



# PCSI

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NORDE CARPENS 00000

# An Ontology for ICD11 chapter 1 Certain Infectious or Parasitic Diseases

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2022

REYKJAVÍK, 27-30. SEPTEMBER

# An Ontology for ICD11 Chapter 1

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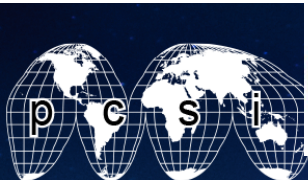
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# Introduction

- 1 Prerequisite : Relation between Casemix and Clinical Coding
- 2. ICD11 Chapter 1 :Certain Infectious or Parasitic Diseases
- 3 . Formal Ontology
- 4. Methods
  - First step :Lexical mapping
  - Second step: Meaning matching
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# Where we are to day

- 1 The differences between casemix groupers are not based on the use of different diagnosis coding systems as most of them are based on ICD-10 or ICD-10 XM
- 2 The differences between casemix groupers are based on the different health intervention coding systems. In another way the casemix groupers follow the health intervention coding systems with several countries having none preventing them to develop casemix systems or increasing the cost of the implementation
- .



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# Case mix groupers and procedures

- ICD 9CM and ICD10 CM : HCFA DRG, APDRG, APRDRG, IRDRG, UNU Case mix, Thai DRG.
- ICD 10AM : AN DRG, ARDRG
- WHO-NorDRG Denmark, Estonia, Finland, Iceland, Latvia, Norway, Sweden,
- National procedures LKF (Austria) G DRG (Germany) GHM (France), HRG (UK), KDRG (Korea), DPC (Japan) DBC (Netherlands) HBCs (Hungary) and (Indonesia)



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# is the initial way from clinical data to casemix grouping optimal?

- 1 Initially countries organised with professional coders have decided to code diagnosis and procedures from the medical record in aggregation terminologies coding systems on which the different Casemix groupers have been developed
- 2 In countries and hospitals having chosen to code their medical record with a reference terminology as SNOMED CT using physicians to code a semi automatic mapping is necessary to input the casemix groupers based on aggregation terminologies.



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# Issues challenges for the future

- The information technology innovations since the 80s **CHALLENGE** the initial organisation where professional coders extract from
  - the medical records free texts
  - highly structured and hierarchized aggregation terminology codes.
- **At least 2 options**
  - 1 professional coders extraction using Natural Language Processing
  - 2 Automatic mapping between free texts and Diagnosis and Procedures classifications based
    - explicit definition as ICD11,
    - fully defined Ontology as SNOMED CT Concepts model and Compositional Grammar using Ontology Web Language (OWL)



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# 3 different types of artefacts

- Clinical language in Interface terminologies
- Reference terminologies: ex SNOMED CT

Compromise between bottom up (Terms and Synonyms) and Top down (Fully Specified Names and OWL Ontology)

