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An evaluation of the usefulness of two terminology models for integrating nursing diagnosis concepts into SNOMED Clinical Terms[®]

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Abstract

Objectives: We evaluated the usefulness of two models for integrating nursing diagnosis concepts into SNOMED Clinical Terms (CT). **Methods:** First, we dissected nursing diagnosis term phrases from two source terminologies (North American Nursing Diagnosis Association Taxonomy 1 (NANDA) and Omaha System) into the semantic categories of the European Committee for Standardization (CEN) categorical structure and ISO reference terminology model (RTM). Second, we critically analyzed the similarities between the semantic links in the CEN and ISO models and the semantic links used to formally define diagnostic concepts in SNOMED CT. **Results:** Our findings demonstrated that focus, bearer/subject of information, and judgment were present in 100% of the NANDA and Omaha term phrases. The Omaha term phrases contained no additional descriptors beyond those considered mandatory in the CEN and ISO models. The comparison among the semantic links showed that SNOMED CT currently contains all but one of the semantic links needed to model the two source terminologies for integration. In conclusion, our findings support the potential utility of the CEN and ISO models for integrating nursing diagnostic concepts into SNOMED CT.

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1. Introduction

Recent studies have demonstrated the impact of concept-oriented terminologies that support data sharing and reuse on significant aspects of care such as retrieving clinical findings, improving understanding of patient

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care data, accessing information resources relevant to specific patient care problems, and applying expert systems to the care of patients [1,2].

Currently, no concept-oriented terminology includes comprehensive content for nursing domain concepts. In order to support interdisciplinary healthcare delivery, research, and policy formulation, it is vital that nursing concepts be incorporated into terminologies with broad coverage for the healthcare domain and that healthcare reference information models support the representation of nursing concepts.

An explicit terminology model is an essential component of a concept-oriented terminology. In this paper, terminology model is defined as an explicit representation of a system of concepts that is optimized for terminology management and that supports the intensional definition of concepts and the mapping among terminologies. A terminology model depicts the associative relationships between an aggregate (molecular) expression (acute abdominal pain) and more primitive (atomic) concepts (pain+acute+abdominal) [3]. A terminology model is closely related to the notion of categorical structure as defined by the European Committee for Standardization (CEN), “a reduced system of concepts to describe the organization of the semantic categories in a particular system of concepts for development, maintenance, and application of terminological systems” [4]. Within a terminology model, a type definition explicitly states which descriptors or attributes *must* be specified for *every* concept of a particular type [5,6].

Recently, models that support the definition of nursing concepts have been proposed and tested [7–10]. Work within CEN integrated aspects of the International Classification of Nursing Practice (ICNP), Telenurse ID, and other European efforts (e.g., nursing

activities within the Galen Projects) into a categorical structure for nursing concepts [11–14]. Building upon the CEN activities, an ISO Committee Draft (ISO/TC 215/WG 3/CD 18104) includes reference terminology models (RTMs) for nursing diagnoses and nursing interventions [15,16]. The ISO project, which is led by the International Council of Nurses and the Nursing Special Interest Group of the International Medical Informatics Association, is continuing through the ISO process towards an international standard.

With the goal of integrating concepts from existing nursing terminologies into SNOMED Clinical Terms (SNOMED CT), the purpose of this study was to evaluate the usefulness of the CEN categorical structure and ISO RTM as terminology models for integrating nursing diagnostic concepts from two source terminologies: North American Nursing Diagnosis Association Taxonomy 1 (NANDA) and Omaha System.

2. Methods

2.1. Research questions

- What percentage of NANDA and Omaha term phrases contains each of the categories of the CEN and ISO models?
- Do the NANDA and Omaha term phrases contain concepts that do not fall into any of the categories of the CEN and ISO models?
- Which semantic links of the CEN and ISO models are similar to those currently used to represent diagnostic concepts in SNOMED CT?

