ICD-11 (JLMMS) and SCT Inter- Operation

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Introduction:

- **SNOMED CT (SCT)** is a standard clinical terminology and supported by a semantic model based on descriptive logic. It contains over 300,000 medical concepts and 19 areas or hierarchies, the most used are ‘’Clinical finding’’, ‘’procedure’’, ‘’organism’’, ‘’substance’’, ‘’body structure’’: The Multi-Kinship is a rule.

- **ICD-11JLMMS** is the final form of ICD-11 to replace ICD-10, it is made of exhaustive and mutually exclusive classes: it does not allow multi-kinship.

- In France, SNOMED CT is used only for research matters, while medical causes of death and billing (PMSI) are based on the ICD-10.

- SCT is used in conjunction with ICD-10 in 27 countries (need of more granular clinical description in the Electronic Health Record (EHR) against the need of statistical aggregation).

an agreement were signed in 2010 between WHO and IHTSDO to built the harmonisation between ICD and SCT around a Common Ontology following the widely acknowledged principles.
Why to represent the ICD-11JLMMS with the descriptive logic of SNOMED CT?

- In 2010 WHO and IHTSDO decided to harmonize SCT and ICD.

- The EHR becomes the source of all health terminologies uses (mortality, pricing, clinical and epidemiological research).

- Multi-terminology tools. Have to be more used in the future.

- The mapping between terminological artifacts can not be correct (1 to 1) for less than 80% of the corpus.

- The ICD-11 is not supported by a semantic model.

- Semantic interoperability is a critical node in e-health.
Goals:

- Ensure a semantic interoperability between ICD-11 JLMMS and SNOMED CT:
  
  - Apply the method developed by the JAG (Joint Advisory Group) on the Circulatory chapter of ICD-11 Foundation to ICD-11 JLMMS.
  
  - Add more steps to the existing method, if necessary.
Materiels :

- The ICD-11 (JLMMS)
- Chapter: «Circulatory System»

The World Health Organization browser

ICD-11 Beta Draft (Joint Linearization for Mortality and Morbidity Statistics)

CA12 Hypertensive renal disease

Definition
Hypertensive renal disease is a medical condition referring to damage to the kidney due to chronic high blood pressure.

Inclusions
- Chronic kidney disease due to hypertension
- arteriosclerosis of kidney
- arteriosclerotic nephritis (chronic)(interstitial)
- hypertensive nephropathy
- nephrosclerosis
- Glomerular diseases due to hypertension
- unspecified contracted kidney due to hypertension

Exclusions
- Secondary hypertension (CA14)

SNOMED CT

IHTSDO SNOMED CT browser

Expression from Stated Concept Definition (*)

Hypertensive renal disease

Parents
- Complication of systemic hypertensive disorder (disorder)
- Kidney disease (disorder)

Children (16)
- Arteriolar nephritis (disorder)
- Autosomal dominant progressive nephropathy with hypertension (disorder)
- Benign hypertensive renal disease (disorder)
- Chronic hypertensive uremia (disorder)
- Chronic kidney disease due to hypertension (disorder)
- End stage renal disease due to hypertension (disorder)
- Hypertension concurrent and due to end stage renal disease on dialysis (disorder)
- Hypertension due to compression of renal parenchyma (disorder)
- Hypertensive heart AND renal disease (disorder)
- Hypertensive nephrosclerosis (disorder)
- Hypertensive renal disease in obstetric context (disorder)
- Hypertensive renal disease with renal failure (disorder)

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- Hypertensive renal disease with renal failure (disorder)
Methods:

- **Step 1:**
  - The ICD-11 Class Définition
    - The concept of SCT FSN, SNF.
  - single match
    - Check
    - SCT Définition.
  - No single match
    - Check
    - Coordination (Two SCT concepts or more)
  - No possible coordination
    - Check and find
    - A representation of one part in SCT and a logical definition (CG) for the other part
  - No way to find a representative SCT part of the ICD-11 class
    - Develop
    - A new logical expression (CG).

