Fulfilling German regulations on the prevention of infections by using SNOMED CT

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Current Situation in Germany

- Data communication in the German Health Care System (GHCS) is
  - characterized by pragmatic attempts of electronic transmission
  - restricted by extended regulative guidelines
- The transmission of health data is provided by different types of media
- Common use of standardized information technology is not state of the art [1]
- Proprietary systems with inadequate networking abilities are often found in particular software utilization
Legal requirements on the prevention of infections

- In Germany, all necessary regulations and obligations are determined in the law on the prevention of infections (IfSG)

- The Robert Koch Institut (RKI) is the central institution for the surveillance of infectious diseases

- Infection or death by an infectious disease specific data is transferred by paper forms via the local health authority, the federal state health authority and at least the RKI in Berlin [2]
The IfSG’s 6th and 7th article summarizes the modalities in the management of notifiable infectious agent data and infectious diseases data: [3]

- Notable reporting of infectious agents that show a direct or indirect proof of an acute infection
- Notable reporting of infectious agents that show a severe threat of the population because of a local or seasonal accumulation
- Not-notable reporting of the direct or indirect detection of specific infectious agents
Table with notifiable agents, methods and specimens
Documentation of notifiable infections

- specific communication paper forms depending on German federal state regulations
- paper forms vary from one federal state to another
- In these forms the infectious agent, the specimen and the method of the diagnosis have to be signed manually by the physician
- a standardized IT-based entry and transfer of data is not state of the art, especially in the prevention of infection
- Proprietary ways of transmission can be the cause of deficient and incomplete availability of medical information
- These circumstances imply non-predictable health-related hazards for the population
**Example of a paper form**

### Patient/In
- Name, Vorname: [Redacted]
- Geschlecht: Männlich
- Geburtsdatum: [Redacted]
- Wohnort: [Redacted]
- Straße und Hausnummer:
- PLZ: [Redacted]
- Ort:
- Derzeitiger Aufenthaltsort:
- Straße und Hausnummer:
- PLZ: [Redacted]
- Ort:

### Labordiagnostischer Untersuchungsbefund

#### Krankheitserreger/Untersuchungsbefund:
- *Legionelle (sp.)*

#### Untersuchungsmaterial:
- Bronchialabstrakt
- Eingangsdatum des Materials: 16.05.20
- [Redacted]

### Nachweismethode:
- Nur bei positivem Befund ankreuzen (Angaben nach § 5 Abs. 2 Nr. 7 HSG zwingend erforderlich, s. Rückseite)

#### Serologischer Nachweis
- Einmal deutlich erhöhter Wert
- Deutliche Änderung zwischen zwei Proben
- IgM: [Redacted]
- IgG: [Redacted]
- IgA: [Redacted]
- Antikörpermachweis: [Redacted]
- Anderehältere Bezeichnung: [Redacted]

#### direkter Erregernachweis
- [Redacted]

#### Toxininnachweis
- [Redacted]

#### Virulenzfaktornachweis
- [Redacted]

#### Histologischer Nachweis / histopathologischer Befund
- [Redacted]
Consequences

- Insufficient spreading of new technologies and standards
- Lacks of information transfer and incomplete availability of medical information
- Dangers of documentation gaps and documentation errors
- Wrong therapy decisions that potentially endanger human lives

High relevance in the field of infection prevention!
The applicability of SNOMED CT shall be tested in the domain of diagnostic findings respective notifiable infectious agents that are determined in the German IfSG

Estimated benefit in the infection prevention use case:
- Precise electronic display of related data
- Opportunity of complete data transmission
- Specific hierarchical links from the agents to the associated infectious diseases
Research method

- All notifiable infectious agents (procedures, specimens) specified in the IfSG are translated into English language and entered into the “CliniClue®” SNOMED CT browser

- Reproducing the connections between infectious agents and the relating infectious diseases in the terminology via “CliniClue®” [5]

- Testing the feasibility of using SNOMED CT with HL7 CDA templates
Example Rotavirus

- causes one quarter of all gastro-enteretic disease hospital treatments of babies and children under the age of five around the world
- the terms “rotavirus” and “infection” are entered into the search field
- in the browser the preferred term “rotavirus infection of children” is suggested
- the concept itself is directly linked to its definition by a relationship icon key: “viral gastroenteritis due to Rotavirus”
- possible to create logical links between the infectious agent and the infectious disease
Example Rotavirus
# Results Infectious Agent

