COHERENT SNOMED CT IMPLEMENTATION
FACILITATING RE-USE OF DATA

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Aalborg University, 14th of February 2014
Agenda

Terminology in Clinical information systems

Comparability and concept selection

Concept selection: Method and tool

Conclusion and further research
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Concept selection: Method and tool

Conclusion and further research
Clinical Information Systems

CONFIDENTIALITY OF CLINICAL INFORMATION SYSTEMS
SNOMED CT IN CLINICAL INFORMATION SYSTEMS

The challenge of local terminology:

- Inconsistency influence:
  - Information management
  - Retrieval
  - Maintenance
SNOMED CLINICAL TERMS

Desiderata for controlled medical vocabularies

1. **Content, Content, and Content (Coverage)**
2. **Concept Orientation**
3. Concept Permanence (consistency)
4. Nonsemantic Concept Identifier
5. Polyhierarchy
6. **Formal Definitions**
7. Reject “Not Elsewhere Classified”
8. Multiple Granularities
9. Multiple Consistent Views
10. Beyond Medical Concepts: Representing Context
11. Evolve Gracefully
12. Recognize Redundancy

- Disederatas describing for the requirements fulfilled by SNOMED Clinical Term
- SNOMED CT is the worlds most comprehensive clinical terminology

High glucose level in blood

Clinical finding

Evaluation finding

Measurement finding

Measurement finding within reference range

Glucose level - finding

Measurement finding outside reference range

Normal glucose level

Abnormal glucose level

Low glucose level in blood

High glucose level in blood

SNOMED CT IN CLINICAL INFORMATION SYSTEMS
High glucose level in blood
Clinical finding

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Glucose level - finding

Measurement finding outside reference range

Normal glucose level

Abnormal glucose level

Low glucose level in blood

High glucose level in blood

SNOMED CT SYSTEM
365811003 BS_LEVEL01_UCO

SNOMED CT SYSTEM
365811003 RESULT_BS_CAR

SNOMED CT SYSTEM
102659003 BSNORMAL_CAR

SNOMED CT SYSTEM
444780001 BSHIGH_CAR

Blood glucose results:
- Blood glucose level: --
- Normal BG level: 
- Decreased BG level: 
- Increased BG level: 

Blood sugar level:
- Blood sugar: --
- Normal blood sugar: 
- Abnormal blood sugar: 

BS result:
- BS result: ...
- BS normal: 
- BS low: 
- BS high: 

Dept. of endocrinology

Dept. of cardiology

Dept. of urology
SNOMED CT IN CLINICAL INFORMATION SYSTEMS

Rector 1999:
Validation of clinical terminologies must include validation in use implemented in software

Lee et al. 2014:
The majority of studies focus on ‘theoretical’ and ‘pre-development/design’. Most implementations are not published in the scientific literature.

CONSISTENT CONCEPT SELECTION
A CHALLENGE IN SNOMED CT IMPLEMENTATION
Attention must be focused on the consistent application of SNOMED CT.
- Concept selection needs clear and extensive rules.
- Necessary to know the content and structure of SNOMED CT.
- Tooling is important, e.g. more sophisticated browsers.


1. **What are the prerequisites for supporting comparability in SNOMED CT implementations?**

- Review potentials and challenges of SNOMED CT implementations
- Explore terminology implementation and management in practice

2. **How can the complexity of SNOMED CT be managed, in order to support data comparability when selecting concepts for data entry?**

- Develop mapping guidelines to support selection of SNOMED CT concepts
- Develop tool to visualize sets of SNOMED CT
Two ways to ensure comparability:

- Hierarchical comparison
- Meaning-based comparison
HIERARCHICAL COMPARISON

- \( \text{Is a} \) relationships are present for every concept in SNOMED CT

- \( \text{Is a} \) relationships determine concept type
  - The least common ancestor reflect the level of granularity that two or more concepts can be hierarchically compared

- Not possible to compare at a very detailed level, and determine the difference between concepts. For example determine that Appendicitis and Colitis have different anatomical positions.
  - Appendix structure vs Colon structure vs.
MEANING-BASED COMPARISON

Inflammation of large intestine

Appendix structure
| finding site |
Inflammation
| associated morphology |
Appendicitis
| is a |
Colitis
| finding site |
Colon structure
| associated morphology |
Inflammation

The compositional grammar:

64572001 : { 116676008 = 23583003, 363698007 = 66754008 }  

The compositional grammar:

64572001 : { 116676008 = 23583003, 363698007 = 71854001 }  


**PRIMITIVE VS. FULLY DEFINED**

- SNOMED CT Concept
  - Clinical finding
    - Neurological finding
      - Sensory nervous system finding
        - Pain / sensation finding
          - Pain