2.2. RTMs: CEN and ISO

In the CEN categorical structure (Fig. 1), a nursing diagnosis is represented as a judgment

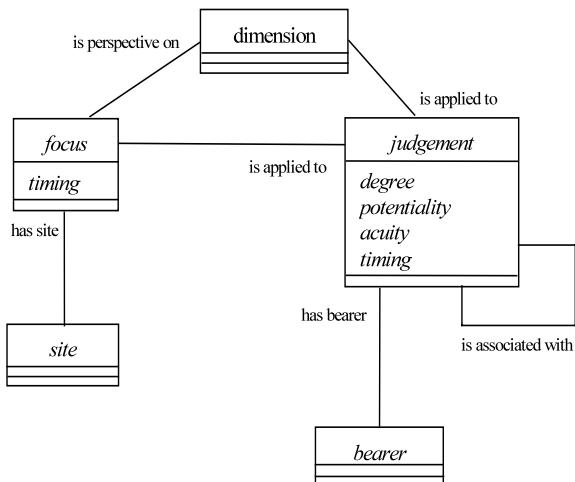


Fig. 1. CEN system of concepts for nursing diagnoses.

on a focus or on a particular dimension of a focus [4]. Judgment and focus are mandatory semantic categories whereas bearer is to be used as necessary to disambiguate different bearers in a terminology. For example, knowledge deficit about diabetes management could relate to the individual with diabetes or to the family caregiver who will be managing the diabetes for a child.

The ISO RTM (Fig. 2) is based upon the CEN categorical structure for nursing diagnoses [15]. The model was refined under the terms of a collaborative agreement between CEN and ISO with ISO designated as the lead for the scope of work. The ISO nursing diagnosis RTM differs from the CEN model in two ways. The semantic category of bearer in the CEN model is labeled subject of information in the ISO model for consistency with other ISO standards. In addition, the “is associated with” semantic link that appeared in the CEN model is not included in the ISO RTM; it is expected that this relationship will be handled in the information model. The documentation supporting the ISO RTM includes definitions of semantic categories and links in an attempt for consistency with other evolving ISO standards (Fig. 2) [16].

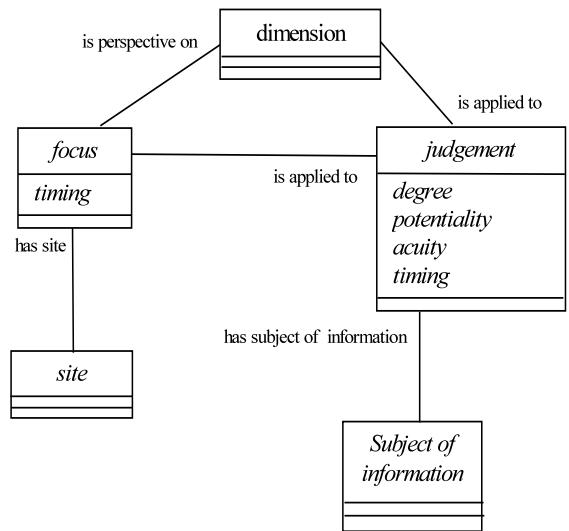


Fig. 2. Proposed ISO RTM for nursing diagnoses. Judgment is an opinion or discernment related to a focus or a dimension. A descriptor for judgment is mandatory for nursing diagnoses. Focus is defined as an area of attention. A descriptor for focus is mandatory for nursing diagnoses. Dimension is a quality possessed by an individual or group, which provides a perspective on, but is not limited to: process, structure, and other semantic categories taking the role of focus. Subject of information is an entity to which a diagnosis refers, also known as the “bearer” in CEN prENV 14032. A descriptor for subject of information should be used as necessary to disambiguate similar rubrics (e.g., ineffective family coping vs. ineffective individual coping) in a terminology.

2.3. Source terminologies

Under development since the mid-1970s, NANDA Taxonomy 1 consists of 150 pre-coordinated diagnostic concepts that are widely implemented in both paper-based and computer-based formats [17,18]. The taxonomy was originally designed as a single axis with diagnoses organized into functional health patterns and each diagnosis described in a problem, etiology, signs, and symptoms format. More recently, a multi-axial representation has been proposed [18]. The proposed axes include several semantic categories and attributes included in the CEN and ISO models such as potentiality, acuity, and unit of care (i.e., subject of information).