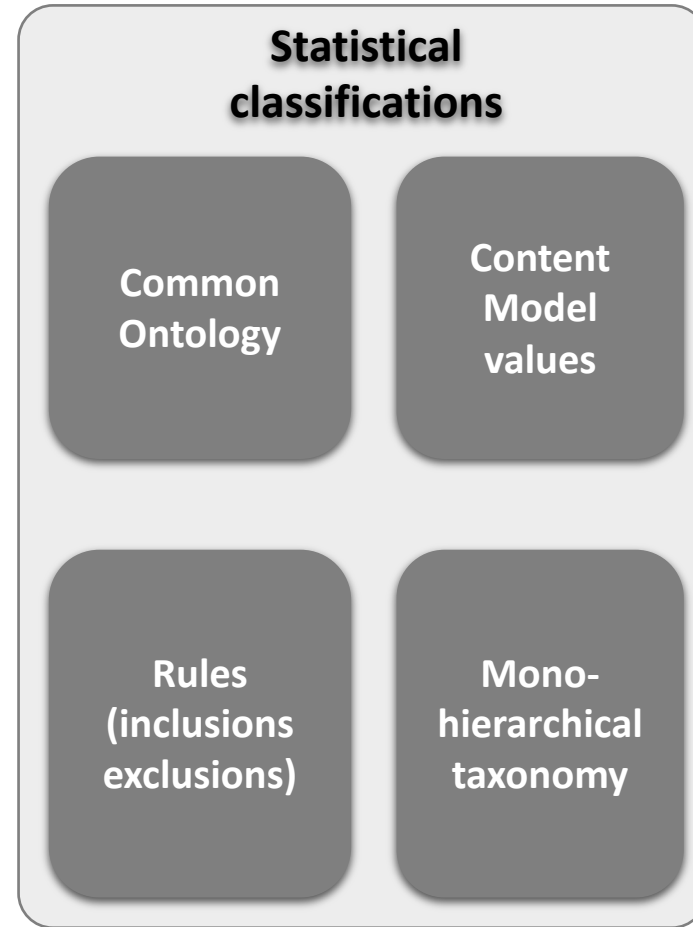
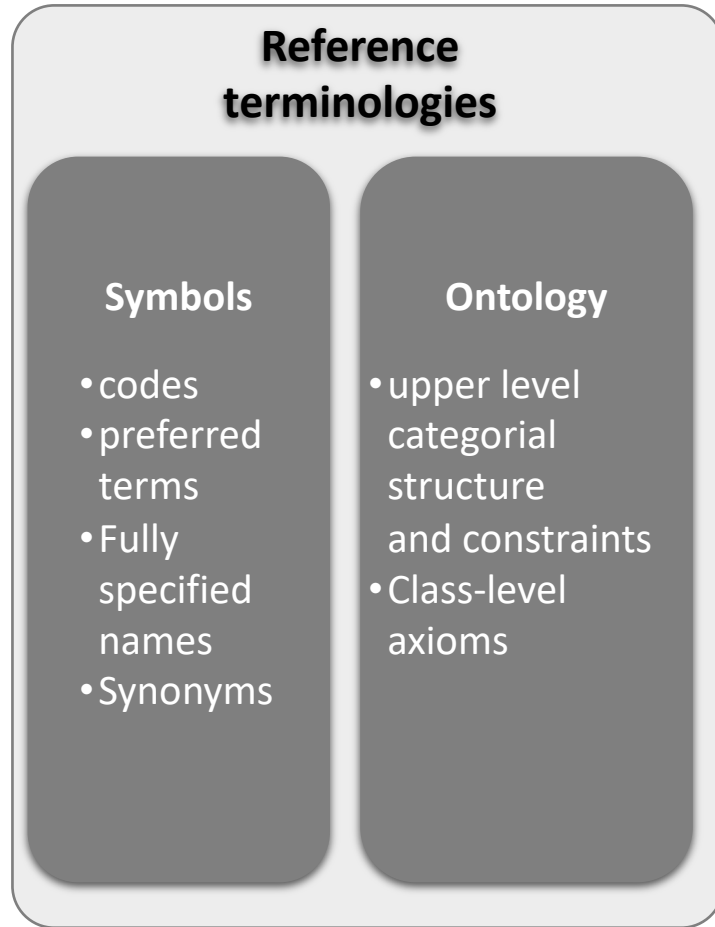
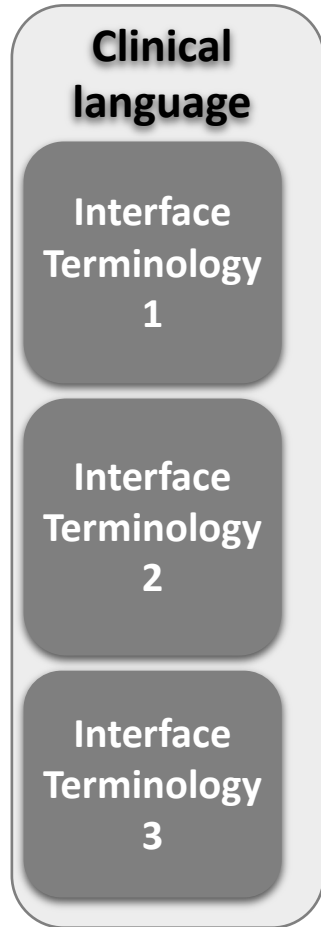
- Statistical classifications or aggregation terminologies: Mix of clinical vocabulary, taxonomy, knowledge and coding rules with meaningless codes as “other” or “unspecified”



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# ICD 11

- Aggregation (statistical) terminology
  - Mix of
    - clinical vocabulary,
    - taxonomy,
    - knowledge and
    - coding rules with meaningless codes as “other” or “unspecified”

And

- Semantic framework (non Formal Ontology)
  - Semantic Categories (13)
  - Textual definitions



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# ICD 11 MMS

- The ICD-11 Mortality Morbidity Statistics (ICD 11-MMS)
- Extracted from the WHO Browser (date: 04 2021).
- The new ICD version approved by WHO World Health Assembly May 2019 to be used for mortality statistics from 2021.
- 28 chapters (1 to 26) plus
  - codes V for Functioning assessment and
  - codes X for Extension codes.
  - It proposes a Browser, a Coding tool and Special View for Infectious agents (lists of infectious agents, notifiable diseases and vaccinable conditions.)
- [icd.who.int](http://icd.who.int)



