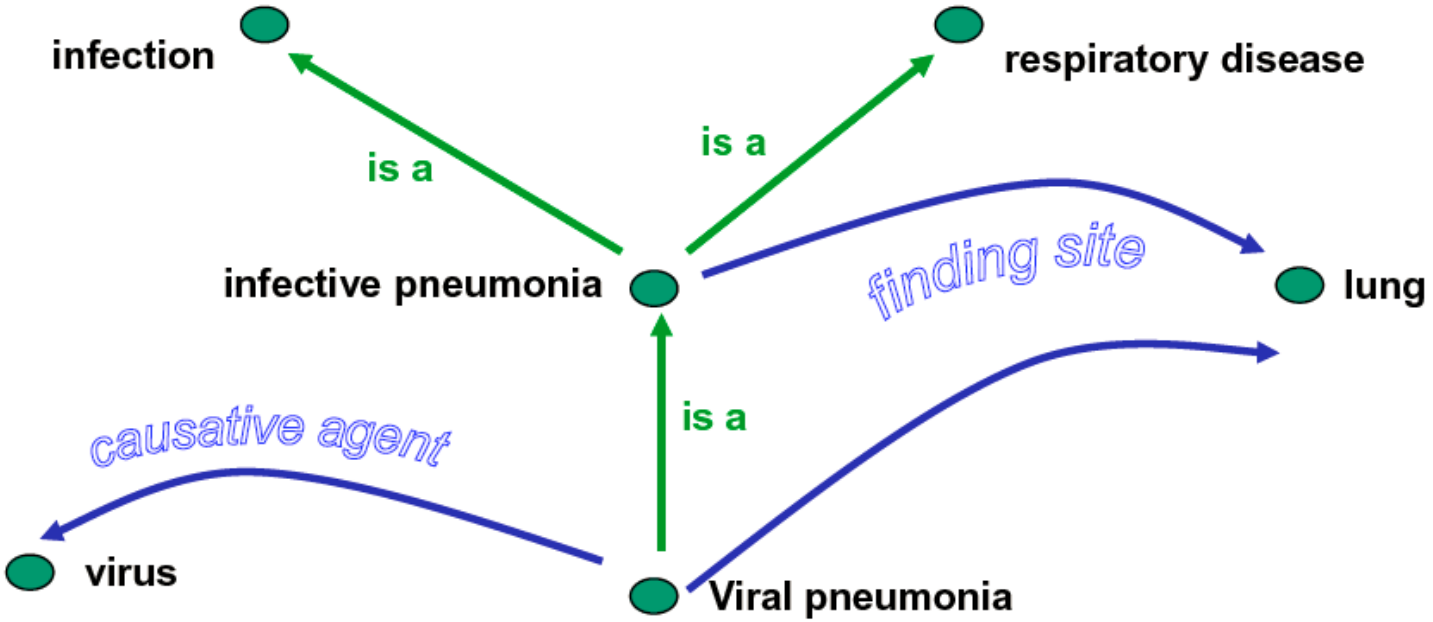
	Nomenclature				Classification
Axis	T	+ M	+ L	+ F	= D
Term	Lung	+ Granuloma	+ *M. tuberculosis*	+ Fever	= Tuberculosis
Code	T-28000	+ M-44000	+ L-21801	+ F-03003	= DE-14800

SNOMED Clinical Terms

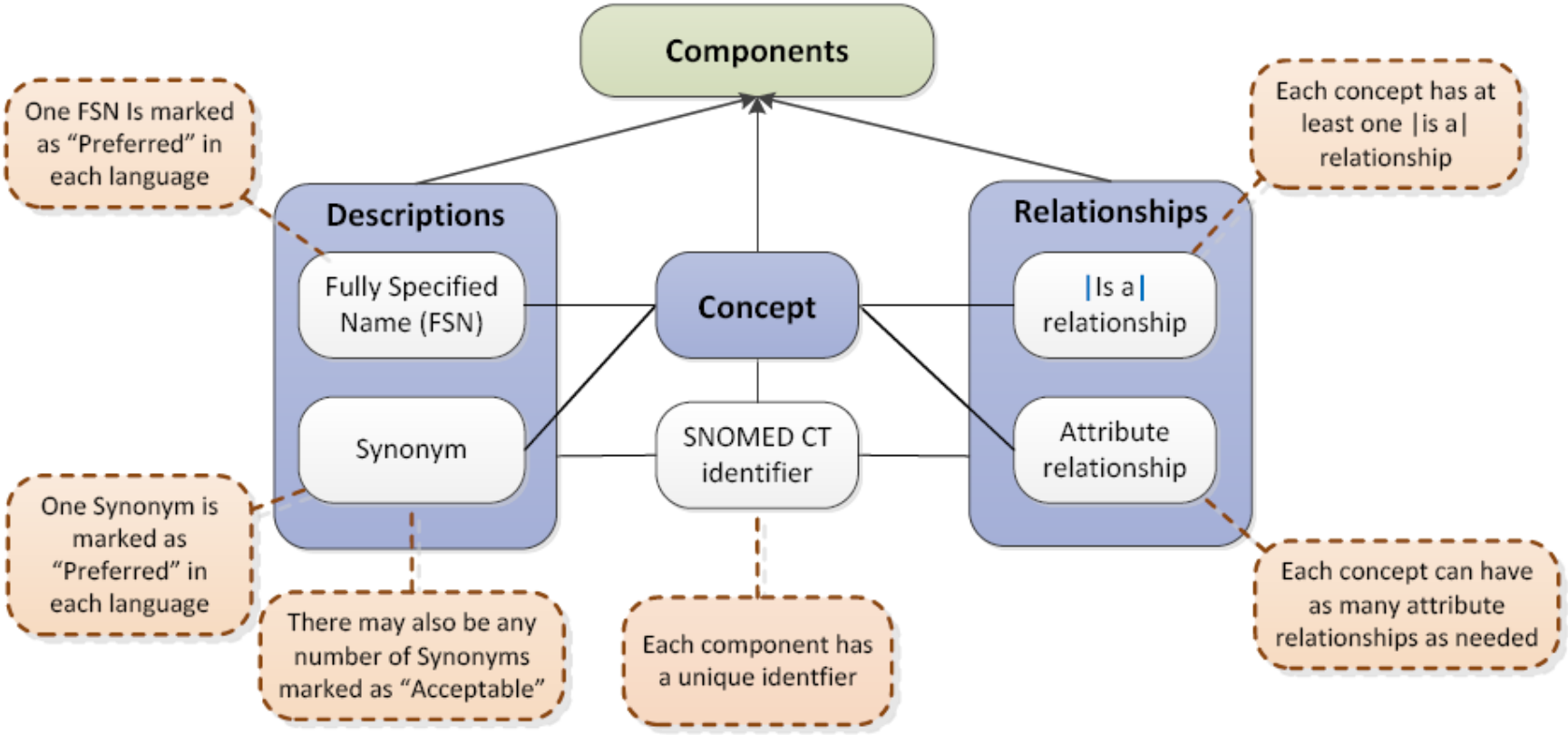
- The primary purpose of SNOMED CT is to encode the meanings that are used in health information and to support the effective clinical recording of data with the aim of improving patient care.
- SNOMED CT is a terminology that can cross-map to other international standards and classifications. Specific language editions are available.
- SNOMED CT adopted a completely different structure. A sub-type hierarchy, supported by defining relationships based on description logic, replaced the axes.
- Core components of SNOMED CT are concepts, descriptions, relationships and reference sets.

