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# Standards to support the ongoing development and maintenance of nursing terminologies

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## Introduction

Version 1.0 of the International Classification for Nursing Practice (ICNP®) was released by the International Council of Nurses in 2005, building on previous versions (*i.e. α, β* and *β*2). ICNP® is described as "a unified nursing language system. It is a compositional terminology for nursing practice that facilitates the development of and the cross-mapping among local terms and existing terminologies" (International Council of Nurses 2007a). In contrast to previous versions, ICNP® Version 1.0 has been developed using the Web Ontology Language (OWL) (World Wide Web Consortium 2004) within the Protégé ontology development environment (Stanford Medical Informatics 2006). As such ICNP® might be considered a formal terminological system (rather than for example a statistical classification).

A Technical Specification developed under the auspices of the International Organization for Standardization, ISO/TS 17117 *Health informatics -- Controlled health terminology -- Structure and high-level indicators*, seeks "to document to principal ideas, which are necessary and sufficient to assign value to a controlled health vocabulary" (International Organization for Standardization 2002). ISO/TS 17117 was published in 2002. Even though the Technical Specification has been available for 5 years, there is little reported evidence of its practical applicability. It is currently under review.

Certain aspects of ISO/TS 17117 focus on issues around the ongoing development or maintenance of controlled health terminologies and in this respect it identifies a number of relevant 'desirable characteristics' for formal terminological systems such as ICNP®. In this paper we seek to determine the suitability of ISO/TS 17117 for assigning value to formal terminologies. We do this by judging the degree of conformance of ICNP® to a set of characteristics identified within ISO/TS 17117. This is an initial exploratory study. We do not consider at this stage issues around activities other than ongoing development and maintenance *e.g.* evaluation; nor do we consider characteristics that pertain to other terminological systems such as statistical classifications.

## Method and results

For each characteristic under examination we reviewed relevant documentation, and applied our knowledge of ICNP®, OWL and Protégé in order to assess degree of conformance of ICNP® to ISO/TS 17117. The chosen characteristics and associated results are presented in Table 1.

*Table 1: Degree of conformance of ICNP® Version 1.0 to a subset of characteristics within ISO/TS 17117*

| Feature | Solution for ICNP Version 1.0 |
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| *Concept orientation* | |

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| **Concept-orientation** The basic unit of a terminology must be a concept, which is the embodiment of some specific meaning and not a code or character string | The basic unit of Version 1.0 is an OWL class (representing a nursing entity), with codes, preferred terms and synonyms maintained in separate tables |
| ***Non-redundancy*** There shall not be more than one concept identifier in the terminology with the same meaning *e.g.* 'Wound dressing' and 'Dressing' (Note that as the *β2* Version comprises multiple axes, there were also multiple parallel hierarchies *e.g.* between the *Target* axis and the *Means* axis. This also introduced redundancy) | The migration to a single hierarchy from the multi-axial representation of the *β2* Version has necessitated a re-examination of all classes across parallel hierarchies *e.g.* the target of an intervention or the means of carrying out that intervention |
| ***Non-ambiguity*** No concept identifier shall have more than one meaning *e.g.* 'Dressing' – as in wound dressing, and 'Dressing' – as in putting on clothes | The use of OWL within Protégé prohibits the use of duplicate knowledge names; moreover, in the asserted Version 1.0 hierarchy, multiple parents are not allowed. This limits substantially the possibility of ambiguity |
| ***Non-vagueness*** Concept names shall be context free *e.g.* terms such as 'Well-controlled' that rely on a parent term such as 'Diabetes' for their interpretation shall not be allowed | Entities, represented as OWL classes within Version 1.0, are described by fully-specified knowledge names *i.e.* context is included in the names of classes so that they can be interpreted independently of their hierarchical placement, often to the detriment of readability *e.g. ActualNegativeAbilityToWalk* |
| ***Internal consistency*** Relations between concepts should be uniform across parallel domains within the terminology | This would be difficult to demonstrate in practice without performing pair-wise comparisons across the entire terminology. However the high degree of compositionality within Version 1.0 and consistent patterns of pre-coordination do serve to promote consistency across parallel domains *e.g. GrandfatherRole* is a child of *FamilyMemberRole*; through composition *Grandfather* is necessarily a child of *FamilyMember* |
| *Purpose and scope* | |
| ***Statement of purpose and scope*** Any terminology shall have its purpose and scope clearly stated in | The International Council of Nurses provides a clear statement of purpose and scope for ICNP®: "The ICNP® is |