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# ICD11 Chapter 1

- 1027 codes
- 376 excluded
  - Needed only to insure the exclusivity and exhaustivity of any Classification system or Aggregation terminology as ICD
  - The excluded codes contain the words “other specified” or ”unspecified
  - These are necessary but have no possible ”FORMAL Ontology” meaning
  - The number measures the gap between the clinical information base of casemix and what is really taken into account by the Casemix groupers. It is an indicator of quality
- 651 selected :
- 474 with textual definitions



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# SNOMED CT 2 Components

- SNOMED CT  
*A terminology* – as constituted by “concepts” (entities of lexical meaning), related terms of different types (Fully Specified Names, Preferred Terms, and Synonyms).
- *B Formal ontology* constituted by classes, individuals and formal relations expressed as axioms in "Compositional Grammar" equivalent to EL<sup>++</sup>/OWL-EL – what SNOMED names the "Concept Model", which can be processed by description logics reasoners



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# IHTSDO Browser

Hierarchy (summary,details)  
and DL definition ( diagram and owl expression)

The screenshot displays the IHTSDO SNOMED CT Browser interface. The search bar contains 'mitral valve stenosis', resulting in 32 matches. The results are filtered by language (English) and semantic tag (disorder). The 'Concept Details' panel on the right shows the pre-coordinated expression: `79619009 |Mitral valve stenosis (disorder)|`. It also displays the expression from the stated concept definition and the expression from the inferred concept definition. The interface includes navigation tabs for Taxonomy, Search, Favorites, and Refset, and a search options panel with filters for language, semantic tag, and module.



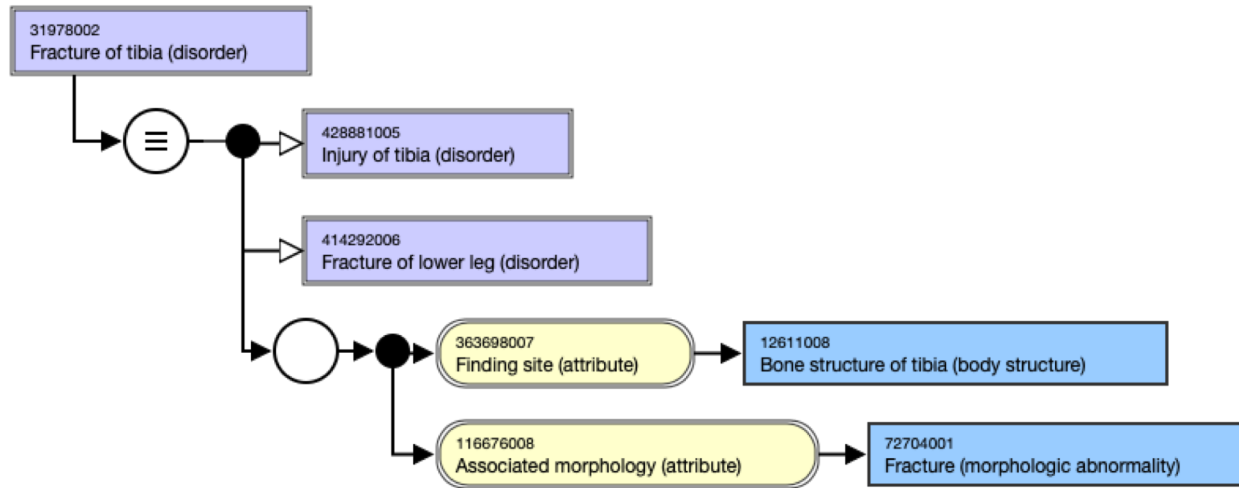
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# Graphic presentation



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# SNOMED CT definitions in Conceptual Grammar (above) and OWL Manchester Syntax (below)

- 31978002 | *Fracture of tibia (disorder)* |  
=== 428881005 | *Injury of tibia (disorder)* | +  
414292006 | *Fracture of lower leg (disorder)* | :  
{ 363698007 | **Finding site (attribute)** | =  
12611008 | *Bone structure of tibia (body structure)* | ,  
116676008 | **Associated morphology (attribute)** | =  
72704001 | *Fracture (morphologic abnormality)* | }
- ‘*Fracture of tibia*’ equivalentTo  
‘*Injury of tibia (disorder)*’ and  
‘*Fracture of lower leg (disorder)*’ and  
**RoleGroup** some  
((‘**Finding site (attribute)**’ some  
‘*Bone structure of tibia (body structure)*’) and  
(‘**Associated morphology (attribute)**’ some  
‘*Fracture (morphologic abnormality)*’))



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# Compare Essential Hypertension SNOMED CT Concept Model (left) Primitive and Fully Defined (Right)