The Omaha system consists of problems, interventions, and outcomes [19,20]. The problem classification scheme consists of 44 problems categorized into four domains (environmental, psychosocial, physiological, and health-related behaviors). Problems are further described by post-coordination of two sets of modifiers. One set of modifiers relates to judgment and its potentiality attribute: (1) health promotion; (2) potential, potential impairment, or potential deficit; or (3) actual, impairment, or deficit. The other set of modifiers relates to subject of information, i.e., family or individual. Each possible combination of problem and modifiers was considered to be a term phrase for purposes of our analysis.

2.4. Target terminology: SNOMED CT

SNOMED CT is a concept-oriented terminology that is being developed through collaboration between the College of American Pathologists and the United Kingdom's Secretary for Health on behalf of the National Health Service (NHS) Executive [21,22]. It is based upon SNOMED RT® and CT Version 3 of the NHS thesaurus of healthcare terms. Building upon the strengths of both terminologies, the proposed design for SNOMED CT is intended to support both interface and reference terminology requirements.

The task of enhancing the nursing content of SNOMED CT is the charge of the Convergent Terminology Group for Nursing (CTGFN), a working group of the SNOMED® International Editorial Board (SIEB). Core members include representatives from the SIEB, Convergent Medical Terminology Project, SNOMED® staff, and the American Nurses Association. CTGFN activities have focused on developing and testing terminology models that will support nursing concepts in SNOMED CT and encouraging,

through outreach and education, collaboration between nursing terminology developers and SNOMED CT developers. The aim of these activities is to ensure that: (1) SNOMED CT builds upon the existing nursing terminologies so that there is broad coverage for the domain of nursing; (2) concepts from the nursing domain are appropriately modeled within SNOMED CT; and (3) mappings between nursing terminologies and SNOMED CT are valid and reliable. Currently, four terminologies that include nursing diagnostic concepts are slated for integration into SNOMED CT: NANDA, Omaha, Home Health Care Classification, and the Peri-Operative Nursing Data Set.

2.5. Procedures

We entered the term phrases from NANDA and Omaha into an access database and dissected them into the relevant semantic categories and attributes as shown in the examples in Table 1. We critically analyzed the semantic links in the CEN and ISO models and SNOMED CT to determine similarities and differences.

3. Results

Focus, bearer/subject of information (either implicit or explicit), and judgment were present in 100% of the NANDA and Omaha term phrases (see Table 2). The Omaha term phrases contained no additional descriptors beyond those semantic categories considered mandatory in the CEN and ISO models. In contrast, NANDA diagnoses included terms in the semantic categories of dimension (e.g., knowledge) and site (e.g., unilateral). Neither NANDA nor Omaha term phrases contained any terms that did not belong to one of the semantic categories in the model.

Table 1
Examples of dissections of nursing diagnostic terms

| <i>Ineffective family coping: disabling (NANDA)</i> |
|--|
| Focus: coping |
| Judgment: ineffective |
| Degree: disabling |
| Potentiality: actual |
| Bearer/subject of information: family |
| <i>Risk for fluid volume deficit (NANDA)</i> |
| Focus: fluid volume |
| Judgment: deficit |
| Potentiality: risk for |
| Bearer/subject of information: individual (Implicit) |
| <i>Pain+actual+individual (Omaha)^a</i> |
| Focus: pain |
| Judgment: pain |
| Potentiality: actual |
| Bearer/subject of information: individual |
| <i>Role change+potential impairment+family (Omaha)</i> |
| Focus: role change |
| Judgment: impairment |
| Potentiality: potential |
| Bearer/subject of information: family |

^a Consistent with the approach described in the CEN and ISO documents, in the diagnostic concept of pain, pain is considered to be an instance in which focus and judgment are pre-coordinated, thus the single descriptor satisfies the provisions for both domains.

Table 2
Percentage of NANDA and Omaha diagnostic term phrases containing semantic categories in CEN and ISO models

| CEN/ISO | NANDA (%) | Omaha (%) |
|-------------------------------|-----------|-----------|
| Focus ^a | 100 | 100 |
| Dimension | 15 | |
| Judgment ^{a,b} | 100 | 100 |
| Degree | 3 | |
| Potentiality | 100 | 100 |
| Acuity | 5 | |
| Timing | 3 | |
| Bearer/subject of information | 100 | 100 |
| Site | 16 | |

^a Required descriptor in CEN and ISO models.

^b In 26% of the NANDA and 8% of Omaha term phrases, a single descriptor served as focus and judgment.

