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Comparing the German Emergency Department Medical Record with the US HL7 Data Elements for Emergency Department Systems

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Abstract. Interoperability between emergency department (ED) information systems requires a shared data specification. In 2013 Health Level Seven International, an international standards body, approved a specification for Data Elements for Emergency Department Systems (DEEDS) for use in the United States. A similar specification was created in Germany for national employment, defining data elements and forms. This study presents the first step in the efforts to harmonize the two data definitions for International approval by comparing the meaning of the German Emergency Department Medical Record (GEDMR) data element definitions with the US DEEDS using a methodology for terminology mapping from ISO/TR 12300. The comparison between GEDMR and DEEDS did show significant differences in certain domains. The results support development of an international standard for ED data elements.

Keywords: medical informatics, data element definition, interoperability standards

1. Introduction

Medical data definitions are the basis of any data processing. Emergency Care data definitions are the product of health care provision in an emergency department and build the basis for information transfer to either the admitting or referring healthcare professional. Furthermore, well defined data definitions are the basis for secondary data usage from administration, reimbursement, research as well as quality improvement programs or pay for performance initiatives [1]. Finally, additional functionalities like drug interaction monitoring or antibiotic stewardship are based on data definitions.
In the USA, a national definition of Data Elements for Emergency Department Systems (DEEDS) was first defined in 1998 to support federal reporting requirements [2] and

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evolved by Health Level 7 (HL7) for the US realm combining a number of related specifications to improve the comprehensiveness of the coverage [3]. In Germany, a national definition for Emergency Department Medical Record (GEDMR) data elements was first defined in 2010 for medical information transfer [4] and specifically for data collection for the national trauma registry TraumaRegister DGU® [5,6].
In an earlier analysis of Emergency Medical Care systems [7] a panel compared Germany and United States emergency systems to 13 ED systems in other countries. At that time, the authors noted rising ED visit rates causing a strain on the ED resources in all countries. Continued increases in visits, constraints on resources and more complex care further strain ED care across the world. The cost of collecting data for operational analysis and research in the ED is significant but a preliminary investment in standardizing data capture may benefit ED performance monitoring and benefit the quality of care [8].
Aim of this study was the comparison of the meaning of the German Emergency Department Data Elements with the US HL7 Data Elements for Emergency Departments as a first step of further development towards an International HL7 Data Elements for Emergency Department Systems specification.

2. Methods

The HL7 DEEDS data definition was retrieved from the HL7 website [9] and data elements were transformed into an Excel spreadsheet. The GEDMR was retrieved from the working group website [10], transformed to an Excel spreadsheet and translated into English. The comparison of the two data element definitions was performed on the term of the data elements using the methodology from the ISO/TR 12300:2014 “Health informatics - Principles of mapping between terminological systems” for measuring the degree of equivalence between source and target (Table 1) [11] excluding data types or values.

Table 1: Rating scale to describe degree of equivalence from ISO/TR 12300:2014

Rating	Meaning
1	Equivalence of meaning; lexical, as well as conceptual. For example, asthma and asthma; ovarian cyst and cyst of ovary.
2	Equivalence of meaning, but with synonymy. For example, ureteric calculus and ureteric stone; gall stones and cholelithiasis.
3	Source concept is broader and has a less specific meaning than the target concept/term. For example, obesity and morbid obesity; diabetes and diabetes mellitus type II.
4	Source concept is narrower and has a more specific meaning than the target concept/term. For example, feels ugly and self-image finding; acute renal failure syndrome secondary to dehydration and acute renal failure syndrome.
5	No map is possible. No concept was found in the target with some degree of equivalence (as measured by any of the other four ratings).

First, a junior researcher (PE) compared the data element names of GEDMR to the DEEDS data element names and judged the degree of equivalence. After completion, a senior researcher (DB) revised the comparison. Disagreement was send back to junior researcher, who commented on the alternative suggestion. After reaching consensus, the mapping was finalized and descriptive statistics were performed using Microsoft Excel. Besides global analysis of degree of equivalence, a detailed examination of the GEDMR partitioned data definition according to its intention for general and specific clinical use

was performed. ISO-rating 1 to 4 were considered successful mapping, only rating category 5 “no map is possible” was considered unsuccessful mapping. Percentage of successful mapping was calculated by the number of ISO-rating 1-4 divided by the number of all data elements of the mapping.