## Essential Hypertension(disorder) Primitive

Has definitional manifestation (attribute) some

*Finding of increased blood pressure (finding) and*

**RoleGroup** some ('**Finding site (attribute)**' some

*'Systemic circulatory system structure (body structure)')*

## Essential Hypertension *Fully Defined*

**RoleGroup** some ('**Finding site (attribute)**' some

*'Systemic circulatory system structure (body structure)')* and  
**'Has interpretation (attribute)'** some

*'Abnormally high (qualifier value)'* and

**'Interprets (attribute)'** some  
**'Blood pressure (observable entity)'** and

**'Pathological process (attribute)'** some

*'Spontaneous (origin) (qualifier value)'*



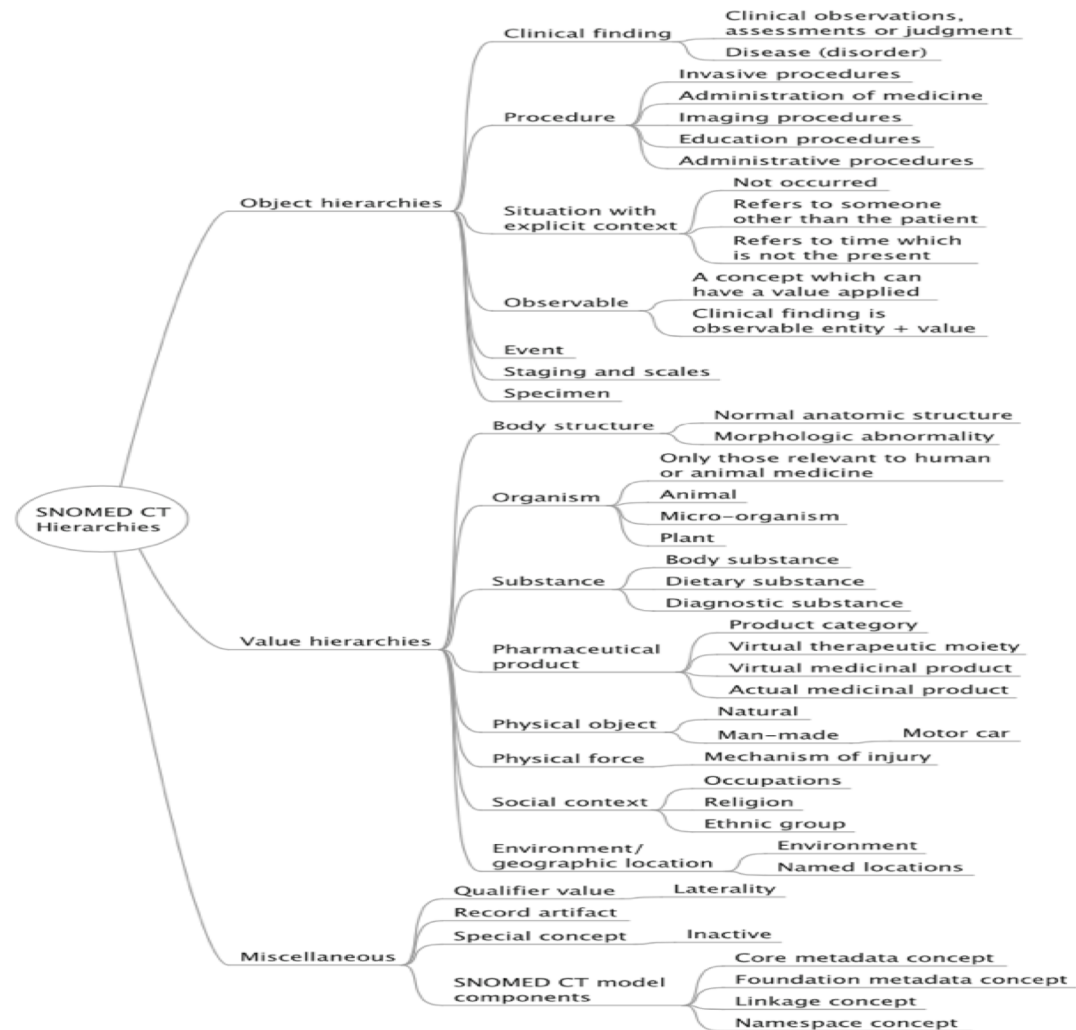
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# SNOMED Model