- **Step 2:**
  - Logical Definition of ICD-11 class
    - Find
    - step1 (CG) plus SCT expression constraint language for the inclusions and exclusions.

Circulatory system of the ICD-11 (JLMMS)
### Results:

<table>
<thead>
<tr>
<th>Matching types and meanings</th>
<th>Numbers</th>
<th>Semantic representation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unique match (M).</td>
<td>244</td>
<td>Short Normal Form (SNF) of SCT.</td>
</tr>
<tr>
<td>80.3 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No unique match, but coordination is possible (O/A).</td>
<td>34</td>
<td>New coordinated expression.</td>
</tr>
<tr>
<td>11.2 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>293 (matches) /304 (the totality)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neither unique match nor coordination possible (O/E).</td>
<td>8</td>
<td>New CG logical expression.</td>
</tr>
<tr>
<td>2.6%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Of match</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No match at all (O/R).</td>
<td>7</td>
<td>New logical expression respecting the compositional grammar.</td>
</tr>
<tr>
<td>2.3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The remaining classes (other and unspecified) excluded.</td>
<td>11</td>
<td>Residual concepts /or need for more clarification.</td>
</tr>
<tr>
<td>3.6%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Circulatory system of the ICD-11 (JLMMS)
### Results:

#### Step 1, example 1

<table>
<thead>
<tr>
<th>Type of correspondance</th>
<th>ICD-11 Rubric</th>
<th>SCT (CG) logical expression</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>Necrosis of artery</td>
<td>359557001</td>
</tr>
<tr>
<td></td>
<td></td>
<td>{ 363698007</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Example of alignment through *unique match*, between ICD-11 and the logical definitions of SCT.*

### Circulatory system of the ICD-11 (JLMMS)
Results:

Step 1, example 2

<table>
<thead>
<tr>
<th>Matching types</th>
<th>ICD-11 rubric</th>
<th>SCT CG logical expression</th>
</tr>
</thead>
<tbody>
<tr>
<td>O/A</td>
<td>Acute myocardial infarction, STEMI, anterior wall</td>
<td>401303003</td>
</tr>
</tbody>
</table>

Available in SNOMED CT, But we must combine two concepts

Example of alignment through coordination, of the logical definitions of SCT.

Circulatory system of the ICD-11 (JLMMS)
Results:

Step 1, example 3

<table>
<thead>
<tr>
<th>Type de correspondance</th>
<th>ICD-11 rubric</th>
<th>SCT CG logical definition</th>
</tr>
</thead>
</table>
| O/E                    | Coronary artery ostial stenosis | 233970002 | Coronary artery stenosis (disorder) : 
|                        | No unique representation with SNOMED CT | { 363698007 | Finding site (attribute) | = 55537005 |
|                        |                                           | Structure of ostium of coronary artery , |
|                        |                                           | 116676008 | Associated morphology | = |
|                        |                                           | 415582006 | Stenosis | } |

Example of alignment through extension, of the logical definitions of SCT.

Circulatory system of the ICD-11 (JLMMS)
Step 2, example 1 with SCT Expression Constraint Language: **Inclusions.**

<table>
<thead>
<tr>
<th>ICD-11 rubric</th>
<th>SCT (CG) logical defintion</th>
<th>Inclusion ICD-11 JLMMS</th>
<th>Representation with SCT expression constraint language</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertensive renal disease M</td>
<td>90708001</td>
<td>Kidney disease (disorder)</td>
<td>1-Chronic kidney disease due to hypertension</td>
</tr>
<tr>
<td></td>
<td>47429007</td>
<td>Associated with (attribute)</td>
<td>2-arteriosclerosis of kidney</td>
</tr>
<tr>
<td></td>
<td>= 38341003</td>
<td>Hypertensive disorder, systemic arterial (disorder)</td>
<td>3-arteriosclerotic nephritis (Chronic)(interstitial)</td>
</tr>
<tr>
<td></td>
<td><strong>Unique match, but problem with inclusions</strong></td>
<td>4-hypertensive nephropathy</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5-nephrosclerosis</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>6-Glomerular diseases due to hypertension</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>7-Unspecified contracted kidney due to hypertension</td>
<td></td>
</tr>
</tbody>
</table>

