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Understanding the dialogue between users and formal terminology systems

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Abstract. In response to the increasing demands placed on existing nursing terminology systems, a number of authors have argued the need for formal terminology systems and significant advances have been made. Until recently the focus has been on using such systems as 'reference terminologies'. However more recently there has been a shift in emphasis with formal terminology systems being considered for direct use in clinical applications. This approach has profound implications both for the applications themselves and for their users; in the case of formal terminology systems it is no longer possible to 'plug and play'. In this article the authors describe preliminary work that seeks to facilitate the implementation and direct use of formal terminology systems in clinical applications i.e. to support the dialogue between users and formal terminology systems, and use a range of techniques to: a) expose potential difficulties and b) contribute to the development of solutions.

1. Introduction

Terminology work within nursing has been motivated by a number of factors including: 1) the implementation of computer-based applications in clinical settings; 2) the quest for reimbursement for nursing services delivered; 3) the documentation of nursing contributions to patient care outcomes; 4) the teaching of students; and 5) the enhancement of the body of nursing knowledge. Consequently nursing terminology systems are now expected to represent different types of information; such as information about individual patients, populations of patients, health care enterprises and nursing knowledge. Terminology systems are also expected to meet the needs of different users such as nurses, patients, teachers, managers, researchers and policy makers. Finally, they are expected to facilitate a number of different tasks, for example entering data, retrieving information, presenting information, sharing information between applications and accessing knowledge sources. It is widely acknowledged that current approaches can no longer keep pace with such a broad array of requirements [1]. In response to this shortcoming a number of authors have documented the need for so-called 'reference terminologies' - formal terminology systems that can support rich descriptions of clinical encounters, data re-use and data comparisons [2, 3]. Seminal work into nursing concept representation [4, 5] has contributed to the widespread recognition of the need for such terminology systems within nursing (since their publication, these landmark studies have played a major role in driving the nursing terminology agenda of standards bodies such as the European Committee for Standardization (CEN) and the International Organization for Standardization (ISO) and of other strategy-setting groups, such as the US Nursing Terminology Summit [6]).

As formal terminology systems become more advanced, so the demands placed on those terminology systems continue to increase, as do the expectations of users. For example, the collaboration between the College of American Pathologists and the UK National Health Service to 'merge'

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SNOMED®Reference Terminology with UK Clinical Terms into SNOMED®Clinical Terms marks a shift in emphasis away from the notion of a mere 'reference terminology' towards a terminology system for direct use in clinical applications. However, the size and inherent complexity of these emerging systems make direct use awkward. Consider for example the International Classification for Nursing Practice (ICNP®). In order to describe nursing phenomena, a user must select terms from several different axes. An individual axis may contain several hundred different terms. An individual term may appear at one of many levels. And many terms may appear at each level. For these reasons, instead of using ICNP® directly the trend has been to use more traditional approaches for data entry and analysis, with mappings 'behind the scenes' to ICNP® [7, 8]. This approach skirts around the awkwardness of ICNP®. However this does little to support the migration towards direct use and it prevents users from exploiting the full potential of the terminology system. It would appear that there is a fundamental conflict between the characteristics of formal terminology systems and the needs of users of clinical applications. Formal terminology systems must behave in a rigorously predictable way. But at the same time they must be understandable and usable i.e. they must fit with routine practice [1]. Before we can hope to use directly formal terminology systems we need a means to resolve this conflict. However, it is unclear where the resolution should reside: with the user, as part of the clinical application (e.g. at the user interface) or within the formal terminology system itself.

In this article the authors describe work initiated at the 2002 US Nursing Terminology Summit. A model of a dialogue that might occur via a clinical application between a nurse and a formal terminology system is presented and the authors demonstrate how such a model may be used to determine the boundaries of responsibility for users, clinical applications and formal terminology systems. In so doing the need to more systematically manage the dialogue between users and formal terminology systems is uncovered.

2. Method

The authors, as members of a working group at the 2002 US Nursing Terminology Summit, used a combination of techniques drawn primarily from an object-oriented analysis and design paradigm. In order to explore relevant issues from a pragmatic rather than from a theoretical point of view, the working group decided to work through the initial stages of a clinical applications development process.

2.1 Inception

The working group considered the following situation as an initial starting point:

A nurse assesses the nutritional status of a patient, in order to make a diagnosis.

The working group's proposed application would support this process while allowing the nurse to document the assessment, in line with routine practice, using a formal terminology system. The group envisioned data entry as an interaction or a series of interactions between the nurse and a set of structured data entry forms i.e. the nurse would be presented with a series of topics and sub-topics, each with an associated set of relevant terms for selection and inclusion into the patient record. (NB it is important to note that although the work is restricted to data entry many of the findings apply equally to other tasks, such as data analysis).