As shown in **Table 3**, the majority of the semantic links designated in the CEN and ISO models have semantic equivalents in SNOMED CT. Terms that include potential-

Table 3
Comparison of semantic links of CEN and ISO RTMs for nursing diagnoses and SNOMED CT[®]

| CEN | ISO | SNOMED CT |
|----------------------------|----------------------------|-------------------------------|
| Is applied to | Is applied to | Interprets/has interpretation |
| Is perspective on | Is perspective on | Has associated finding |
| Is associated with | | Has subject of information |
| Has bearer | Has subject of information | Has subject of information |
| Has gradation qualifier | Has gradation qualifier | Has severity |
| Has potentiality qualifier | Has potentiality qualifier | Context-dependent category |
| Has acuity qualifier | Has acuity qualifier | Has course; has onset |
| Has temporal qualifier | Has temporal qualifier | Has occurrence |
| Has site | Has site | Has finding site |

ity other than actual (e.g., at risk for, negation) are intended to be handled through a context-dependent category of pre-coordinated terms rather than through a specific semantic link. Currently, there is no equivalent semantic link for “is perspective on”. The use of specific semantic links is illustrated in **Table 4**, which displays two nursing diagnoses as represented in SNOMED CT.

4. Discussion

The two nursing source terminologies were purposively selected to evaluate the CEN and ISO models because of the differences in the underlying structure (pre-coordinated vs. post-coordinated) and granularity of their term phrases. Our results demonstrate that for those semantic categories, for which descriptors were required in the CEN and ISO models, descriptors were universally present in the two sets of term phrases.

We found the dissection of the term phrases into all semantic categories, with the excep-

Table 4
Representations of nursing diagnostic^a terms in SNOMED CT

| |
|--|
| <i>Decreased cardiac output (finding)^b</i> |
| IS-A <i>decreased cardiac function (finding)</i> |
| Some interprets <i>cardiac output (observable entity)</i> |
| Some has interpretation <i>decreased (qualifier value)</i> |
| NANDA: 00029 |
| <i>Ineffective family coping: disabling (finding)</i> |
| IS-A <i>finding related to ability to cope (finding)</i> |
| Some interprets <i>ability to cope (observable entity)</i> |
| Some has interpretation <i>ineffective (qualifier value)</i> |
| Some subject of information <i>family (social concept)</i> |
| NANDA: 00073 |
| <i>Caregiver role strain (finding)</i> |
| IS-A <i>coping stress tolerance finding (finding)</i> |
| Some interprets: <i>ability to cope (observable entity)</i> |
| Some subject of information: <i>caregiver (person)</i> |
| NANDA: 00061 |

^a The concept “nursing diagnosis” does exist within SNOMED CT as part of the context-dependent hierarchy, but is not attached to individual nursing diagnostic concepts through an explicit IS-A relationship.

^b Note that since the subject of information is not ambiguous in this diagnosis there is no need to include it in the representation.

tion of dimension, to be straightforward for the majority of phrases. In this analysis, NANDA term phrases contained terms that were judged to be dimensions by the nursing diagnosis expert who dissected them (JJW). For the Omaha system, dimensions are not explicated in the Problem Classification Scheme that served as the data set for this analysis. The dimensions of knowledge, behavior, and status are evaluated only for actual problems using the Omaha Problem Rating Scale for Outcomes and are designed to be linked in the information model rather than as part of the terminology model [19].

In conclusion, our findings support the potential usefulness of the CEN and ISO models for formally defining nursing diagnostic concepts for integration into SNOMED CT. However, in order to accomplish this task, several activities must occur. Per editorial policy, any proposed role (e.g., is perspective on) must be explicitly defined and must

meet criteria for usefulness, understandability, and reproducibility [23]. In addition, the findings hierarchy in SNOMED CT must be evaluated to ensure that it supports the appropriate classification of nursing diagnostic concepts.

Our study should not be construed as a full-scale evaluation of the CEN and ISO models. Our data set included only two source terminologies and a single target terminology. The terms from each source terminology were dissected by a nurse who was well acquainted with the terminology. Continued evaluation with other data sets and refinement of the ISO nursing diagnosis model is critical in the progress toward an international standard for an RTM under ISO auspices.

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