CORE COMPONENTS OF SNOMED CT

- Concepts - Identify clinical terms, ranging from abscess to zygote.
- Descriptions - human readable textual descriptions of concepts.
- Relationships - link a concept to others and provide formal definitions and other properties of the concept. (‘is a’ and attribute relationships)



CORE COMPONENTS OF SNOMED CT



- Reference Sets - used to group Concepts or Descriptions into sets, and cross-maps to other classifications and standards.

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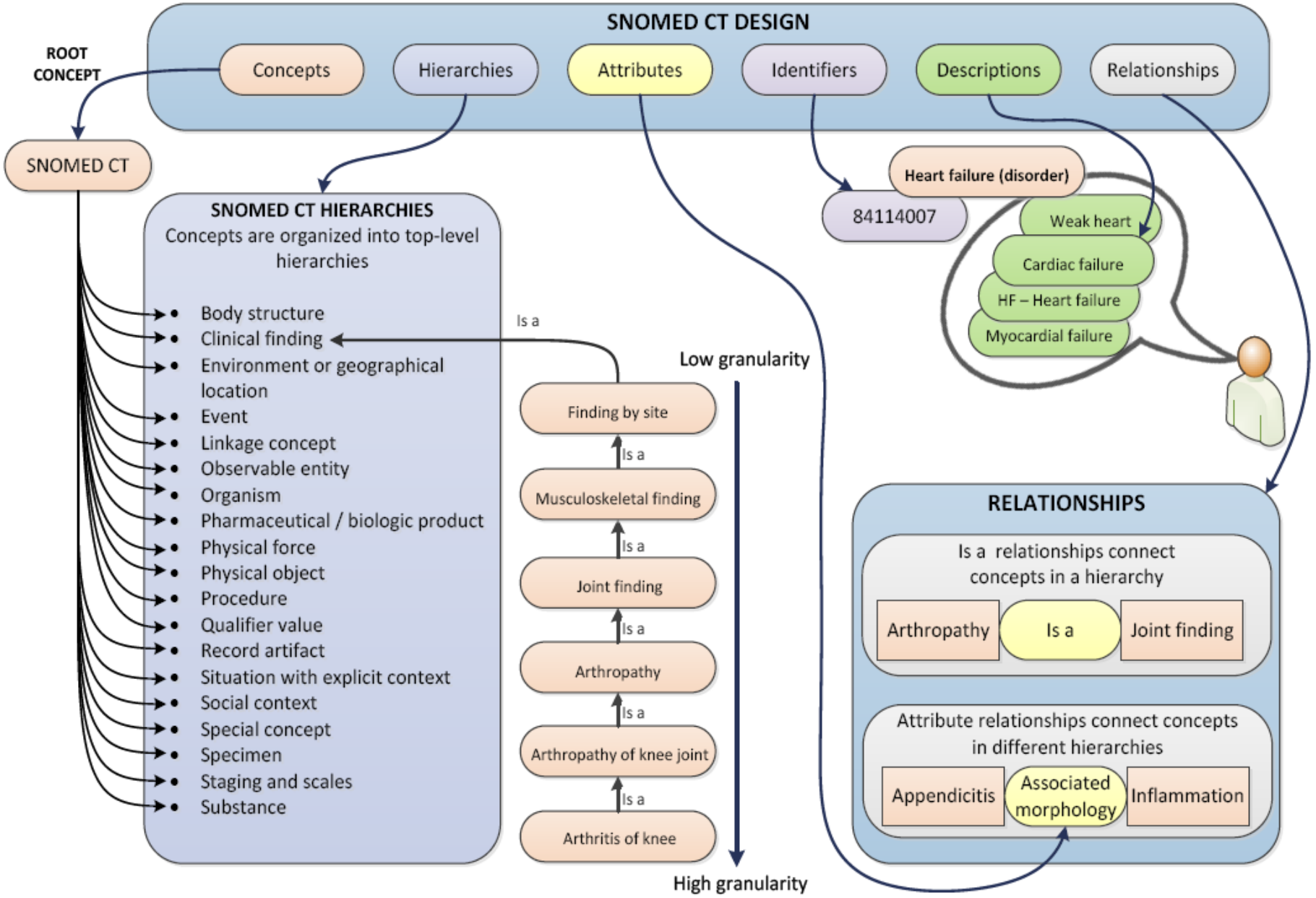

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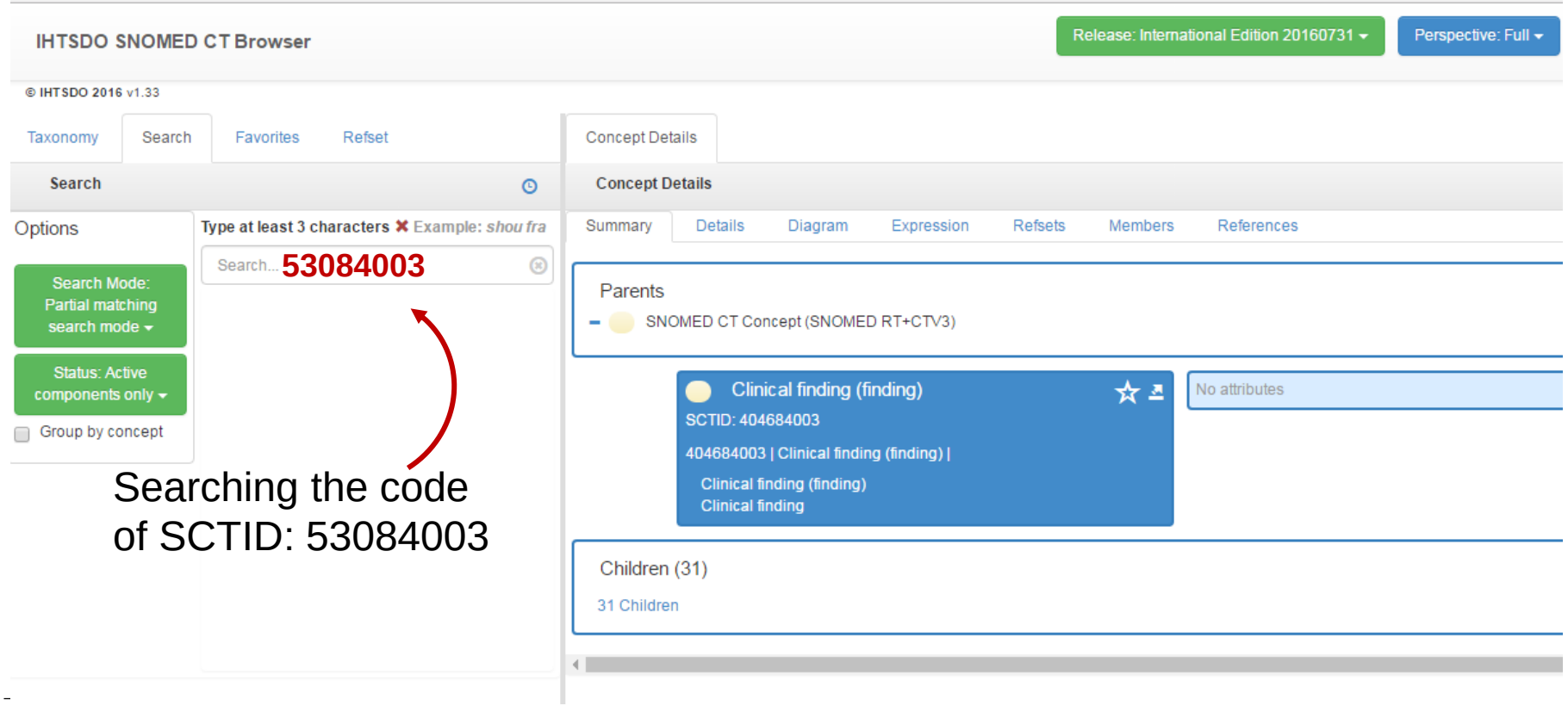
IHTSDO SNOMED CT BROWSER