3. Results

HL7 DEEDS contains of 525 data elements while the GEDMR data definition contains 768 data elements. As the GEDMR data definition is divided into six modules, each module repeats data elements like patient demographics. There are 27 redundant data elements in the 768 GEDMR data elements. Overall mapping was successful in 583 or 76% of the GEDMR data elements with 186 elements (24%) not mapping according to ISO/TR 12300 equivalence rating 5 for no equivalence. Of these 186 elements, 10 elements were internal administrative data elements of the GEDMR. Further 32 data elements contain prehospital data of the Emergency Medical Service. Of the successful mapped, 561 GEDMR elements could be mapped with a cardinality of one-to-one to DEEDS. Twenty-two (22) GEDMR elements had a cardinality of more than one time with DEEDS, thus resulting in a total of 890 mappings. Figure 1 shows the distribution of the degree of equivalence rating of the GEDMR compared to DEEDS according to ISO/TR 12300:2014 for the complete data definition.

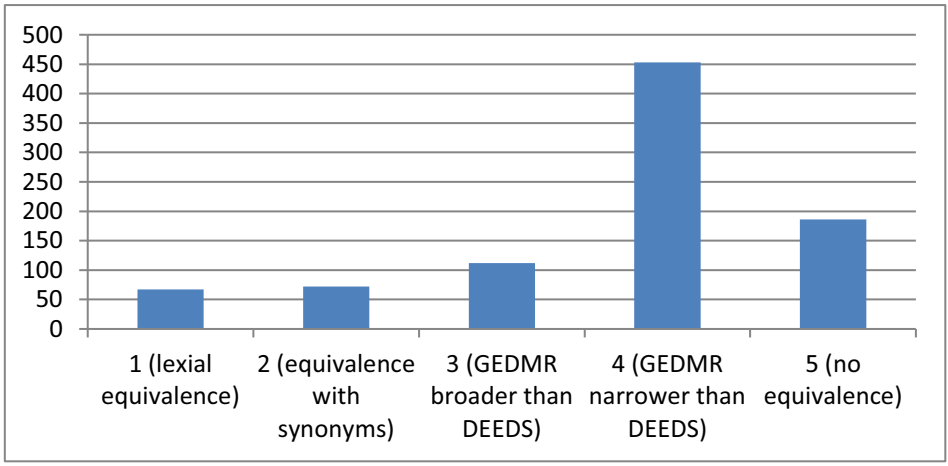

Figure 1: Overall mapping of GEDMR to DEEDS according to ISO/TR 12300

The amount of equivalence rating 5 or unsuccessful mapping varies between the categories defined by GEDMR modules. Data elements from the general module category had the least share (7%) of unsuccessful mapping with the DEEDS data definition, followed by the neurology module category (10%), monitoring (17%) and trauma module category (21%, respectivly. Data elements from the anesthesia (55%) and consultation module (65%) had the highest proportion of unsuccessful mapping with DEEDS data elements.

An equivalence of meaning (rating 1 and 2) between GEDMR and DEEDS data definition could be found in 139 GEDMR data elements (20%). In 112 elements (16%), the GEDMR had a broader and less specific meaning than the target concept of DEEDS. In 453 (64%) elements, the GEDMR had a narrower concept and more specific meaning

than DEEDS. A more detailed analysis of the degree of equivalence according to the categorization by GEDMR modules reveals a more heterogeneous picture. While GEDMR module trauma and neurology are very specific in their data elements compared to DEEDS, the GEDMR basic module has many data elements being broader than DEEDS as shown in Figure 2.