<table>
<thead>
<tr>
<th>RKI Agent</th>
<th>SNOMED CT Concept –ID</th>
<th>SNOMED CT Agent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adenovirus</td>
<td>74871001</td>
<td>Human adenovirus (organism)</td>
</tr>
<tr>
<td>Bordetella parapertussis</td>
<td>26183002</td>
<td>Bordetella parapertussis (organism)</td>
</tr>
<tr>
<td>Bordetella pertussis</td>
<td>5247005</td>
<td>Bordetella pertussis (organism)</td>
</tr>
<tr>
<td>Campylobacter</td>
<td>35408001</td>
<td>Genus Campylobacter (organism)</td>
</tr>
<tr>
<td>Cryptosporidium parvum</td>
<td>51504002</td>
<td>Cryptosporidium parvum (organism)</td>
</tr>
<tr>
<td>EHEC, Escherichia coli</td>
<td>116395006</td>
<td>Enterohemorrhagic Escherichia coli (organism)</td>
</tr>
<tr>
<td>Escherichia coli</td>
<td>112283007</td>
<td>Escherichia coli (organism)</td>
</tr>
<tr>
<td>Giardia lamblia</td>
<td>78181009</td>
<td>Giardia lamblia (organism)</td>
</tr>
<tr>
<td>Hantavirus</td>
<td>49445003</td>
<td>Genus Hantavirus (organism)</td>
</tr>
<tr>
<td>Puumalavirus</td>
<td>40754006</td>
<td>Puumala virus (organism)</td>
</tr>
<tr>
<td>Hepatitis-A-Virus</td>
<td>32452004</td>
<td>Hepatitis A virus (organism)</td>
</tr>
<tr>
<td>Hepatitis-B-Virus</td>
<td>81665004</td>
<td>Hepatitis B virus (organism)</td>
</tr>
<tr>
<td>Hepatitis-C-Virus</td>
<td>6294402</td>
<td>Hepatitis C virus (organism)</td>
</tr>
<tr>
<td>Influenza virus</td>
<td>55014007</td>
<td>Family Orthomyxoviridae (organism)</td>
</tr>
<tr>
<td>Legionella species</td>
<td>115514004</td>
<td>Legionella species (organism)</td>
</tr>
<tr>
<td>Legionella pneumophila</td>
<td>80897008</td>
<td>Legionella pneumophila (organism)</td>
</tr>
<tr>
<td>Listeria monocytogenes</td>
<td>36094007</td>
<td>Listeria monocytogenes (organism)</td>
</tr>
<tr>
<td>Mycobacterium tuberculosis</td>
<td>113861009</td>
<td>Mycobacterium tuberculosis (organism)</td>
</tr>
<tr>
<td>Neisseria meningitidis</td>
<td>17872004</td>
<td>Neisseria meningitidis (organism)</td>
</tr>
<tr>
<td>Norovirus</td>
<td>407359000</td>
<td>Genus Norovirus (organism)</td>
</tr>
<tr>
<td>Rotavirus</td>
<td>417542000</td>
<td>Genus Rotavirus (organism)</td>
</tr>
</tbody>
</table>
## Results

### Procedure

<table>
<thead>
<tr>
<th>RKI Procedure</th>
<th>SNOMED CT Concept –ID</th>
<th>SNOMED CT Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antikörpernachweis</td>
<td>121258006</td>
<td>antibody detection</td>
</tr>
<tr>
<td>Antigennachweis</td>
<td>121276004</td>
<td>antigen detection</td>
</tr>
<tr>
<td>IgG-Antikörpernachweis</td>
<td>45293001</td>
<td>Immunoglobulin G measurement</td>
</tr>
<tr>
<td>Erregerisolierung (kulturell)</td>
<td>61594008</td>
<td>microbial culture</td>
</tr>
<tr>
<td>Mikroskopischer Nachweis</td>
<td>117259009</td>
<td>microscopy</td>
</tr>
<tr>
<td>Nukleinsäure-Nachweis (z.B. PCR)</td>
<td>117040002</td>
<td>nucleid acid sequencing</td>
</tr>
<tr>
<td>IgM-Antikörpernachweis</td>
<td>74889000</td>
<td>Procedure to identify antibody: Immunoglobulin IgM</td>
</tr>
<tr>
<td>Toxinnachweis</td>
<td>252403005</td>
<td>toxin detection</td>
</tr>
<tr>
<td>histologischer Nachweis</td>
<td>263540008</td>
<td>histological finding</td>
</tr>
<tr>
<td>IgA-Antikörpernachweis</td>
<td>359897007</td>
<td>IgA antibody measurement</td>
</tr>
<tr>
<td>Virusisolierung</td>
<td>122442008</td>
<td>detection of a virus</td>
</tr>
</tbody>
</table>
## Results Specimen