|                              | <= 90708001 |Kidney disease (disorder) | AND <= 32916005 |Nephrosclerosis (disorder) | ) AND 709978007 |Contracted kidney (disorder) | : 42752001 |Due to (attribute) | = <= 38341003 |Hypertensive disorder, systemic arterial (disorder) |

*Exemple of a SCT logical definition, using the SCT Expression Constraint Language.*

**Circulatory system of the ICD-11 (JLMMS)**
### Results:

Step 2, example 2 with SCT Expression Constraint Language:

#### Exclusions.

<table>
<thead>
<tr>
<th>ICD-11 rubric</th>
<th>SCT (CG) logical definitions</th>
<th>Exclusions ICD-11 JLMMS</th>
<th>representation with SCT constraint expression language</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mitral valve stenosis</td>
<td>11851006</td>
<td>Mitral valve disorder (disorder)</td>
<td>:</td>
</tr>
<tr>
<td></td>
<td>{ 363698007</td>
<td>Finding site (attribute)</td>
<td>= 91134007</td>
</tr>
<tr>
<td></td>
<td>Unique match, but problem with exclusions</td>
<td></td>
<td>&lt;&lt; 11851006</td>
</tr>
</tbody>
</table>

**Example of a SCT logical definition, using the SCT Expression Constraint Language.**

**Circulatory system of the ICD-11 (JLMMS)**
## Results:

Step2, example 3 with SCT Expression Constraint Language:

**Inclusions and exclusions.**

<table>
<thead>
<tr>
<th>ICD-11 rubric</th>
<th>SCT CG logical definition</th>
<th>ICD -11 JLMMS Inclusions and exclusions</th>
<th>Representation with SCT«constraint expression language</th>
</tr>
</thead>
</table>
| Coronary artery aneurysm M | 301433005 |Aneurysm of artery of trunk (disorder)|: {116676008 |Associated morphology (attribute)| = 85659009 |Aneurysm (morphologic abnormality)|, 363698007 |Finding site (attribute)| = 41801008 |Coronary artery structure (body structure)| } | Inclusions:
- Coronary arteriovenous fistula, acquired
Exclusions:
- Congenital coronary aneurysm
 | (<<301433005 |Aneurysm of artery of trunk (disorder)| AND <<253720000 |Congenital coronary arteriovenous fistula (disorder)| ) MINUS 204378009 |Congenital coronary aneurysm (disorder)| : {116676008 |Associated morphology (attribute)| = 85659009 |Aneurysm (morphologic abnormality)|, 363698007 |Finding site (attribute)| = 41801008 |Coronary artery structure (body structure)| } |

*Exemple of a SCT logical definition, using the SCT Expression Constraint Language.*

**Circulatory system of the ICD-11 (JLMMS)**
Discussion/Conclusion:

- This work shows some limitations:
  - Some of logical representations of SNOMED CT are not really complete (we say "primitive").
  - Some JLMMS classes are represented in descriptive logic as the categories "other" and "unspecified".

- However, in most cases, the representation of ICD11 JLMMS classes can best be represented with the two IHTSDO tools compositional grammar and expression constraint language much more effectively than with the ICD11 Foundation Component.

- Therefore, it seems that the methods initiated by the work can contribute to improving the interoperability between the two main worldwide health terminologies ICD-11 and SNOMED CT, despite their different structures, details and uses cases.
Thank you
Vielen Dank
Merci
Questions?