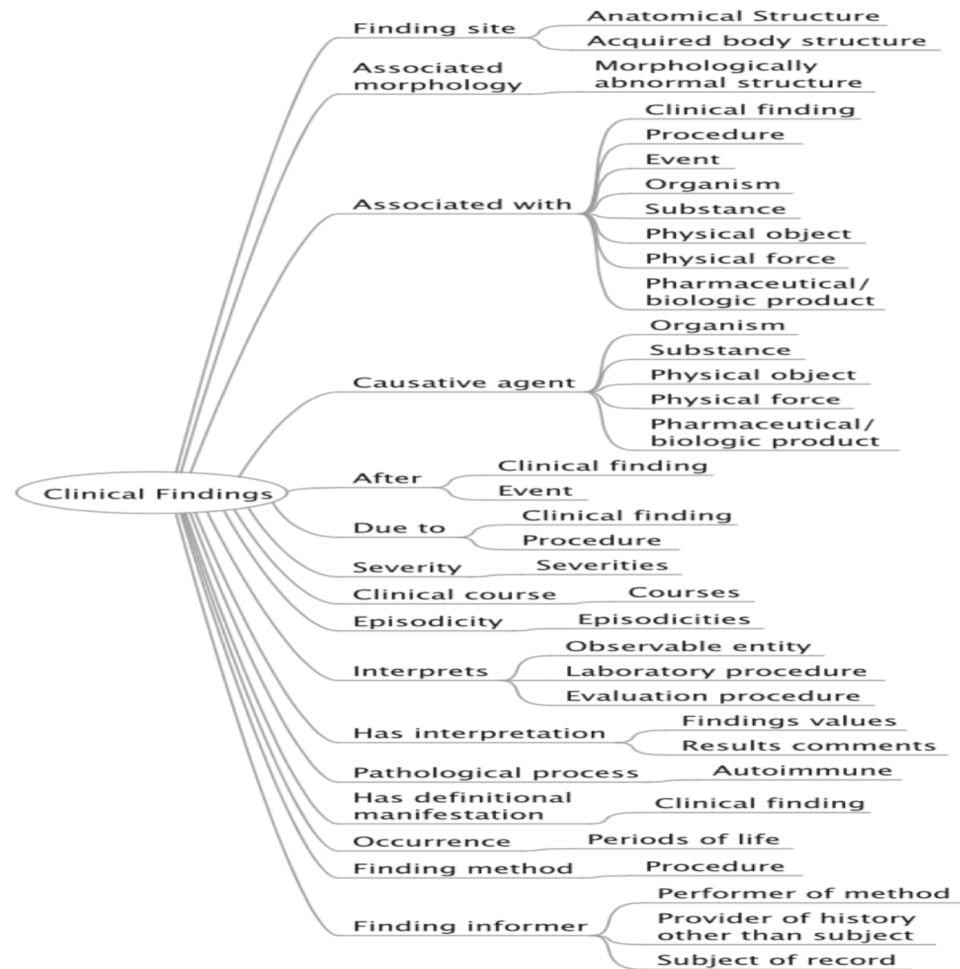


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# Clinical Finding Model



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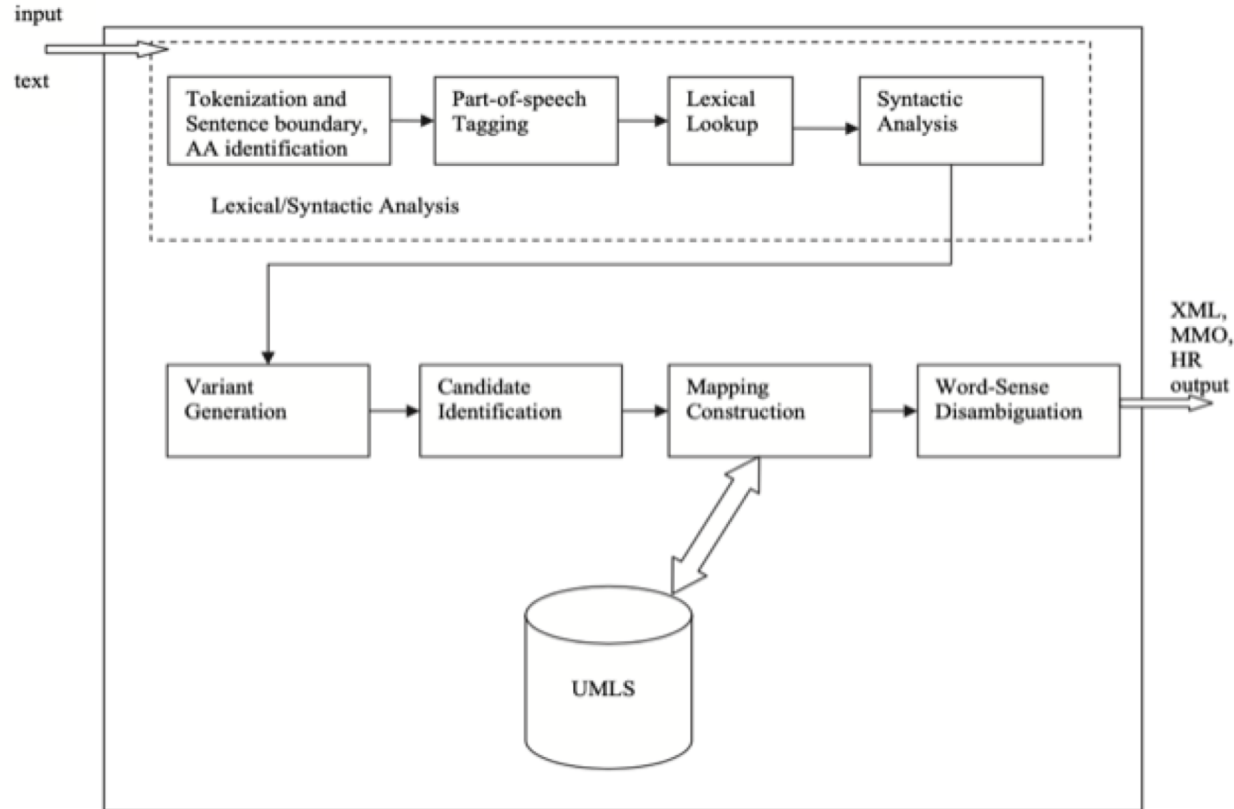