<table>
<thead>
<tr>
<th>RKI Specimen</th>
<th>SNOMED CT Concept –ID</th>
<th>SNOMED CT Specimen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blut</td>
<td>87612001</td>
<td>Blood</td>
</tr>
<tr>
<td>Liquor</td>
<td>65216001</td>
<td>CSF</td>
</tr>
<tr>
<td>Serum</td>
<td>67922002</td>
<td>Serum</td>
</tr>
<tr>
<td>Abstrich</td>
<td>258433009</td>
<td>Smear Sample</td>
</tr>
<tr>
<td>Stuhl</td>
<td>39477002</td>
<td>Stool</td>
</tr>
<tr>
<td>Nasenabstrich</td>
<td>445297001</td>
<td>Swab of internal nose</td>
</tr>
<tr>
<td>Rachenabstrich</td>
<td>258529004</td>
<td>Throat swab</td>
</tr>
<tr>
<td>Gewebeprobe</td>
<td>85756007</td>
<td>Tissue</td>
</tr>
<tr>
<td>Urin</td>
<td>78014005</td>
<td>Urine</td>
</tr>
<tr>
<td>Konjunktivalabstrich</td>
<td>119401005</td>
<td>Specimen from conjunctiva</td>
</tr>
</tbody>
</table>
Results

- The notifiable infectious agents are represented at 100 percent, each agent is determined by a special SNOMED CT Concept-ID
- Possibility of connection to procedures and specimens to fulfill the German regulations
- Possibility of connections to the relating infectious diseases in the meaning of post-coordination
- Each single infectious agent is hierarchically connected to relating infectious diseases through phrases like “infection”
- Feasibility of using SNOMED CT with HL7 CDA
HL7 CDA

- HL7’s Clinical Document Architecture (CDA) is used by designing appropriate CDA templates to define the contents of the Notifiable Disease Documentation Sections were created on base of the document that is used by physicians:

<table>
<thead>
<tr>
<th>Name</th>
<th>Typ</th>
<th>Card</th>
<th>Conf</th>
<th>Template Name</th>
<th>Template OID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnose</td>
<td>Section Level</td>
<td>0..1</td>
<td>konditional</td>
<td>Diagnose Section Notifyable Diseases</td>
<td>1.2.276.0.76.10.3013</td>
</tr>
<tr>
<td>__Problemliste</td>
<td>Entry Level</td>
<td>1..1</td>
<td>verpflichtend</td>
<td>Problem Concern Act Notifyable Diseases</td>
<td>1.2.276.0.76.10.4002</td>
</tr>
<tr>
<td>____Diagnose</td>
<td>Entry Level</td>
<td>1..*</td>
<td>verpflichtend</td>
<td>Diagnosis Observation Notifyable Diseases</td>
<td>1.2.276.0.76.10.4003</td>
</tr>
<tr>
<td>____Symptom</td>
<td>Entry Level</td>
<td>0..*</td>
<td>optional</td>
<td>Symptoms Observation Notifyable Diseases</td>
<td>1.2.276.0.76.10.4004</td>
</tr>
<tr>
<td>Angaben zum Tod</td>
<td>Section Level</td>
<td>0..1</td>
<td>optional</td>
<td>Summary Of Death Section</td>
<td>1.2.276.0.76.10.3014</td>
</tr>
</tbody>
</table>
HL7 Implementation guide

- In the CDA template for the section Diagnosis codes from ICD-10-German Modification (GM) and SNOMED CT are possible semantic interoperability using HL7 CDA 2 and SNOMED CT

```xml
<observation classCode="OBS" moodCode="EVN">
  <templateId root="1.2.276.0.76.10.4003"/>
  <id root="08edbc70-2111-43f2-a784-9a5fdaa67f0"/>
  <code code="282291009" codeSystem="2.16.840.1.113883.6.96" display="Diagnosis"/>
  <text>
    <reference value="#DIAG1"/>
  </text>
  <statusCode code="completed"/>
  <effectiveTime>
    <low value="20130722"/>
  </effectiveTime>
  <value xsi:type="CD" code="B05" codeSystem="1.2.276.0.76.5.413" display="Masern"/>
</observation>
```
Discussion

- SNOMED CT is suitable for the display of infection prevention data
- The use of SNOMED CT shows obvious advantages in this field and an implementation of the terminology can be recommended
- Due to the absence of a validated German version of SNOMED CT the results are transferrable to a limited extend
- Possibility to examine the potential of SNOMED CT concerning laboratory tests in comparison with other recognized medical terminologies, for example LOINC®
References

[1] E-Health Planungsstudie Interoperabilität
http://www.bmg.bund.de/fileadmin/dateien/Pressemittteilungen/2012/2012_03/120924_PM_69_Anlage_E-Health-_Planungsstudie_Interoperabilitaet.pdf

http://www.rki.de/DE/Content/Infekt/IfSG/Meldeboegen/Meldungen_node.html


Thank you for your interest

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