Does mapping to SNOMED CT improve precision of subjective clinical evaluations?

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Abstract

Generally clinical documentation should be precise and unambiguous, but often this is not the case. This is the case for clinical subjective evaluations like "decrease in appetite". This paper examines if the precision of the evaluation can be improved by mapping to SNOMED CT. Two examples of subjective clinical evaluations from real clinical documentation are mapped to SNOMED CT using three different modelling approaches in order fit pre-defined levels of precision. The findings suggest that mapping to SNOMED CT alone cannot improve the precision, but by mapping the context of the subjective evaluation or the underlying objective observations, the precision might be improved. To determine the appropriate level of precision fitting a clinical situation, Health Care Professionals (HCPs) should preferably validate the different possible mappings.

Keywords: SNOMED CT, Computerized Medical Records Systems, Terminology as topic, Documentation/standards

Introduction

When studying what should characterise clinical documentation proposed quality indicators are among others accurate, correct, comprehensible and consistent[1]. However, health records often include imprecise clinical evaluations; consider common expressions like:

- "Decrease in appetite"
- "Impairment of vision"

The problem is that in itself, the evaluation cannot be interpreted since they are. Therefore there is a risk of misinterpreting the information, as the precision of the expressions are rather low. What does a decrease in appetite mean? For patients having surgery for obesity, a decrease in appetite might indicate that the surgery was successful. For an anorexic patient a decrease in appetite might be a serious worsening of the disease.

On the other hand, in health records the evaluations are often nested with other clinical statements. It is for instance common to document the rationale behind decisions or evaluations. This nesting in the record is an important context for the interpretation of the statements within.[2]

When introducing Electronic Health Records, reusing the information for both primary and secondary might end up fragmenting the information, and hereby withdraw important context information. The importance of precise clinical documentation will depend on the use:

- In shared care the importance of precision is greater than when treating a patient within the same department. This is highlighted by Eccher et al. They state that “semantic accuracy is essential in order to avoid possible misunderstandings among the different actors involved in the process of care.”[3]
- The needed ability of the retrieved information to be accumulated for secondary purposes as quality assurance and research. For statistics to be expressive high precision of data is a prerequisite.

The consequences of imprecise documenting will change drastically as more interoperable EHR systems are introduced because one department might know exactly what they mean by "Decrease in appetite", but when sharing this information with another department or using the information for secondary purposes the implicit definition might be lost. Therefore it is no surprise that linking to standardised terminology is regarded an important task by researchers i.e. [4] and standardisation organisations[1][5][6] state that ideally clinical terminologies among other should be characterised by:

- Concepts does not change with respect to time, perception or use
- It should be possible to identify duplications, ambiguities and synonyms

Also Elkin et al. describe general quality metrics of clinical terminology as "non-vagueness, non-ambiguity and non-redundancy."[7]

These statements hint that unambiguity and consistency are goals of introducing standardised clinical terminologies.

The aim of this paper is to study, the precision of subjective evaluations in EHRs. What nesting of information is necessary for the subjective evaluation to be useful both

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1http://www.openehr.org/wiki/display/term/Terminology+and+openEHR
primarily and secondarily? Three levels of precision for two subjective clinical evaluations are studied in order to add to the knowledge of how mapping to SNOMED CT can improve the precision of clinical statements.

Materials and Methods
In this section the clinical cases including the clinical evaluations will be described. Afterwards the three different modelling approaches applied to obtain different levels of precision will be presented. The purpose of all three approaches is documentation in clinical information systems and they all use SNOMED CT. For each precision level, the two clinical cases was interpreted and mapped to SNOMED CT.

The clinical cases
Both cases are Danish and are identified in Master’s theses written at Department of Health Science and Technology at Aalborg University. As both are written in Danish the evaluations are translated to English, which might modify the semantics. Therefore both Danish and English terms are included in the descriptions.

Evaluation 1: Tolerable bleeding
The first clinical case is related to maternal blood loss during labour. The case originates from an interview regarding clinical documentation in EHR systems in an obstetrics and gynecology department. The case is documented in detail in [8].

When documenting maternal blood loss during labour, the clinicians used to evaluate if the bleeding was tolerable (“tilladelig” in Danish). When working with electronic clinical documentation they realised that they did not have the same perception of what the expression meant and therefore saw the need of consensus. They specified that by tolerable bleeding they meant that the mother was bleeding less than 100ml and that the consciousness was unaffected.

Evaluation 2: Eating too little
The second clinical case is related to nutrition screening and treatment. The case originates from a project studying how to support electronic nutrition documentation using SNOMED CT. The case is based on both interviews with nurses and analysis of guidelines and schemes regarding nutrition screening and treatment. The case is documented in detail in [9].