- The IHTSDO SNOMED CT Browser provides ways to browse and search SNOMED CT. The browser has been implemented by the IHTSDO and its development partners (http://browser.ihtsdotools.org)



Concept Details

Concept Details

Summary | Details | Diagram | Expression | Refsets | Members | References

Parents

- Bacterial lower respiratory infection (disorder)
- Infective pneumonia (disorder)

Bacterial pneumonia (disorder)

SCTID: 53084003

53084003 | Bacterial pneumonia (disorder) |

Bacterial pneumonia
Bacterial pneumonia (disorder)

Pathological process → Infectious process
Associated morphology → Inflammation and consolidation
Finding site → Lung structure
Causative agent → Superkingdom Bacteria

Children (14)

- Bacterial pneumonia associated with acquired immunodeficiency syndrome (disorder)
- Bacterial pneumonia co-occurrent with human immunodeficiency virus infection (disorder)
- Bronchopneumonia caused by bacteria (disorder)
- Congenital bacterial pneumonia (disorder)
- Healthcare associated bacterial pneumonia (disorder)
- Pneumonia caused by aerobic bacteria (disorder)
- Pneumonia caused by anaerobic bacteria (disorder)
- Pneumonia caused by Gram negative bacteria (disorder)

Concept Details

Concept Details

Summary | Details | Diagram | Expression | Refsets | Members | References

≡ Bacterial pneumonia (disorder)

SCTID: 53084003 , Fully defined , Active . Descendants count, Stated: 2 concepts, Inferred: 76 concepts.

United States of America English language reference set

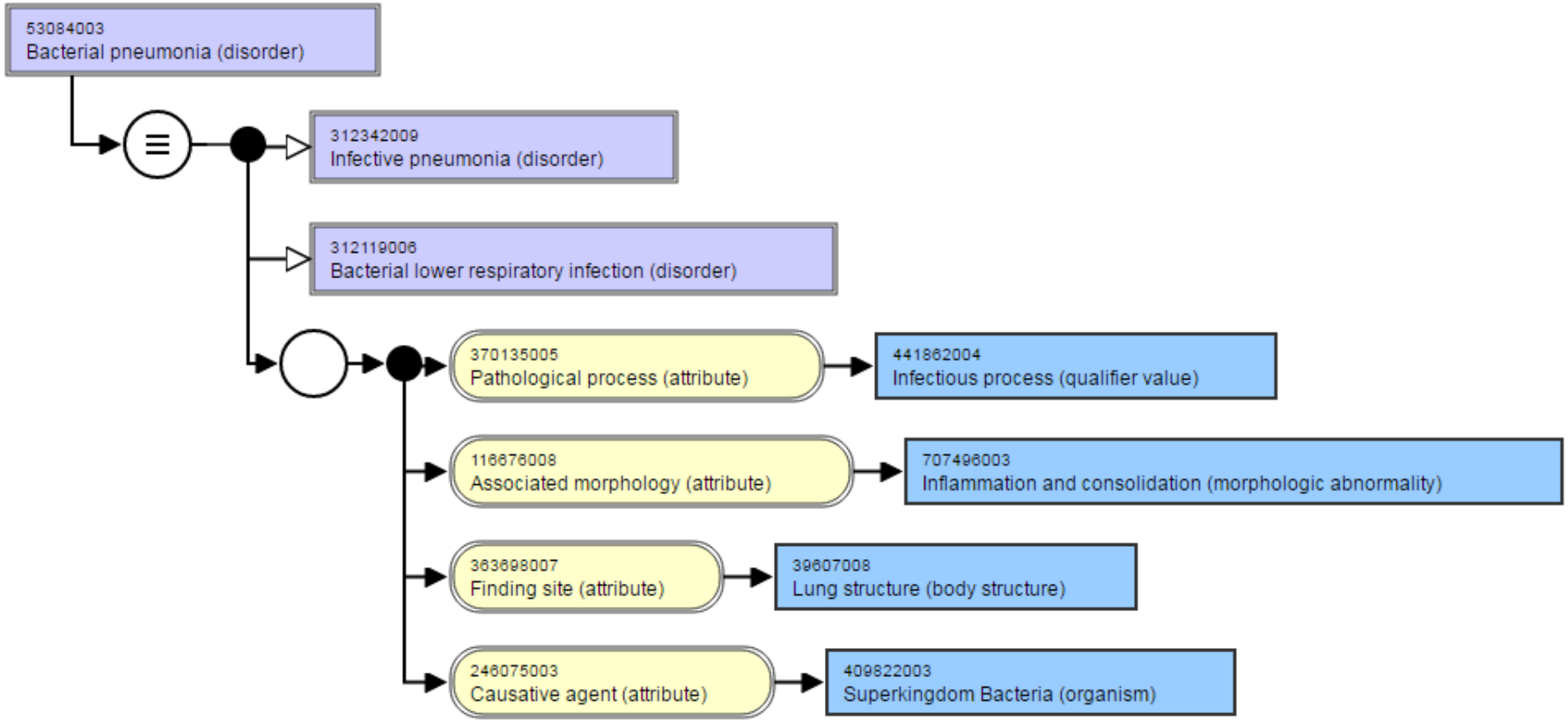
Term	Acceptability (US)
F ☆ Bacterial pneumonia (disorder)	Preferred
S ★ Bacterial pneumonia	Preferred

Type	Destination	Group	CharType
Is a (attribute)	≡ Infective pneumonia (disorder)	0	Inferred
Is a (attribute)	≡ Bacterial lower respiratory infection (disorder)	0	Inferred
Pathological process (attribute)	Infectious process (qualifier value)	1	Inferred
Associated morphology (attribute)	Inflammation and consolidation (morphologic abnormality)	1	Inferred
Finding site (attribute)	Lung structure (body structure)	1	Inferred
Causative agent (attribute)	Superkingdom Bacteria (organism)	1	Inferred