- Finding site
  - Finding by site
    - Finding of body region
      - Pain
        - Pain finding at anatomical site
          - Pain of head and neck region
            - Head and neck structure

22253000 | pain | 363698007 | finding site | 774007 | head and neck structure
COMPARABILITY AND CONCEPT SELECTION

Concept selection supporting comparability:
• Attention on the logical definition of concepts
• Primitive concepts impede the possibility of meaning-based comparison

• Hierarchical comparison is a pragmatic starting point to ensure comparability
Terminology in Clinical information systems
Comparability and concept selection
Concept selection: Method and tool
Conclusion and further research
The objective of this study is to provide a clear methodology for SNOMED CT mapping to enhance applicability of SNOMED CT

- EHR-templates from 5 different EHR-systems
  - 6 general EHR-templates
  - 8 speciality-specific templates
Information type/Top-level hierarchy selection

Represent similar information types consistently

Both procedures and clinical findings can be chosen

Select concepts from the same (sub-)hierarchy to represent the same information type

Clinical findings are chosen to represent the free text content

Organising elements

Determine list type

Input fields

Lists

Supplemental fields

Search

Represent these fields by the same concept as the nearest organising element

Sufficient qualifier values should be added specifying the type of supplemental field - otherwise be supplied as local extension

Subtype hierarchy/Concept selection
Select concepts from the same (sub) hierarchy to represent information about the same domain.

Select the most general concept that sufficiently specify the level of detail to describe the actual clinical expression.

Pre-coordinated concepts are chosen over post-coordinated concepts.

Exception: If this means selecting a pre-coordinated concept from another hierarchy the guideline is neglected.

If post-coordination is performed launch by a concept from the subhierarchy of the related concepts.

Composite expressions are divided into separate fields.

Post-coordination by combination is used for composite clinical expressions that is chosen not to be separated.

Consistency in concept selection is prior to mapping precision. Analyze implications of this prioritisation before final selection.

Performing post-coordination should apply to the reference model of SNOMED CT.

Applying post-coordination by combination the involved concepts should derive from the same top-level hierarchy or from the qualifier value hierarchy.
CONSISTENCY AND COHERENCY

Consistency:
Representing the same clinical meaning through identical SNOMED CT expressions every time that a specific meaning occurs.

Coherency:
Selecting concepts/expressions that support the best possibilities with respect to comparability and retrieval.

Concept-specific

Sets of concepts
CONSISTENCY AND COHERENCY

Mapping proposal 1:

Typical browser solutions apply single concept visualisation.

Visualizing sets of concepts can support the overview needed to support coherency in concept selection.

Data entry template:

Physical examination template:

Ear: ...
Nose: ...
Throat: ...

SNOMED CT Concept
Clinical finding
Body
Ear finding
Nose finding
Throat finding
... ...
• Features
  – Merged graphs
  – Common paths
  – Least common ancestor
  – Descendants

PROTOTYPE EXAMPLE

<table>
<thead>
<tr>
<th>A. Merged trees (Interest Set)</th>
<th>B. Least Common Parents</th>
<th>C. Common concepts and paths</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Diagram A]</td>
<td>![Diagram B]</td>
<td>![Diagram C]</td>
</tr>
</tbody>
</table>

- **A. Merged trees (Interest Set)**
  - Organ system
  - Blood vessel structure
  - Cardiovascular structure of trunk

- **B. Least Common Parents**
  - Anatomical structure
  - Organ system
  - Cardiovascular system
  - Blood vessel structure

- **C. Common concepts and paths**
  - SNOMED CT
  - Physical anatomical entity
  - Anatomical or acquired body structure
  - Organ system
  - Cardiovascular system
  - Blood vessel structure
  - Cardiovascular structure of trunk
PROTOTYPE EXAMPLE

A. Least Common Parents

B. Common concepts and paths
METHOD AND TOOL: NEXT STEP

Refine mapping guidelines:

- Increase the scope
  - Body structures
  - Negations, absence, presence
  - Post-coordination

Refine visualization tool:

- Integrate with browser functionality
- Defining attribute relationship
- Post-coordinated expressions
In the process of SNOMED CT implementation, comparability can be supported by ensuring consistent and coherent concept selection.

The developed mapping guidelines and visualisation tool support a pragmatic starting point for ensuring hierarchical comparison of clinical data by the use of SNOMED CT.
FURTHER RESEARCH
– FROM CONCEPT SELECTION TO DATABASE STORAGE

- Storage of SNOMED CT expressions
  - Guidelines for storage of SNOMED CT expressions to support retrieval
  - Requirements for database structure
  - Co-existence with statistical classifications and/or local terminologies

- Retrieval of SNOMED CT expressions
  - Demonstrate application of simple and advanced SNOMED CT queries for various use cases
Thank you

... For your attention!