Whenever a patient is admitted to the hospital, a nutrition screening is performed. Here it is determined if the patient is in nutritional risk. If the patient is at risk, the first thing the nurse will do is to document “characteristic of patient” or “nursing diagnose”. There are four primary diagnoses: eating too little, weight loss, BMI or other. These can be qualified by explaining the diagnoses i.e. decrease in appetite, nausea or pain. Documenting the diagnose forms the basis of the treatment regime. (Eating too little is “småtspisende” in Danish)

Levels of precision
The levels of precision take their point of departure in:

- Existing pre-coordinated SNOMED CT terms consisting of a finding and a qualifier. In the introducing example of decrease in appetite, this would mean identifying findings related to appetite in the SNOMED CT hierarchy and see if “findings related to appetite” have any children which pre-coordinates the finding with the qualifier “decrease”. This level try to map the evaluation as is, without interpretation.
- The clinical situation in which the evaluation is obtained. In the introducing example the decrease in appetite meant something different because of the context; the patient being either overweight or anorexic. Hereby this level interprets what clinical situation would distinguish the present evaluation from similar evaluations, hereby improving the precision.
- Nesting the subjective evaluation with the rationale behind the evaluation. The rationale behind an evaluation is often patient observations, to improve precision these should preferably be structured. If you want to evaluate that a patient is hypertensive, measurements of the blood pressure would be convincing observations to use as rationale. Hereby this level interprets the observable rationale on which the evaluation can be based.

The mapping to SNOMED CT is performed by the first author and reviewed by the second. The SNOMED CT® version 0907 was used in the study.

To illustrate the three different levels, nesting of information is necessary. For the first two precision levels, this is rather simple using only SNOMED CT expressions. For the last precision level a more complex nesting of clinical statements is needed. Therefore Mock-Ups of user-interfaces are used to illustrate this.

Results
The result section consists of the interpretation and mapping of the two clinical evaluations using the three different modelling approaches.

Pre-coordinated finings and qualifiers
Evaluation 1: Tolerable bleeding
When identifying bleeding (finding) in SNOMED CT both the associated morphology haemorrhage and the child finding of vaginal bleeding has pre-coordinated expressions consisting of bleeding and a qualifier. Examples of different qualifiers are illustrated in figure 1 and figure 2. The qualifier “tolerable” cannot be found, but as it is tolerable you could presume that it is a moderate vaginal bleeding, you could also argue that since it generally bleed a lot when giving birth, is must be a
massive haemorrhage. Generally it is difficult to discriminate the SNOMED CT qualifiers as they are just as imprecise as “tolerable”.

- Massive
- Subacute
- Chronic

Figure 1: Examples of clinical statements in SNOMED CT identified when trying to find “tolerable bleeding”

**Evaluation 2: Eating too little**

A basic question to ask is what comparison is made when evaluating that the patient eats too little? Looking at the other nursing diagnoses, the second specifies weight loss and the third BMI. Therefore the purpose of specifying “eating too little” is probably to say that we cannot see an alteration in the weight, and the BMI is not critical, but the patient does not meet the required energy intake and therefore there is a risk of weight loss. Also the time might be a decisive factor, if the patient did not eat enough yesterday, you would probably not diagnose that the patient “eat too little”. So a suggestion would be:

Inadequate dietary caloric intake (88202002) CLINICAL COURSE Continual (263730007)

The first term specify that the energy intake is inadequate. The CLINICAL COURSE post-coordination specify that it is a continual problem, not just one day. Here the precision is better, but we do not know how much less than the required energy intake the patient eats as well as its unknown for how long time it has been a problem.

Registering both observations and evaluation

When linking together different observations, evaluations and treatments in a clinical IT system, there would typically be a need for choosing an information model to handle this or to link them by long post-coordinated expressions. But since the aim of this paper is to study how to improve the precision of clinical statements, there is no need for choosing one model over another. Instead small mock-ups of user-interfaces are presented to show how the observations and evaluations could be interrelated in order to avoid ambiguity. SNOMED CT is used to find labels and content of drop down menus, but there are no underlying post-coordinated expressions.

**Evaluation 1: Tolerable bleeding**

The observations, on which it can be based if the bleeding is tolerable, are, according to the example, the quantity of maternal blood loss and the consciousness of the patient.

Semantically it does not make sense that you can evaluate something about the bleeding by looking at consciousness and when looking at the expression maternal blood loss within normal limits, it is clear that this only refers to the quantity of blood measured. But since the consciousness is also important, it might be that we were evaluating something broader than the bleeding i.e. the maternal condition during labour and in this perspective the consciousness is important. These are the presumptions leading to the design of the Mock-Up in figure 4. All terms in the interface are drawn from SNOMED CT except for the unit “ml”.

When documenting consciousness, the precision of the observation would be improved, if using the Glasgow Coma Scale, but since the case is about bleeding it was decided not to specify consciousness in detail, and just
draw expressions from SNOMED CT that was directly related to consciousness findings.