No additional relationships

SNOMED REPRESANTATION EXAMPLES

- Diagrams of concept details-details of SCTID: 53084003 (Bacterial pneumonia-disorder)



SNOMED REPRESANTATION EXAMPLES

- Expression of SCTID: 53084003 (Bacterial pneumonia-disorder)

Concept Details

Concept Details

Summary | Details | Diagram | Expression | Refsets | Members | References

Pre-coordinated Expression (*)

```
53084003 |Bacterial pneumonia (disorder)|
```

Expression from Stated Concept Definition (*)

```
=== 64572001 |Disease (disorder)| :
            { 370135005 |Pathological process (attribute)| = 441862004 |Infectious process (qualifier value)|,
              116676008 |Associated morphology (attribute)| = 707496003 |Inflammation and consolidation (morphologic abnormality)|,
              363698007 |Finding site (attribute)| = 39607008 |Lung structure (body structure)|,
              246075003 |Causative agent (attribute)| = 409822003 |Superkingdom Bacteria (organism)| }
```

Expression from Inferred Concept Definition (*)

```
=== 312342009 |Infective pneumonia (disorder)| +
    312119006 |Bacterial lower respiratory infection (disorder)| :
            { 370135005 |Pathological process (attribute)| = 441862004 |Infectious process (qualifier value)|,
              116676008 |Associated morphology (attribute)| = 707496003 |Inflammation and consolidation (morphologic abnormality)|,
              363698007 |Finding site (attribute)| = 39607008 |Lung structure (body structure)|,
              246075003 |Causative agent (attribute)| = 409822003 |Superkingdom Bacteria (organism)| }
```

ICD vs SNOMED CT

- SNOMED CT is a clinical terminology designed to capture and represent patient data for clinical purposes. ICD is an internationally used medical classification system which is used to assign diagnostic codes.
- SNOMED CT enables information input into an EHR system during the course of patient care, while ICD facilitates information retrieval, or output for higher level abstraction of medical data.
- SNOMED CT describes and defines clinical information for primary data purposes. ICD aggregates and categorises clinical information for secondary data purposes.

ICD vs SNOMED CT

SNOMED-CT Concept ID **	SNOMED-CT Concept Description	ICD-10-CM Code	ICD-10-CM Code Description
11530004	Brittle diabetes	E10.9	Type 1 diabetes mellitus without complication
190371008	Type I diabetes mellitus - poor control	E10.9	Type 1 diabetes mellitus without complication
237619009	Diabetes-deafness syndrome maternally transmitted	E13.9	Other specified diabetes mellitus without complications
237613005	Hyperproinsulinemia	E13.9	Other specified diabetes mellitus without complications
83728000	Polyglandular autoimmune syndrome, type 2	E13.9	Other specified diabetes mellitus without complications
91352004	Diabetes mellitus due to structurally abnormal insulin	E13.9	Other specified diabetes mellitus without complications
123763000	Houssay's syndrome	E13.9	Other specified diabetes mellitus without complications

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SCENARIOS FOR USE OF ICD AND SNOMED CT

Use case for ***classification*** based on ICD:

- ***I have a record.*** Everything in the record needs to be assigned ***the right code*** in a classification system.
- Not everything is in the classification system, therefore "Not Otherwise Specified" (NOS) and "Not Elsewhere Classified" (NEC) codes are necessary and meaningful.
- Supports consistent administrative reporting and financial transactions.

Use case for ***clinical terminology*** based on SNOMED CT:

- ***I have a patient.*** I can document everything that is relevant, and my EHR system will attach codes to much of it ***(but not all)***.
- NOS and NEC are meaningless.
- Supports semantic interoperability, decision support, care of individual patients, and population health management.

ANATOMICAL THERAPEUTIC CHEMICAL (ATC) CLASSIFICATION SYSTEM

- In the Anatomical Therapeutic Chemical (ATC) classification system, the active substances are divided into different groups according to the organ or system on which they act and their therapeutic, pharmacological and chemical properties.
- Drugs are classified in groups at five different levels.

A	Alimentary tract and metabolism (1st level, anatomical main group)
A10	Drugs used in diabetes (2nd level, therapeutic subgroup)
A10B	Blood glucose lowering drugs, excl. insulins (3rd level, pharmacological subgroup)
A10BA	Biguanides (4th level, chemical subgroup)
A10BA02	metformin ← ATC name (5th level, chemical substance)

ATC code →

INTERNATIONAL NON-PROPRIETARY NAMES (INN)

- In the identification of pharmaceutical substances or active pharmaceutical ingredients (ATC level name), International non-proprietary names (INN) is preferred.
- Each INN is a unique name that is globally recognized and is public property. This is also known as a generic name. If INN names are not assigned, USAN (United States Adopted Name) or BAN (British Approved Name) names are usually chosen.

ATC code	N02BE01
ATC name	paracetamol
INN	paracetamol (en), paracétamol (fr) etc.
BAN	paracetamol
USAN	acetaminophen

DEFINED DAILY DOSE (DDD)

- The basic definition of the Defined Daily Dose (DDD) is a statistical measure of drug consumption, defined by the WHO.
- DDD is a unit of measurement and does not necessarily reflect the recommended or prescribed daily dose.
- The ATC system also includes DDDs for many drugs. A DDD will only be assigned for drugs that already have an ATC code.
- The main purpose of the ATC/DDD system is as a tool for presenting drug utilization statistics.
- In Germany, DIMDI has issued the official version of the ATC classification with DDD since 2004.

EXAMPLES FOR ATC/DDD

ATC code	ATC level name (INN/generic name)	DDD	Unit	Adm.route
A10BH06	gemigliptin	50	mg	O
A10BX09	dapagliflozin	10	mg	O
A11CC05	colecalciferol	20	mcg	O
G03XB02	ulipristal	5	mg	O
G04BD12	mirabegron	50	mg	O
H01AB01	thyrotropin alfa	0.9	mg	P
H01CB05	pasireotide	1.2	mg	P
J01DI02	ceftaroline fosamil	1.2	g	P
J04AK05	bedaquiline	86	mg	O
L04AA31	teriflunomide	14	mg	O
N03AX22	perampanel	8	mg	O
N07XX08	tafamidis	20	mg	O
R03BB05	aclidinium bromide [1)]	0.644	mg	Inhal powder
R03BB06	glycopyrronium bromide [2)]	44	mcg	Inhal powder
R05CB16	mannitol	0.8	g	Inhal powder
R07AX02	ivacaftor	0.3	g	O