2.2 Use case analysis

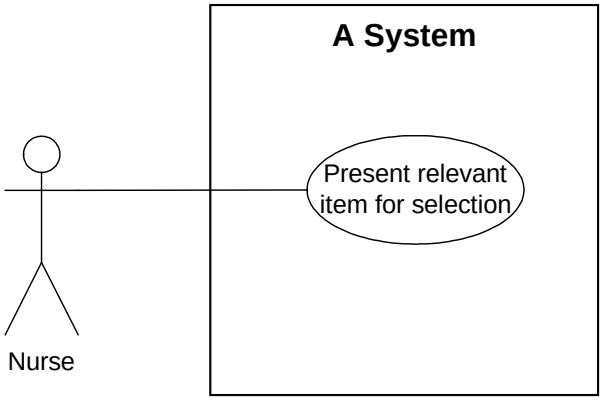

Figure 1: Use case diagram

A use case specifies 'the behavior of a system or part of a system..'. It is 'a description of a set of sequences of actions, including variants, that a system performs that yields an observable result of value to an actor' [9 p. 219]. The main actor in the situation described in the previous sub-section is a nurse; he/she is responsible for inputting information into the application. The working group focused on the use case 'Present relevant item for selection' (Figure 1) i.e. the application presents to the nurse a set of relevant options for selection (the '…observable result of value…') throughout the assessment process.

Ultimately the nurse would like to see, in any given context, all and only those terms that might be relevant in that context.

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2.3 Scenarios

A scenario is 'a specific sequence of actions that illustrate behavior' [9 p. 466]. Each scenario represents one path through the flow of events for the use case – it is an instance of a use case. The working group developed a number of scenarios from the 'Present relevant item for selection' use case. These are described textually below:

1) The application presents a list of relevant assessment topics, including for example 'Nutritional assessment'.
2) The application presents through a data entry form a number of relevant sub-topics such as a) 'Appearance' b) 'Mobility' and c) 'Weight'. It also makes a link to and displays the subject field 'Diagnosis'.
3) For each of these sub-topics the application presents a number of possible terms such as a) 'Underweight', 'Overweight' b) 'Mobile', 'Immobile', or in the case of c) a field for entering a numerical value.
4) Options would be displayed for the subject field for diagnosis, for example 'Nutrition ↑', 'Nutrition ↓'.

2.4 Prototyping

From these scenarios the working group developed a simulated prototype data entry form (Figure 2).

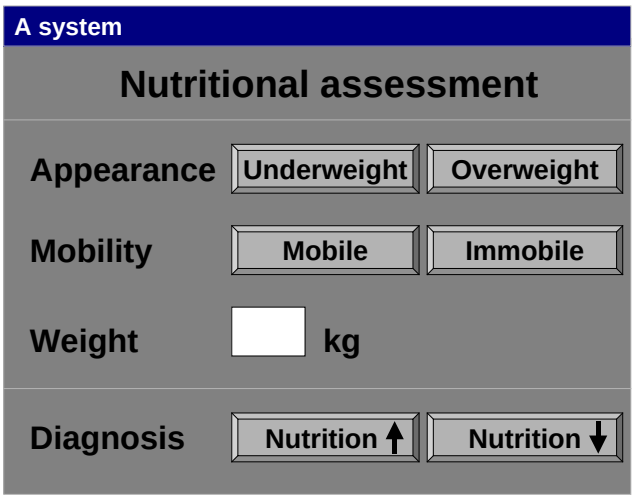

Figure 2: Simulated data entry form

The working group then derived a number of general requirements from the scenarios and from the prototype (NB while the focus of the work was on formal terminology systems, many if not all of these requirements would also apply in the case of applications underpinned by more traditional nursing terminology systems). The requirements included a need to:

1) Initiate the dialogue (e.g. present a list of topics)
2) Determine what should/should not appear (e.g. 'Appearance', 'Mobility' and 'Weight' and not 'Social circumstance')
3) Group related but heterogeneous elements (e.g. 'Mobility' and 'Appearance')
4) Make links based on professional knowledge (e.g. between 'Nutritional assessment' and a relevant diagnosis)
5) Include elements from outside the terminology (e.g. numerical values for 'Weight')
6) Present terms in an appropriate form i.e.
   - Determine which synonyms should appear (e.g. 'Nutrition ↑' rather than 'Nutrition, altered: more than body requirements')
   - Determine the level of granularity at which terms should appear (e.g. 'Mobile' rather than 'Well coordinated upper body mobility')
7) Determine the order of elements (e.g. always present Nutritional Assessment subtopics before 'Diagnosis')
8) Determine which elements are optional and which are mandatory (e.g. ensure that a diagnosis is always entered).

Implicit in these requirements is the need to consider users and their tasks to determine the context of the dialogue.