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| operational terms so that its fitness for particular purposes can be assessed and evaluated | a unified nursing language system. It is a compositional terminology for nursing practice that facilitates the development of and the cross-mapping among local terms and existing terminologies" (International Council of Nurses 2007b) |
| **Coverage** The extent to which the depth of coverage is incomplete shall be explicitly specified for each domain and purpose *e.g.* a terminology developer might state that their terminology does not cover job role below the level of principal professional grouping | There is no evidence for Version 1.0 of incompleteness of depth of coverage. However this would be difficult to demonstrate in practice without specifying depth of coverage for each entity represented within the terminology |
| **Comprehensiveness** The extent to which the degree of comprehensiveness is incomplete shall be explicitly specified for each domain and purpose | Version 1.0 complies by inclusion rather than exclusion *i.e.* ICNP® comprises the following nursing elements: phenomena (diagnoses), actions, outcomes (International Council of Nurses 2007b) |
| **Mapping** The degree to which the terminology is "mappable" to other classifications shall be explicitly stated | Previous work has demonstrated that it is possible to map other terminologies to ICNP® through processes that reveal resolvable deficiencies in source and target terminologies and in the mapping process itself (Hardiker et al 2006). However there is no explicit statement that indicates the degree to which mapping is possible. This would be difficult to demonstrate in practice without specifying degree of ability to map to all known classifications |
| *General organisation* | |
| **Structure** The structure of the terminology will be appropriate for the stated purpose(s) and domain of use | Version 1.0 conforms to current best practice for reference terminologies (*i.e.* the mechanism for cross-mapping as cited in the statement of purpose and scope) *e.g.* it is underpinned by description logic and amenable to automated reasoning |
| *Additional organisational characteristics of formal systems* | |
| **Formal definitions** A compositional system shall contain formal definitions for non-atomic concepts | Within OWL, conditions associated with classes represent formal definitions for entities. OWL is |

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| and formal rules for inferring subsumption from these definitions | underpinned by description logic that helps to determining subsumption relations among classes |
| *Explicitness of relations* The formal behaviour of all relations among concepts in a concept system shall be explicitly defined | Within OWL, relations among classes are explicit – there are no implied relations. Version 1.0 is represented in OWL with associated description logic for determining the behaviour of relations among classes |
| *Composite concepts* Composite concepts shall fit into a practical model that extends a terminology | The Version 1.0 ontology comprises OWL classes, properties and conditions. The conditions form part of and serve to extend Version 1.0 |
| *Normalisation of semantics* The extent to which normalization of semantics can be performed formally by the terminology shall be clearly indicated | Although not explicitly stated in the context of Version 1.0, OWL has an explicit formal semantics (World Wide Web Consortium 2004) that can be subjected to automated description logic-based reasoning. It is the responsibility of the reasoner used to explicitly state the degree of normalisation that can be performed |
| *Multiple hierarchies* Concepts shall be accessible through all reasonable hierarchical paths | OWL permits multiple parents for individual classes. While in the asserted Version 1.0 hierarchy, multiple parents are not allowed (see **Non-ambiguity**), Version 1.0 is multi-hierarchical after reasoning |
| *Maintenance* | |
| **Context-free identifiers** Unique codes attached to concepts must not be tied to hierarchical position or other contexts | Sequential numeric codes are arbitrarily-assigned to OWL classes within Version 1.0 (see **Concept orientation**) |
| *Persistence of identifiers* Codes shall not be reused when a concept is obsolete or superseded | There is no evidence of any systems to support quality management and version control for ICNP® |
| *Version control* Updates and modifications shall be referable to consistent version identifiers | |
| *Editorial information* New and revised terms, concepts and synonyms shall have their date of entry or effect in the terminological system, along with pointers to their source and/or authority | |

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| **Obsolete marking** Superseded entries shall be so marked, together with their preferred successor | |

## Summary

Through this exploratory study we have sought:

- to demonstrate the practical applicability of ISO/TS 17117 to its intended users (*i.e.* 'governments, funding agencies, terminology developers, terminology integration organizations, and the purchasers and users of controlled health terminology systems')

- to facilitate the further development and maintenance of ICNP®.

This paper does not constitute a comprehensive statement of conformance of ICNP® to ISO/TS 17117. However, by identifying positive characteristics concerning purpose, scope and organisation, while highlighting significant deficiencies concerning quality management and version control, this initial assessment has demonstrated the usefulness of ISO/TS 17117 for developers of terminologies such as ICNP®.

It has also raised issues to be resolved for ISO/TS 17117, such as how in practical terms to specify **Internal consistency**, **Coverage** and **Mapping**, and whether it is necessary to specify for a formal terminology its semantic properties or whether this should more properly be the responsibility of the particular representation or reasoner used.

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