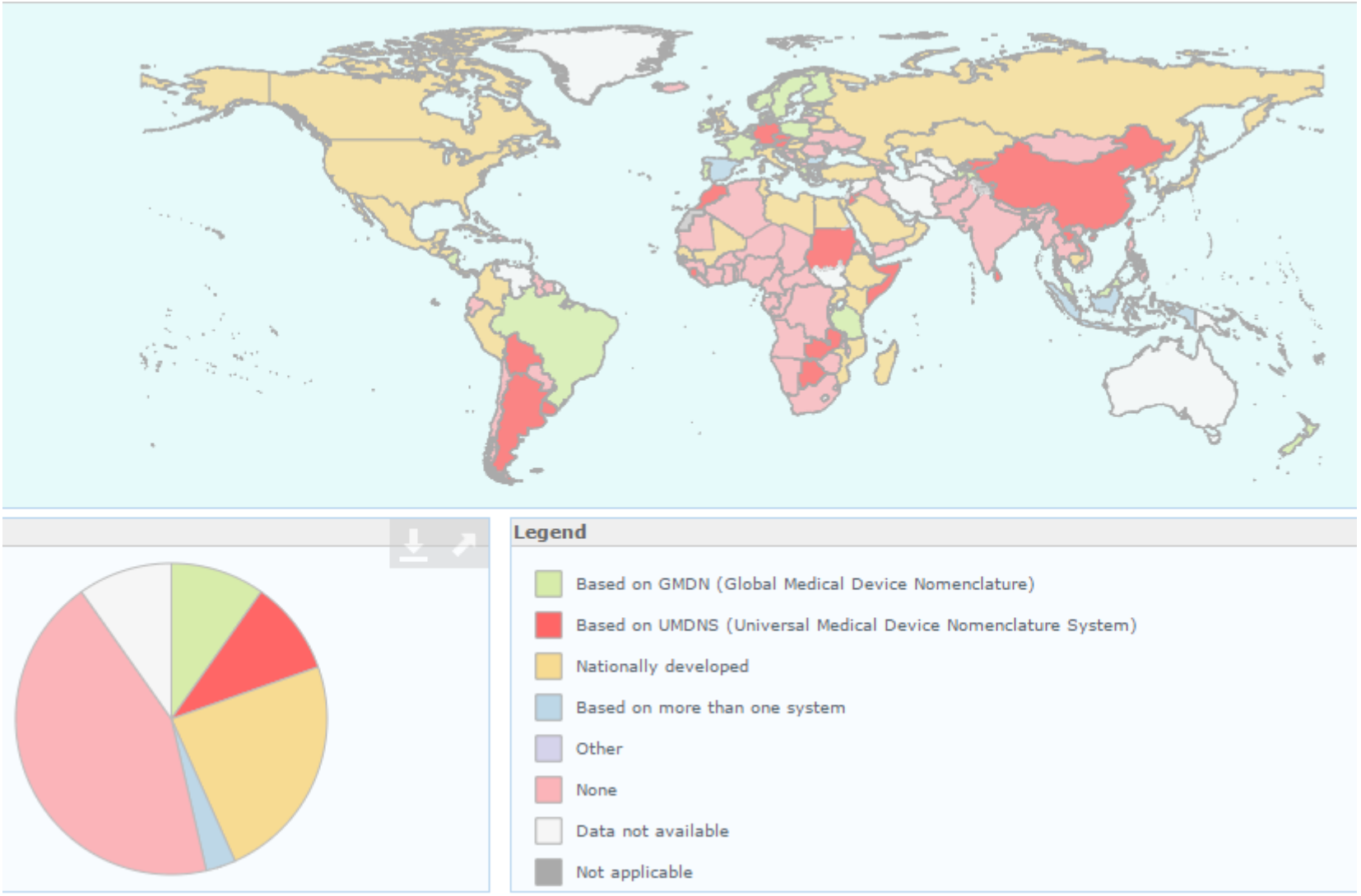
Oral

Parenteral (injectable)

UNIVERSAL MEDICAL DEVICE NOMENCLATURE SYSTEM (UMDNS)

- UMDNS is a standard, free of charge, monthly updated, international nomenclature and computer coding system to manage medical devices.
- UMDNS is the worldwide nomenclature that has been officially adopted by many nations. Related dataset includes 30,000 device manufacturer/supplier/servicer company names and their associated codes.
- Global Medical Device Nomenclature (GMDN) is another type of medical device nomenclature.

UMDNS AND OTHER MEDICAL DEVICE NOMENCLATURES



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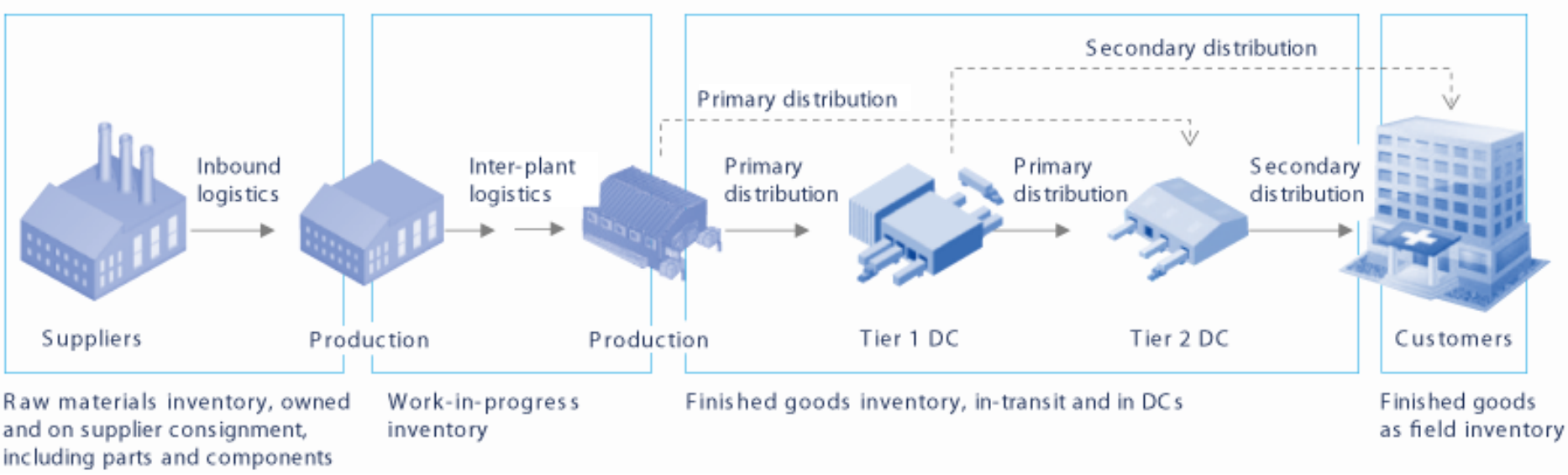
UNIVERSAL MEDICAL DEVICE NOMENCLATURE SYSTEM (UMDNS)

- UMDNS facilitates identifying, processing, filing, storing, retrieving, transferring, and communicating data about medical devices.
- The nomenclature is used in ranging from hospital inventory to national agency medical device regulatory systems and from procurement to medical device databases.