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# Metamap Mapping Processus



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# Metamap parameter options

- Term Processing (-z) forces Metamap to analyze each ICD-11 label as an only post coordinated phrase when the syntactic analysis is proposing 2 separated phrases
- After the Mapping Process with the UMLS terminology data base and the Sense Disambiguation we obtain the Metamap Machin Output (MMo)file
- The MMo gives the score of Lexical Alignment Between 0 and 1000
- We consider 800 as the Alignment threshold



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# Meaning matching

- The SNOMED CT concept model validated to day named FD for Fully Defined
- or
- the SNOMED Grammar provides the tools (attributes and values) to fully define the ICD11 Classes textual definitions lexically map to SNOMED CT concepts NON Fully Defined named NON FD.












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# Color Codes for Textual Definition and Ontology Representation

Attributs	Codes couleurs
116676008 Associated morphology (attribute)	
363698007 Finding site (attribute)	
370135005 Pathological process (attribute)	
246075003 Causative agent (attribute)	
263502005 Clinical course (attribute)	
363713009 Has interpretation (attribute)	
363714003 Interprets (attribute)	
42752001 Due to (attribute)	
255234002 After (attribute)	





# ICD11 textual definition Fully Defined and Full Ontology Representation

Tableau comparatif CIM11 SCT	
Id et Libelle CIM11	1A03 Intestinal infections due to Escherichia coli
Définition CIM11	Any condition of the <b>gastrointestinal system</b> , caused by an <b>infection</b> with the gram-negative bacteria <b>Escherichia coli</b> .
id et libellé SOMED CT	111839008  Intestinal infection caused by Escherichia coli (disorder)
Définition SCT	



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# First step

- Lexical mapping pre-coordinated
  - 615
  - 94%
- Lexical mapping post-coordinated
  - 36
  - 6%
- Lexical mapping total
  - 651
  - 100%



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# 1A03.0

- An **infection** of the **gastrointestinal system**, caused by the gram-negative bacteria **Escherichia coli**. It is *characterised by acute, profuse, watery diarrhoea*. Transmission is by the **faecal-oral route** from contaminated food, water, or fomites. Confirmation is by **identification** of the **Escherichia coli** in a **faecal sample**.

