Interpreting Patient Data using Medical Background Knowledge

Heiner Oberkampf¹, Sonja Zillner¹, Bernhard Bauer², Matthias Hammon³

¹ Siemens AG, Corporate Technology, Munich, Germany
² Software Methodologies for Distributed Systems, University Augsburg, Germany
³ University Hospital Erlangen, Germany
Overview

1. Problem:
Integrate patient-data in clinical decision support systems

2. Our Approach:
Development of a Disease-Symptom Knowledge Model

3. Prototype

4. Conclusion and Future Work
Annotations to unstructured clinical data

**Problem:**
Annotations representing the descriptive content of the clinical data need to be understood with respect to …
- diseases
- examinations
- treatment evaluation …

**Problems:**
- Data is mostly unstructured
- Difficult to access all information needed in a specific clinical task
- Clinicians don’t use the full information contained in existing patient data

**Interpretation**
- e.g. Disease-Symptom-Ontology

**Clinical Decision Support**
- Ranking of likely diseases
- Planning next examinations
Search in the Diagnosis Process

Search for
Cancer-indicating symptoms

There exist medical ontologies that cover symptom-related and disease-related information

There exist no medical ontologies covering the relationship between symptoms and diseases
Human Disease Ontology (DOID)

✓ Contains about 8000 diseases
✓ Well linked to MSH, SNOMED, UMLS, ICD, ...
✓ About 15 ObjectProperty relations

<table>
<thead>
<tr>
<th>owl:ObjectProperty</th>
<th>total use</th>
<th>described diseases</th>
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</thead>
<tbody>
<tr>
<td>doid:has_symptom</td>
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<td>232</td>
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<tr>
<td>doid:located_in</td>
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<tr>
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<td>doid:transmitted_by</td>
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<tr>
<td>doid:derives_from</td>
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<td>43</td>
</tr>
</tbody>
</table>

Ref: http://disease-ontology.org/
Towards a Disease Symptom Knowledge Model

Disease
- Therapy
- Staging
- Etiology
- Importance
- Epidemiology
- Incidence
- Risk-factors
  - Typical age

has Differential Diagnosis

Symptom
- Patient
  - Age
  - Gender
- Shows Symptom
  - Indicates to check for
  - Anat. Region
  - Modification
  - Importance
  - Intensity
  - Temporal Relevance

Examination
- Probability
  - Has (Leading) Symptom
  - is (Leading)Symptom for
  - Significance value

Might detect
- Risk
- Costs

Knowledge Resource:
Herold – “Innere Medizin”
Outgoing from the Lymphoma use-case we included 5 diseases and 40 symptoms in the Disease-Symptom-Ontology.
Linkage from disy to Other Ontologies
Use in Clinical Decision Support: Ranking likely Diseases

Ranking Factors:
- proportion of present over absent symptoms of a disease
- age and gender specific incidence proportion
- leading symptoms
- symptom intensity
- intrinsic importance of symptoms

Clinical Decision Support Systems: MYCIN, INTERNIST, CASNET, DXplain, CADIAG...
Conclusion and Future Work

Relations between diseases and symptoms make possible to integrate unstructured clinical data in decision support systems.

Future Work:
- Populating the Disease-Symptom Ontology / extending DOID
- Creating Annotations: problems with German
- Temporal information
- Big Data: combining structured and unstructured data
Questions ?

Contact: heiner.oberkampf.ext@siemens.com