UNIVERSAL MEDICAL DEVICE NOMENCLATURE SYSTEM (UMDNS)

- UMDNS developed by ECRI Institute, a nonprofit organization (formerly the Emergency Care Research Institute).
- A UMDNS code is unique 5-digit numeric code/identifier corresponding to each preferred term.
- Assigned randomly and sequentially.
- Codes intentionally do not carry inherent meaning.
- Examples;

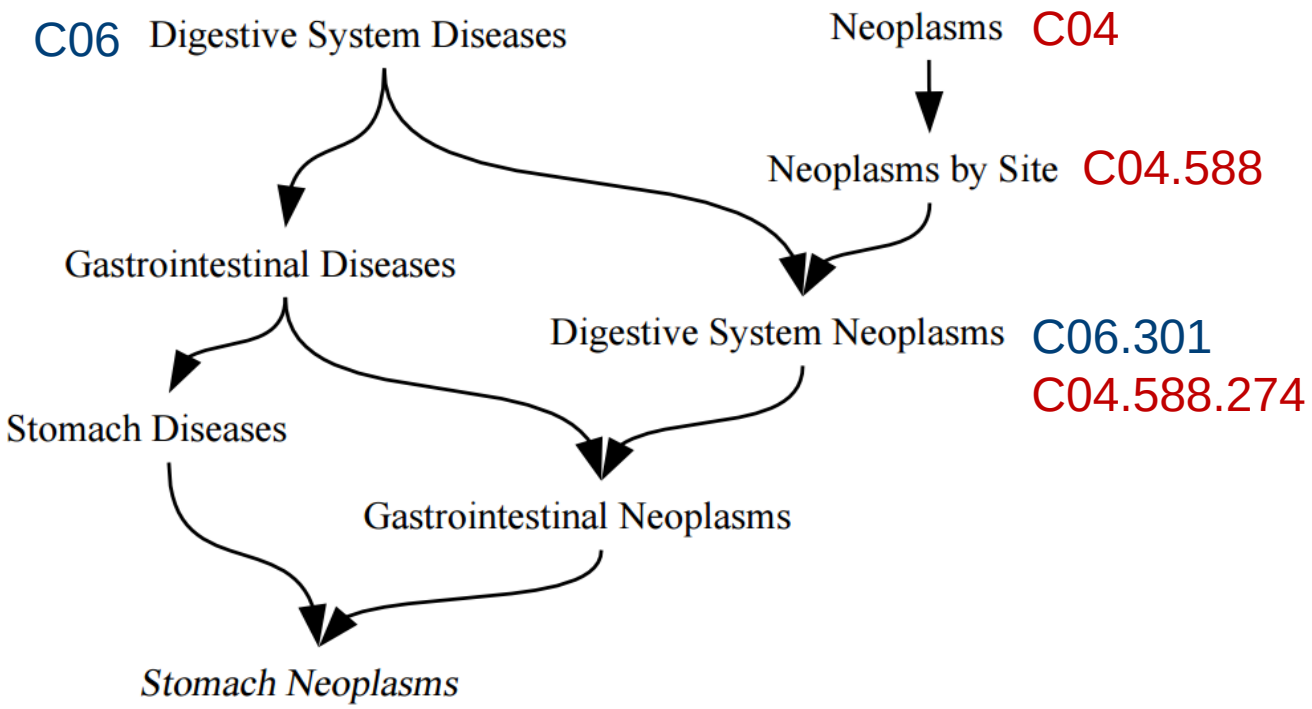
18504 Defibrillator/Cardioverter/Pacemakers, Implantable
20376 Defibrillator/Cardioverter/Pacemakers, Implantable, Resynchronization
17577 Testers, Implantable Defibrillator/Cardioverter

MEDICAL SUBJECT HEADINGS (MESH)

- MeSH (by U.S. National Library of Medicine, NHL) is a comprehensive controlled vocabulary for the purpose of indexing journal articles and books in the life sciences. It serves as a thesaurus that facilitates searching.
- The MeSH thesaurus is used by NLM for indexing articles from 5,400 of the world's leading biomedical journals for the MEDLINE®/PubMED® database, and NLM-produced cataloging database.
- It consists of sets of terms naming descriptors in a hierarchical structure that permits searching at various levels of specificity.

BASIC TYPES OF THE MeSH RECORD

- A given descriptor may appear at several locations in the hierarchical tree.
- The tree locations carry systematic labels known as tree numbers, and consequently one descriptor can carry several tree numbers.



BASIC TYPES OF THE MeSH RECORD

All MeSH Categories
Diseases Category
Neoplasms
Neoplasms by Site
Digestive System Neoplasms
Biliary Tract Neoplasms
Bile Duct Neoplasms +
Gallbladder Neoplasms
Gastrointestinal Neoplasms
Esophageal Neoplasms
Intestinal Neoplasms +
Stomach Neoplasms
Liver Neoplasms
Adenoma, Liver Cell
Carcinoma, Hepatocellular
Liver Neoplasms, Experimental
Pancreatic Neoplasms
Adenoma, Islet Cell +
Carcinoma, Islet Cell +
Carcinoma, Pancreatic Ductal
Peritoneal Neoplasms

C04
C04.588
C04.588.274

All MeSH Categories
Diseases Category
Digestive System Diseases
Digestive System Neoplasms
Biliary Tract Neoplasms
Bile Duct Neoplasms +
Gallbladder Neoplasms
Gastrointestinal Neoplasms
Esophageal Neoplasms
Gastrointestinal Stromal Tumors
Intestinal Neoplasms +
Stomach Neoplasms
Zollinger-Ellison Syndrome
Liver Neoplasms
Adenoma, Liver Cell
Carcinoma, Hepatocellular
Liver Neoplasms, Experimental
Pancreatic Neoplasms
Adenoma, Islet Cell +
Carcinoma, Islet Cell +
Carcinoma, Pancreatic Ductal
Peritoneal Neoplasms