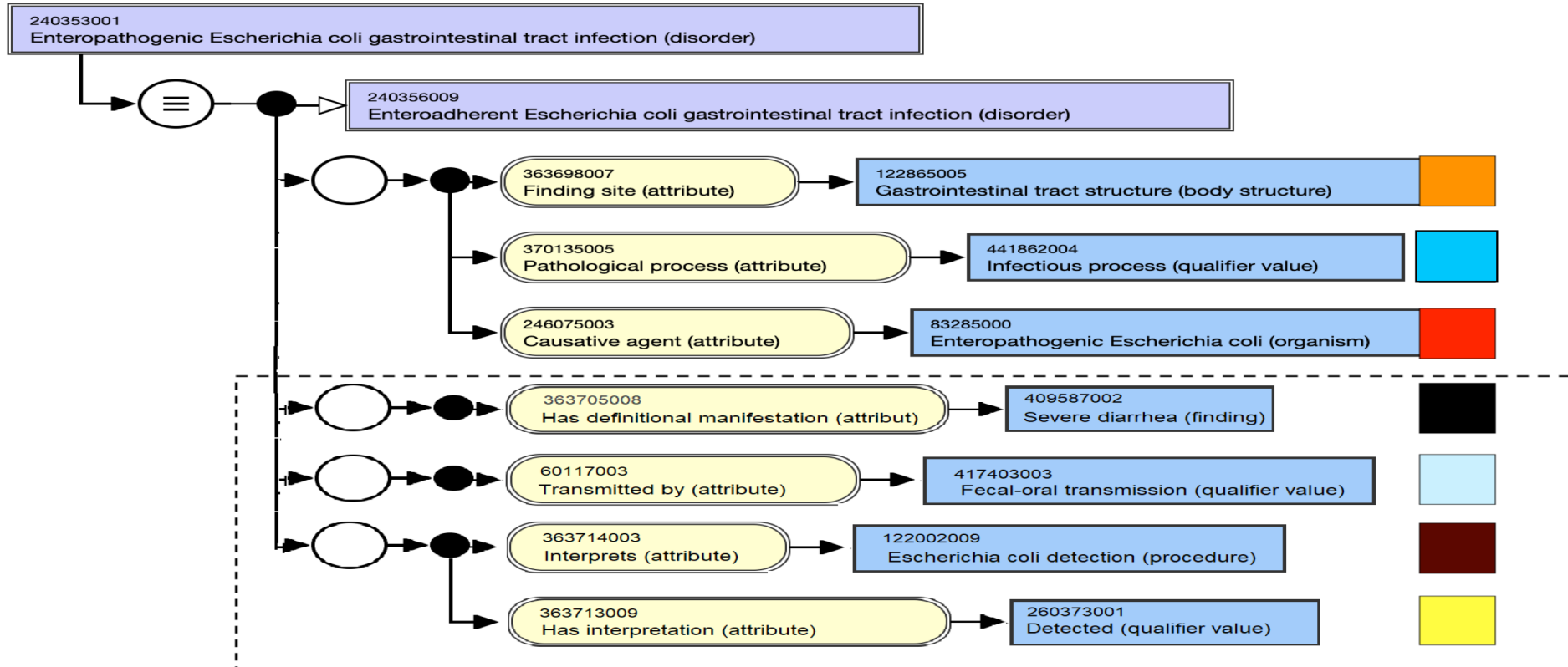


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# 1A03.0



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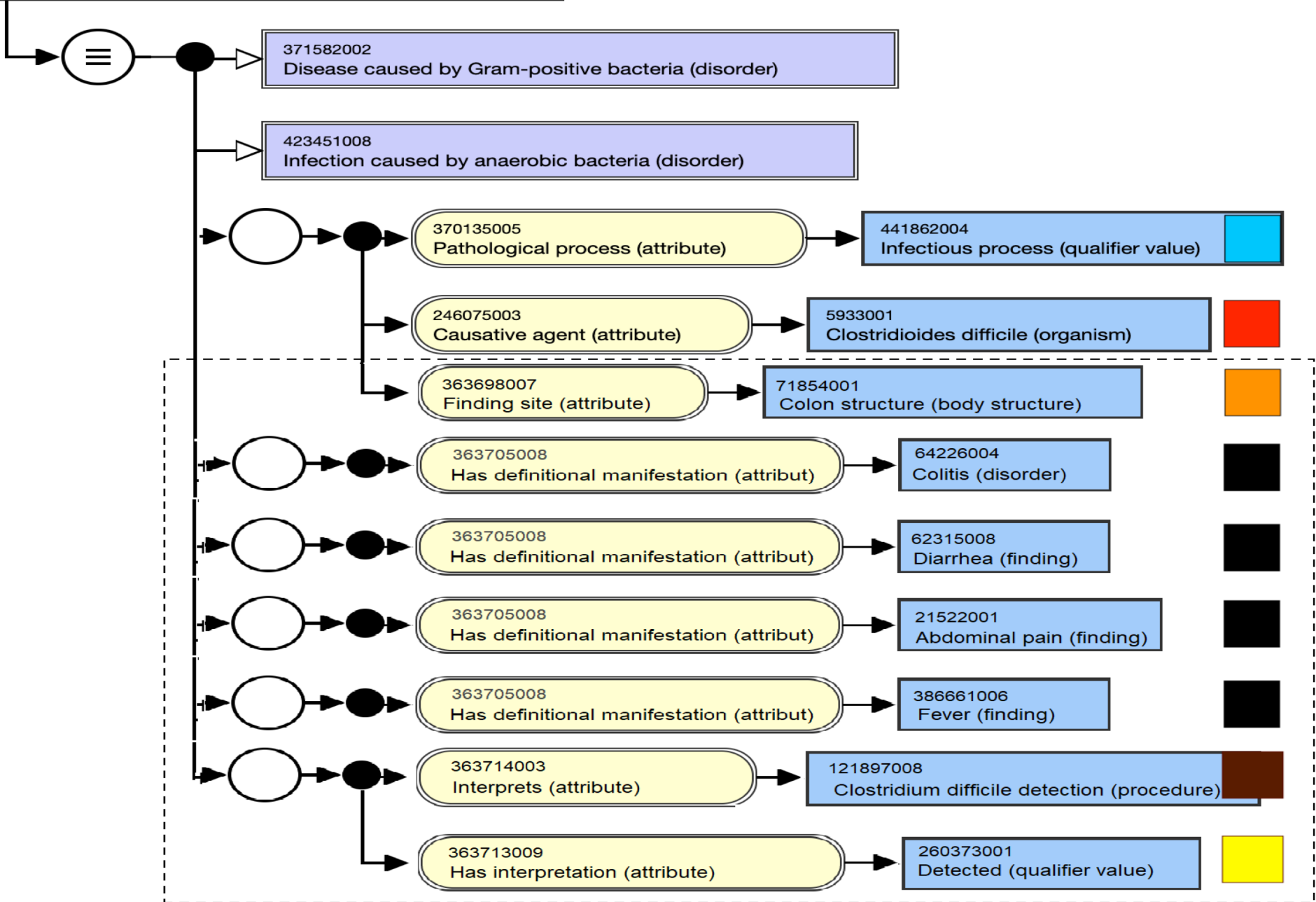
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# 1A04