2.5 Activity diagrams

The requirements described in the previous section are general requirements that pertain to the application as a whole. The different components of the application have a collective responsibility to meet these requirements. In order to delimit the boundaries of responsibility between the various components, the working group used an activity diagram to determine the flow of control within certain of the scenarios. Activity diagrams seek to model the dynamic aspects of a system, showing 'the flow from activity to activity' [9 p. 259]. Within activity diagrams, swimlanes are used to partition responsibilities. Take for example a situation where the nurse has selected an assessment topic. The application must now present in a data entry form a set of relevant sub-topics and their possible values (i.e. scenarios 2 and 3). An activity diagram showing

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the flow of control or responsibility between the various components is provided in Figure 3.

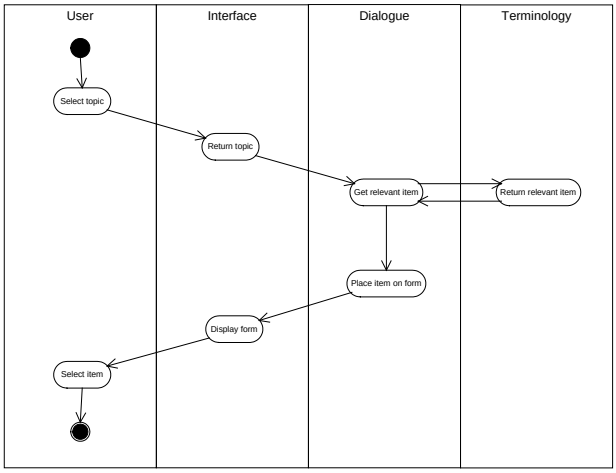

Figure 3: Activity diagram for scenarios 2 and 3

Within this diagram the application itself has two main responsibilities: to manage the user interface and to manage, via the user interface, the dialogue between the user and the formal terminology system. While user interfaces can control how data entry forms appear to users (i.e. color, size, nature of input fields, etc.), they cannot alone determine precisely what elements do and do not appear. Moreover, because formal terminology systems have a logical foundation, they cannot capture the pragmatics of routine use alone. Thus in applications which are underpinned by a formal terminology system, a sub-system is needed to manage the dialogue – a sub-system that avoids the 'bells and whistles' of the user interface and avoids the ontologies and formalisms of the formal terminology system.

3. Discussion

The working group used a range of techniques in their analysis:

Storyboarding: At the inception phase, the description of a realistic clinical process served to focus the analysis and allowed the working group to describe, at a high level, how an application might support that process.

Use case analysis: The definition of a key use case allowed the working group to describe the behavior of a specific aspect of the proposed application.

Scenario development: The working group used the use case to derive a number of scenarios - each representing a separate path through the use case.

Prototyping: The scenarios were used in the development of a simulated data entry form. Both the scenarios and the simulated data entry form were used to derive the general requirements for such forms.

Activity diagramming: The working group took two scenarios and developed an activity diagram to model the flow of control between the user and various aspects of the proposed application. The diagram represented graphically how the set of requirements defined in the previous phase might be met and where responsibility for meeting each of these requirements might lie.

The worked example described in section 2 is relatively simple and limited in scope. Nevertheless it has exposed a number of important issues:

- Formal terminology systems perform terminological reasoning. It is difficult to capture the pragmatics of routine practice within such systems.
- A dialogue sub-system is needed to manage things that are traditionally handled by terminology systems (so-called 'interface terminologies') such as:
  - Deciding what should or should not appear and in what order, through use of encoded clinical knowledge (e.g. within the Omaha System Domains do not form part of the terminology system itself – they 'provide organizational groupings for client problems' [10 p. 13-14]).
  - Maintaining the association between topics, sub-topics and terms through the use of encoded business rules (e.g. the association between problems and their modifiers within the Omaha System)
- Formal terminology systems must be able to interact with the dialogue sub-system so that together they can process things other than terms (e.g. topics).
- The interaction between the dialogue sub-system and the formal terminology system is likely to be iterative. For example, a form will generally consist of more than one sub-topic. The interaction is also likely to embody some degree of filtering on the part of the dialogue sub-system. For example, for a particular sub-topic not all terms will be relevant.
- Finally, and very importantly, in clinical applications there will be a dependency between the user interface, the dialogue sub-system, and the formal terminology system. Each will have a profound impact on the others.

These are important findings that serve to demonstrate the value and validity of the techniques used.

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5. Conclusion

While the direct use of formal terminology systems will bring many benefits to nurses and to nursing practice, the impact of their introduction should not be underestimated. Within this article the authors have described ongoing essential work that seeks to facilitate the implementation and use of formal terminology systems. They have described how a range of techniques may be used to more clearly predict key problem areas and to help to unpack them, thereby informing the implementation process. Understanding the dialogue between users and formal terminology systems will enable us to develop clinical applications that more effectively document the delivery of patient care.

6. Acknowledgements

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