C06.301
C06.301

https://www.ncbi.nlm.nih.gov/mesh/?term=digestive+system+neoplasms

BASIC TYPES OF THE MeSH RECORD

Digestive System Neoplasms **Definition**

Tumors or cancer of the DIGESTIVE SYSTEM.
Year introduced: 1980

https://www.ncbi.nlm.nih.gov/mesh/?term=digestive+system+neoplasms

PubMed search builder options

Subheadings: **Qualifiers=Subheadings**

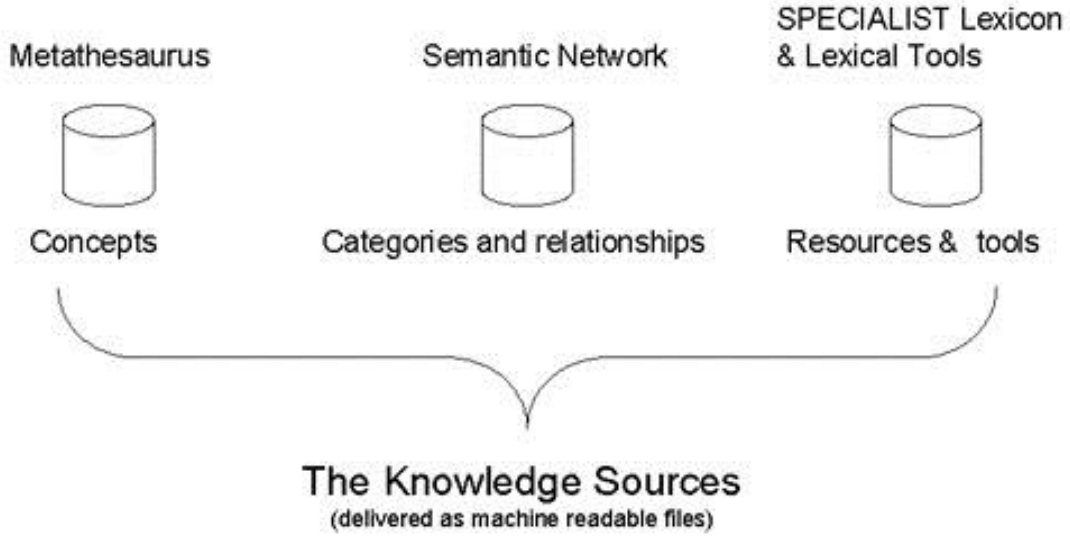
- analysis
- anatomy and histology
- blood
- blood supply
- cerebrospinal fluid
- chemical synthesis
- chemically induced
- chemistry
- classification
- complications
- congenital
- cytology
- diagnosis
- diet therapy
- drug effects
- drug therapy
- economics
- embryology
- enzymology
- epidemiology
- ethnology
- etiology
- genetics
- history
- immunology
- legislation and jurisprudence
- metabolism
- microbiology
- mortality
- nursing
- organization and administration
- parasitology
- pathology
- physiology
- physiopathology
- prevention and control
- psychology
- radiography
- radionuclide imaging
- radiotherapy
- rehabilitation
- secondary
- secretion
- statistics and numerical data
- surgery
- therapy
- transmission
- transplantation
- ultrasonography
- ultrastructure
- urine
- veterinary
- virology

- Restrict to MeSH Major Topic.
- Do not include MeSH terms found below this term in the MeSH hierarchy.

Tree Number(s): C04.588.274, C06.301 **Tree Numbers**

UNIFIED MEDICAL LANGUAGE SYSTEM (UMLS)

- The UMLS is a set of files and software that brings together many health and biomedical vocabularies and standards to enable interoperability between computer systems. It was built by US National Library of Medicine (NLM) in 1986.
- We can use the UMLS to enhance or develop applications, such as EHR systems, classification tools, dictionaries and language translators.
- The UMLS has three tools (knowledge sources); metathesaurus, semantic network, and SPECIALIST Lexicon and Lexical Tools.



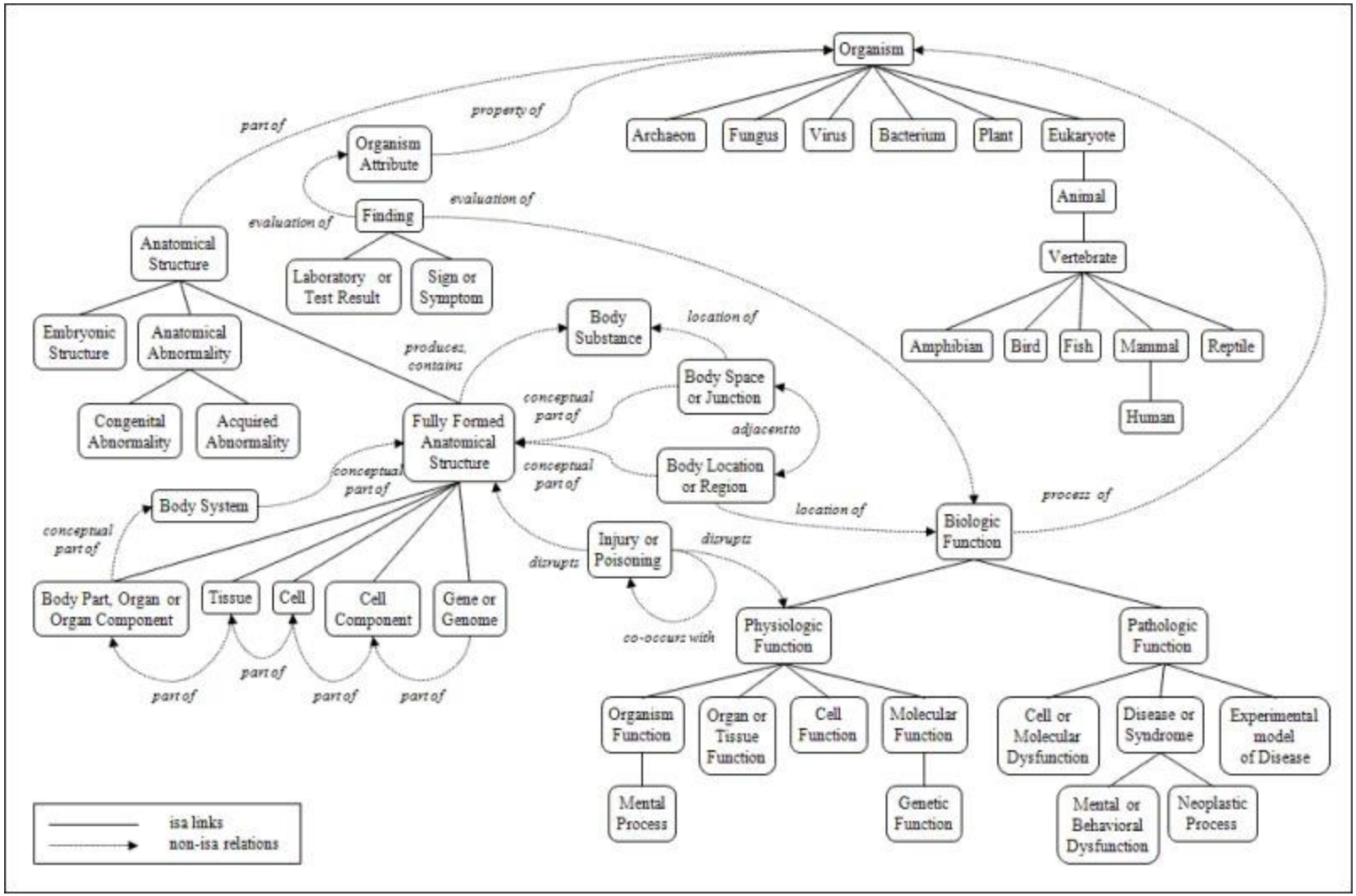
UNIFIED MEDICAL LANGUAGE SYSTEM (UMLS)

- The UMLS Metathesaurus is the biggest component.
- It is a large biomedical thesaurus linking nearly 200 different vocabularies -including CPT, ICD-10-CM, LOINC, MeSH, RxNorm, ICPC, WHO Adverse Drug Reaction Terminology and SNOMED CT- into a common structure.
- The 2014 edition of the Metathesaurus included 2.9 million concepts and 11.6 million unique concept names.
- The Metathesaurus identifies useful relationships between concepts and preserves the meanings, concept names, and relationships from each vocabulary.

UNIFIED MEDICAL LANGUAGE SYSTEM (UMLS)

- UMLS Semantic Network includes broad categories (semantic types) and their relationships (semantic relations).
- The semantic types are the nodes in the network, and the relationships between them are the links.
- There are major groupings of semantic types for organisms, anatomical structures, biologic function, chemicals, events, physical objects, and concepts or ideas.
- The UMLS semantic network reduces the complexity of the Metathesaurus by grouping concepts according to the semantic types that have been assigned to them.