- A disease of **the colon**, caused by an **infection** with the gram-positive bacteria **Clostridium difficile**. This disease is *characterised by colitis, diarrhoea, abdominal pain, and fever*. Transmission is commonly by direct or indirect contact, or from a disturbance of the normal bacterial flora of the colon. Confirmation is by **identification** of **Clostridium difficile** in a faecal sample.



186431008  
Infection caused by Clostridioides difficile (disorder)



# Second Step

- Meaning matching with SCT Concept model 01/07/2022
  - 500
  - 77 %
- Meaning matching with SCT Compositional Grammar
  - 151
  - 23%
- Meaning matching with both
  - 651
  - 100%



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# ICD 11 SCT FD Meaning Matching

Concepts SCT FD alignés lexicalement sur la définition textuelle CIM 11	Résultat	Pourcentage
<b>1 Représentation Ontologique Complète :</b> Représentations SNOMED FD	500	100% (77 %)
<b>2 Représentation Ontologique Complète :</b> Représentations SNOMED FD Représentation ontologique complète des définitions textuelles de la CIM 11 (par défaut les libellés)	368	74 % (57 %)
<b>3 Représentation Incomplète Mais dans le cas de</b> Représentations SNOMED FD MAIS que l'on peut représenter avec la SCT Grammar disponible dans le browser	122	26% (19 %)
<b>4 Pas de Représentation ni</b> Avec le concept model SCT ni Avec la SCT Grammar disponible dans le browser	0	0 %
Total des Concepts SCT FD alignés lexicalement aux définitions textuelles de la CIM 11	500	100 %
Total des définitions textuelles de la CIM 11 (ou par défaut les Libellés)	651	(100%)



# ICD11 SCT NON FD Meaning Matching

Concepts SCT NON FD alignés lexicalement sur la définition textuelle CIM 11	Résultat	Pourcentage
1 Représentation Ontologique Incomplète : Représentations SNOMED FD	151	100% (23 %)
2 Représentation Incomplète Mais dans le cas de Représentations SNOMED NON FD MAIS que l'on peut représenter avec la SCT Grammar disponible dans le browser	151	100 % (23 %)
Pas de Représentation ni Avec le concept model SCT ni Avec la SCT Grammar disponible dans le browser	0	0 %
Total des Concepts SCT NON FD alignés lexicalement aux définitions textuelles de la CIM 11	151	100 %
Total des définitions textuelles de la CIM 11 (ou par défaut les Libellés)	651	(100%)







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# CONCLUSION

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# Conclusion

- Lexical Alignment ICD 11 Chapter 1 SNOMED CT
  - Total
  - No surprise
- Meaning Matching with actual SNOMED CT authorised concept model
  - Partial but high
  - Predictable : textual definition vs ontology
- Meaning Matching with SNOMED CT Grammar
  - Total
  - Opening a better link between clinical management and funding management



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- Thank you
- Vielen Dank für Ihre Aufmerksamkeit
  - Merci
  - Gracie
  - Gracias
  - Obrigado
  - Efcharisto
  - Kessenem
  - Mange takk
    - Tack
    - Tänan
    - Kiitos
    - Spasibo
  - Arigato Gozaimasu
    - Terima Kasih
    - Et BONJOUR

