



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]

IfSG

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

RKI

Erreger

infectious agent

procedure

specimen

Bemerkungen: Meldepflichtig durch das Labor sind die Nachweise der aufgeführten Krankheitserreger: namentlich gemäß § 7 Abs. 1 IfSG soweit sie auf eine akute Infektion hinweisen (Sonderregelung für Hepatitis C, Salmonella Paratyphi, Salmonella Typhi) bzw. nichtnamentlich gemäß § 7 Abs. 3 IfSG (separates Meldeformular). Der Falldefinition für die Übermittlung durch das Gesundheitsamt gemäß § 11 IfSG entsprechen nur die Nachweismethoden:

Erreger	Erregersollierung/ Virusisolierung	(Sub-)spezies/ Serovar/Genotyp	Mikroskopischer Nachweis	Nukleinsäure-Nachweis	Antigennachweis	Ak-Nachweis deutlich erhöht	Ak-Nachweis (Änderung zwischen Toxinachweis)	Nachweis des Toxins	Gens	Histologischer Nachweis	Nachweis des Virulenzfaktor-Gens	Bemerkungen
Adenoviren	*			*	*							* nur im Konjunktivalabstrich
<i>Bacillus anthracis</i>				*	**							* des PA (protektives Antigen), ** der Kapsel mittels IFT
<i>Bordetella pertussis</i> , <i>Bordetella parapertussis</i>	*			*		**	**					* in Abstrichen oder Sekreten des Nasenrachenraums **Pertussis-spezifische IgA- oder IgG-Antikörper im Serum
<i>Borrelia recurrentis</i>	*		#									* nur im Blut, # in Dunkelfeld-, Phasenkontrastmikroskopie oder im gefärbten Ausstrich
<i>Brucella</i> spp.												
<i>Campylobacter</i> spp., dampathogen		◇			*							◇ Speziesbestimmung, * ELISA

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]		<input type="radio"/> Weiblich	<input checked="" type="radio"/> Männlich	Geburtsdatum: [REDACTED]
Hauptwohnsitz Straße und Hausnummer:		PLZ:	Ort:	
Derzeitiger Aufenthaltsort (falls abweichend) Straße und Hausnummer:		PLZ:	Ort:	
Labordiagnostischer Untersuchungsbefund				
Krankheitserreger/Untersuchungsbefund: <i>Legionelle sp.</i>				
<small>(keine Angaben zu Spezies, Serovar, Pathovar, Toxotyp etc. liefert durchgeführt)</small>				
Untersuchungsmaterial: <small>(s. Hinweise zu Angaben zum Untersuchungsmaterial auf der Rückseite)</small>		Eingangdatum des Materials: <i>16.05.20</i>		
(bei mehreren Materialien bitte Methoden mit angeben)		Tag Monat Jahr		
Labornummer: <i>UA/2121</i>				
Nachweismethode: Nur bei positivem Befund ankreuzen (Angaben nach § 5 Abs. 2 Nr. 7 IfSG zwingend erforderlich, s. Rückseite)				
Serologischer Nachweis		direkter Erregernachweis		
	Einmalig deutlich erhöhter Wert	Deutliche Änderung zwischen zwei Proben	<input checked="" type="checkbox"/> Erregersolierung (kulturell) / Virusisolierung	
IgM	<input type="radio"/>	<input type="radio"/>	<input type="checkbox"/> Nukleinsäurenachweis (z.B. PCR)	
IgG	<input type="radio"/>	<input type="radio"/>	<input type="checkbox"/> Antigennachweis *	
IgA	<input type="radio"/>	<input type="radio"/>	<small>* (z.B. HBs-Antigen, L. pneumophila-Antigen)</small>	
Antikörperrnachweis	<input type="radio"/>	<input type="radio"/>	<input type="checkbox"/> Mikroskopischer Nachweis *	
Andere/nähere Bezeichnung *	<input type="radio"/>	<input type="radio"/>	<small>* (z.B. Trophozoiten von G. lamblia, gram-negative Diplokokken, Trichinella-Larven)</small>	
<small>(z.B. HBc-IgM-Antikörper, Chlamydiales-Antikörper, intrahepatisch gebildete / SMI-spezifische Antikörper)</small>		<input type="checkbox"/> Elektronenmikroskopie		
Zusatztest * <small>* (z.B. Immunoblot HBsAg-AIT)</small>		<input type="checkbox"/> Zusatztest * <small>* (z.B. HBV-Nukleinsäurenachweis bei HBs)</small>		
Toxinnachweis		Histologischer Nachweis / histopathologischer Befund		
<input type="radio"/> Toxinnachweis		<input type="checkbox"/> charakteristische Veränderungen		
<input type="radio"/> Toxin-Gennachweis (z.B. PCR)		Befund:		
Virulenzfaktornachweis				
<input type="radio"/> eae				
<input type="radio"/> ipaH				
<input type="radio"/> andere				

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!**

Research approach

- 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

The screenshot displays the CliniClue Xplore interface for the concept 'rotavirus infection of children'. The top bar shows the user 'heike.dewenter@hs-niederrhein.de' and standard menu options. The main content area includes:

- Concept Id:** 359662008
- Description Id:** 474357019
- Concept Name:** rotavirus infection of children (Type: clinical finding)
- Search:** A search box with 'rotavirus infection' and a list of results, with 'rotavirus infection of children' selected.
- Hierarchy:** A tree view showing 'viral gastroenteritis due to Rotavirus' as the parent and 'rotavirus infection of children' as the child.
- Properties:** A detailed list of relationships and qualifiers for the concept, including:
 - Concept Status:** current
 - Descriptions:**
 - Definition: Primitive
 - is a
 - viral gastroenteritis due to Rotavirus
 - causative agent
 - Rotavirus
 - pathological process
 - infectious process
 - Group
 - associated morphology
 - inflammation
 - finding site
 - intestinal structure
 - Group
 - associated morphology
 - inflammation
 - finding site
 - stomach structure
 - Qualifiers:**
 - severity
 - severities
 - episodicity
 - episodicities
 - clinical course
 - courses

Results Infectious Agent

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

Results Procedure

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

Results Specimen

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

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:

Name	Typ	Card	Conf	Template Name	Template OID
Diagnose	Section Level	0..1	konditional	Diagnose Section Notifiable Diseases	1.2.276.0.76.10.3013
__Problemliste	Entry Level	1..1	verpflichtend	Problem Concern Act Notifiable Diseases	1.2.276.0.76.10.4002
____Diagnose	Entry Level	1..*	verpflichtend	Diagnosis Observation Notifiable Diseases	1.2.276.0.76.10.4003
____Symptom	Entry Level	0..*	optional	Symptoms Observation Notifiable Diseases	1.2.276.0.76.10.4004
Angaben zum Tod	Section Level	0..1	optional	Summary Of Death Section	1.2.276.0.76.10.3014

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

```
<observation classCode="OBS" moodCode="EVN">
  <templateId root="1.2.276.0.76.10.4003"/>
  <id root="08edb7c0-2111-43f2-a784-9a5fdfaa67f0"/>
  <code code="282291009" codeSystem="2.16.840.1.113883.6.96"
  displayName="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"
  displayName="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
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- [2] Robert-Koch-Institut (RKI) Deutschland . 2013.
http://www.rki.de/DE/Content/Infekt/IfSG/Meldeboegen/Meldungen_node.html
- [3] Deutsches Bundesministerium der Justiz. Infektionsschutzgesetz (IfSG). Artikel 7. http://www.gesetze-im-internet.de/ifsg/___7.html
- [5] CliniClue®. 2013. <http://www.cliniclue.com>

Thank you for your interest

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