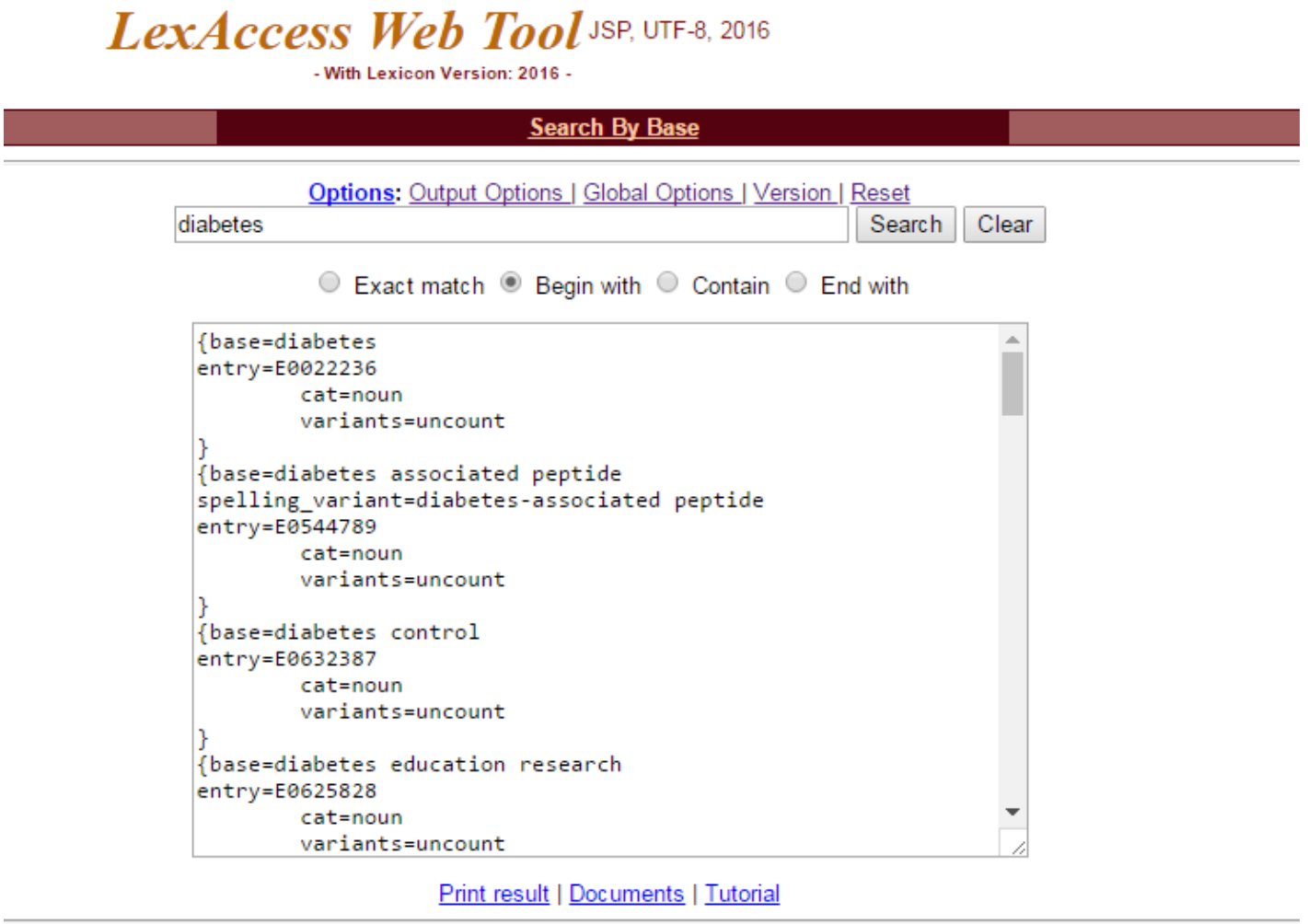
UNIFIED MEDICAL LANGUAGE SYSTEM (UMLS)



UNIFIED MEDICAL LANGUAGE SYSTEM (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 about common English vocabulary and biomedical terms found in MEDLINE and the UMLS Metathesaurus. It also includes words that do not appear in the Metathesaurus, as well as 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.
- A set of Java programs use the lexicon (e.g. LexAccess) to work through the variations in biomedical texts by relating words.

UNIFIED MEDICAL LANGUAGE SYSTEM (UMLS)



https://lsg2.nlm.nih.gov/webapps/WebLexAccess.2016/jsp/setMenu.jsp

REFERENCES

- Enrico Coiera. Guide to Health Informatics. 3rd Ed, 2015.
- Tim Benson. Principles of Health Interoperability HL7 and SNOMED. 2010.
- Marion J. Ball et al. Nursing Informatics, Where Technology and Caring Meet. 4th Ed, 2011.
- Andreas Holzinger. Biomedical Informatics, Discovering Knowledge in Big Data. 2014.
- Edward H. Shortliffe, James J. Cimino. Biomedical Informatics, Computer Applications in Health Care and Biomedicine. 4th Ed, 2014.
- J.H.van Bemmel, M.A.Musen. Handbook of Medical Informatics. 1997.
- Nanette B. Sayles . Health Information Management Technology, An Applied Approach. 4th Ed, 2013.
- World Health Organization. How to Use ICF, A Practical Manuel. Draft, 2013.
- Rosemary Roberts et al. Report of ICD-11. Revision Review, 2015.
- World Health Organization. Family of International Classifications. June 2004.
- Medical terminologies, nomenclatures, coding and classification systems: an introduction. http://www.openclinical.org/medicalterminologies.html

REFERENCES: WEBSITES AND BROWSERS

- DIMDI, Klassifikationen, Terminologien und Standards im Gesundheitswesen, http://www.dimdi.de/static/de/klassi/index.htm
- ICD-10 Version 2016, http://apps.who.int/classifications/icd10/browse/2016/en
- ICD-10 GM Version 2016, http://www.dimdi.de/static/de/klassi/icd-10-gm/kodesuche/onlinefassungen/htmlgm2016/index.htm
- ICF Browser, http://apps.who.int/classifications/icfbrowser/
- ATC/DDD Index 2016, http://www.whocc.no/atc_ddd_index/
- IHTSDO SNOMED CT Browser, http://browser.ihtsdotools.org/
- LOINC for Regenstrief, https://search.loinc.org/
- OPS2017,https://www.dimdi.de/static/de/klassi/ops/kodesuche/onlinefassungen/opshtml2017/index.htm
- Medical Subject Headings, https://www.nlm.nih.gov/mesh/
- Unified Medical Language System (UMLS), https://www.nlm.nih.gov/research/umls/

REFERENCES: BOOKS FOR ICD STANDARDS

- International Classification of Diseases for Oncology (ICD-O)
- International Classification of Procedures in Medicine (ICPM) Volume 1 and 2
- International Classification of Functioning, Disability and Health (ICF)
- International Classification of Functioning, Disability and Health (ICF-CY)