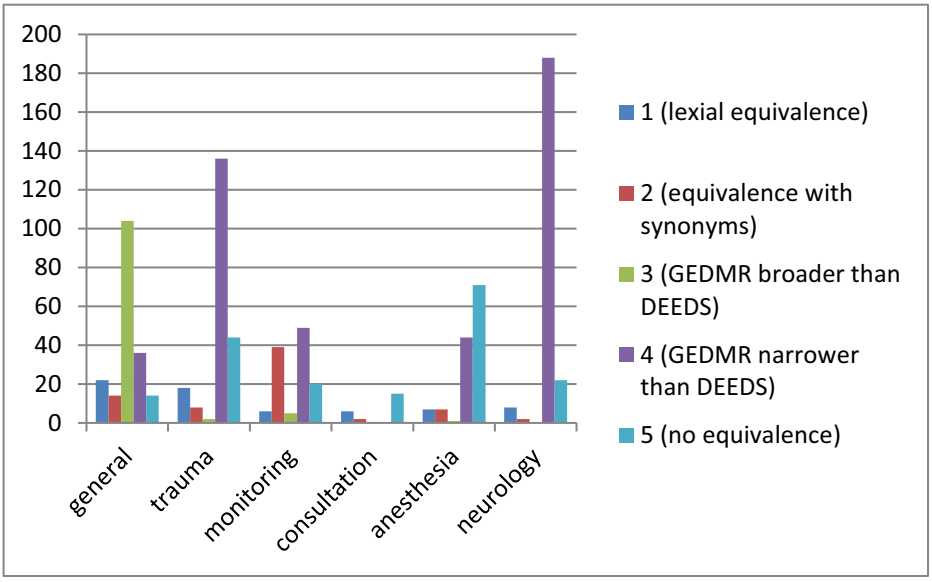

Figure 2: Degree of equivalence between GEDMR and DEEDS data elements differentiated by GEDMR module categories and ISO rating scale

4. Discussion

Prior studies comparing healthcare data definitions have utilized ad-hoc rating systems. For instance, Goossen et al [12] compared different international nursing data definitions on a conceptual level but did not compare the single data items in terms of equivalence. In 2014, the ISO published a methodology for measuring the degree of equivalence between source and target [11] to help users navigate the complexity of equivalent meaning between two very different resources. Although created for comparing terminologies, the methodology was adopted for comparing the meaning of two data element definitions as the data element descriptions should as well be mapped with existing terminologies while excluding the data type or value set from the evaluation. The work presented here is to the knowledge of the authors the first study comparing international data element definitions using the ISO/TR 12300 rating system.

The comparison between GEDMR and DEEDS did show major differences in certain domains. A significant part of GEDMR data elements were not mappable to DEEDS at all. Of these, some reveal missing concepts or data elements within DEEDS. As an example, DEEDS has no representation for isolation procedure or the reason for the isolation of a patient in the ED.

Items with ISO rating 3 (GEDMR is broader than DEEDS) occur mainly in the general module of GEDMR. The GEDMR has only four data elements for allergy, patient history, findings and treatment in the ED and recommendations for referral. DEEDS

contains a much more detailed model for those items, but it is questionable if there is a need to model findings of an ED examination into 50 partly overlapping data elements. Data elements with ISO rating 4 (GEDMR is narrower than DEEDS) occur constantly across all modules of GEDMR, especially with clinical specific modules like trauma, anesthesia or neurology. All parts of the GEDMR contain explicitly detailed models of clinical findings, procedures, medication and process time which may be contained in general data containers of DEEDS with respect to the filling system. By this, the GEDMR seems to be more normative in terms of data items collected than the DEEDS. This is due to the development process of GEDMR with a generic basic documentation and highly specialized data modules defined elsewhere like the national trauma registry.

The presented analysis using the ISO/TR 12300 rating system creates a systematic comparison of the equivalence of data element definitions in terms of semantics between two data definitions. The resulting table of equivalence categorizes the GEDMR data elements into different groups for further review in achieving an International Version of HL7 DEEDS allowing for comparative research between both nations. A 2007 analysis of international trauma registries [13] found the only common data elements were based on a prior standard, the Trauma and Injury Severity Score (TRISS). Finally, international vendors could profit from an international data definition resulting in reduced development expense.

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