Figure 4- Illustration of nested clinical statements that could explain the rationale behind the evaluation “tolerable bleeding”

**Evaluation 2: Eating too little**

What should be objectively measured in order to determine if the patient eat too little? For this example we presumed that the patient’s energy requirement compared to the daily intake of energy was needed. This is illustrated in figure 5, where the expressions Calorie requirement and dietary calorie intake are found in SNOMED CT. Continual inadequate dietary caloric intake refers to the post-coordination: Inadequate dietary caloric intake CLINICAL COURSE Continual.

Since calories/day is not easy to measure, some help for the calculations would probably be needed. This explains the blue links in figure 5.

**Discussion**

In this section it is discussed how to choose between the levels of precision in different clinical situations. Afterwards the methodological approach of this paper is discussed. In the end importance of this type research is discussed, since it differs from most SNOMED CT related research.

**Method discussion**

In this study only two examples of subjective evaluations are evaluated, and a limited number of persons are performing the SNOMED CT mappings. Therefore it is not possible to generalise based on the results from this paper. The aim of this paper is merely to introduce another way of perceiving SNOMED CT mapping. Based on our results, we hypothesise, that we cannot map directly from existing documentation to SNOMED CT and expect more precise documentation. Therefore it is interesting to perform research, where the focus is to discuss single mappings in detail.

In 2008 a review concluded, that most SNOMED CT related research is concerned with the comparison of SNOMED CT with other terminology systems - typically providing coverage percentages. [10] Here there is no or little information in the papers regarding the details of how each mapping is performed and what arguments the terminologists, HCPs or researchers performing the mapping have for one mapping over another. In [11] 864 expressions are mapped from a General Medical Evaluation Template to SNOMED CT and MEDICIN®. Even though four examples of mapping are presented, the alternatives are not discussed.

Detail oriented SNOMED CT research would allow research communities and other SNOMED CT interest groups to share experience regarding representation of clinical documentation using SNOMED CT.

Choosing between levels of precision clinically

The findings suggest, that merely mapping the subjective evaluation itself to SNOMED CT will not improve the precision, the consequence could on the other hand be, that the clinical meaning of the expression could be altered, hereby adding to the imprecision. Therefore, using a standardised terminology as SNOMED CT is not a guarantee that subjective evaluations automatically become more precise. This also suggests that whenever possible the first level of precision should be avoided.

For the two clinical cases presented, which of the two remaining precision level would be clinically useful? We acknowledge that this decision should be qualified by clinical experts, but we will never the less put forward a solution based on the clinical situation in which the information is documented.

For “tolerable bleeding” it would be adequate to choose the third level, where the observations and evaluations are linked together. It seems to be important, that similar maternal blood loss is not evaluated differently. This could lead to the case where two patients having similar blood losses, would be treated differently. I.e. Blood transfusion would be considered and after the delivery the fluid balance would be monitored closely if the bleeding was evaluated as intolerable. Furthermore, the patient record is written after the delivery, so there will not be a tight time-limit of documentation related to a busy clinical situation.
In the case of “eating too little” it would be adequate to choose the second level, where the context of the evaluation is included. This is mainly due to the fact, that in the clinical situation the relevant observations are not available. The question of characteristics of the patients is the first to be answered after the nutrition screening, which is performed just after patient admission to a hospital. Therefore the information of how much the patient eats can only be answered by the patient or a relative. Going through all meals i.e. the preceding week in order to determine the precise calorie intake would be nonsense and presume a non-existing data-quality. Instead the nurse would probably question the patient about nutrition and based on this give an evaluation of the adequacy or inadequacy of the energy intake.

Different modelling approaches to specify subjective evaluations

In this paper it was attempted to model subjective evaluations according to three pre-specified levels of precision. It made sense for this study to predefine the levels, but to categorise detail-levels is of course an abstraction as there are levels in between and even more precise ways to document. For example the term inadequate dietary caloric intake could be post-coordinated with a term specifying that it was “one week since the onset” instead of the more imprecise “continual”. Another example of improved precision is using the Glasgow Coma Scale to represent findings of consciousness. With a term specifying that it was “one week since the onset” could add to the significance of the findings.

Conclusion

The findings of this paper are only based on two examples of subjective evaluations. However preliminary findings suggest that:

- Using SNOMED CT is not a guarantee that subjective evaluations become more precise. When trying to map the evaluation directly, the consequence could on the other hand be that the clinical meaning of the expression could be altered.
- Two modelling approaches are suggested taking into account the context of the finding or specifying the underlying observations related to the evaluations. This could possibly improve the precision of clinical evaluations.
- Through the process of making the information precise using SNOMED CT presumptions and choices were made. Choosing the appropriate level of precision requires clinical validation.

In the future it would be interesting to study the mappings of other types of clinical expressions this could i.e. be treatment onsets and underlying findings. More clinical expressions and HCP validation of the different modelling approaches would add to the significance of the findings.

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References


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