TECHNICAL IMPLEMENTATION GUIDE

International Classification for Nursing Practice (ICNP) Programme

International Council of Nurses

Contents

1 Introduction

1.1 About this guide

This guide seeks to provide an authoritative source of information to support the development and implementation of electronic record systems that use the International Classification for Nursing Practice (ICNP), a product and programme of the International Council of Nurses (ICN). The guide is particularly relevant to (a) system developers to ensure optimal deployment of ICNP within emerging and existing systems, and (b) health informatics specialists to ensure that the needs of potential users of those systems are fully met. Other people might find the guide useful in improving their technical understanding of ICNP.

1.2 About ICNP

ICNP is a standardised terminology that can support nursing practice and patient care worldwide. In order to achieve this, ICNP is built on a formal Web Ontology Language (OWL)[1] foundation. This formal foundation accommodates both interface properties (to facilitate use at the point of care) and reference properties (to facilitate secondary use of data and harmonisation with other terminologies).

ICNP appears within the Unified Medical Language System, it is recognised by a number of National Nurses' Organisations as a terminology that supports nursing practice, and it is a Related Classification within the World Health Organization Family of International Classifications. There are harmonization/collaboration agreements in place between ICN and SNOMED International (for SNOMED CT) and Sabacare (for the Clinical Care Classification).

A new release of ICNP is made available every two years at the ICN Congress/Conference.

ICNP is distributed as a set of comma separated values (.csv) tables covering, among other things: entities and entity information; hierarchical relationships; inactivated entities and replacements; and a changes log. ICNP can also be distributed as a Web Ontology Language (OWL) file (available on request).

ICNP has been translated from English into a range of spoken languages and there is an increasing number of derived catalogues (or subsets) to support implementation.

There are additional derived products such as hierarchies of pre-coordinated diagnosis and intervention entities (i.e. without elemental entities). This range of representations has been developed to meet the needs of a very diverse ICNP user base. For example, ICNP terms drawn from .pdf representations can be used in paper records as a way of standardising the language of nursing practice in non-technological environments. The focus of this guide is on technical implementation of ICNP in electronic record systems.

[1] The Web Ontology Language (OWL) is used in the development and maintenance of ICNP; it is not intended for end-users and any further description of OWL is therefore out of scope for this guide. Further details on OWL can be found at: www.w3.org/TR/2004/REC-owl-features-20040210/

2 ICNP implementation

2.1 Applications that use ICNP

ICNP is a global terminology that can support a range of different informational processes in health and social care. ICNP has been developed by nurses to support nursing practice and patient care worldwide. However, its reach goes beyond nursing in that it embodies content that is relevant and useful to other disciplines and other areas of health and social care practice.

While the use of ICNP in practice may be very diverse, there are currently four main application areas: (a) clinical recording; (b) data retrieval, aggregation and analysis; (c) decision support and indexing; and (d) terminology tools. The way that ICNP is implemented within each of these application areas has implications for the resulting functionality (see also 2.2 Approaches to ICNP implementation).

2.1.1 Clinical recording

ICNP is commonly used as the terminology component of electronic record systems. ICNP-enabled health record systems are required to provide services that allow for the entry, storage and retrieval of ICNP expressions. These systems may also be required to provide services that allow for the communication of ICNP expressions between systems.

As ICNP has both interface and reference properties, it may be used within these systems as either:

- an interface terminology - providing ICNP expressions to users for selection. The ICNP expressions may be stored as they are, or there may be local linkages between ICNP as an interface terminology and other standardised terminologies, such as SNOMED CT. The use of a single terminology (i.e. ICNP) may be the simpler option as it obviates the need for linkages between interface and reference expressions. However, linkages between ICNP expressions and equivalent expressions within multi-disciplinary terminologies may be useful for shared record-keeping or multi-disciplinary working;
- a reference terminology - providing local terms to users for selection, with local linkages to reference ICNP expressions.

Terminology linkages would generally be defined and held locally within the host system (although exceptions may be ICN-defined transformations between ICNP and other standardised terminologies, such as SNOMED CT).

2.1.2 Data retrieval, aggregation and analysis

ICNP supports the consistent recording of data about individuals and groups of individuals. This consistency in representation facilitates the analysis of data within individual records and from data warehouses. The use of ICNP does not obviate the need for (1) a robust locally-defined model that specifies the content and structure of data required to effect the analysis i.e. an information model, and (2) the specification of queries that can be run against this information model.

The formal foundation of ICNP provides, through the inferred OWL representation, a robust and rich poly-hierarchical structure in which entities are classified in terms of their relationship with each other (as compared to merely an organising framework or a less formal folk taxonomy). As the hierarchy is based on the generic relation only (‘is a’, ‘kind of’, ‘type of’), it facilitates the consistent aggregation of data. For example, if a data warehouse holds the following data on different individuals – Risk for Child Abuse and Risk

for Elder Abuse – then analysts can group these together as instances of the entity Risk for Abuse, by virtue of the fact that within the ICNP hierarchy Risk for Abuse subsumes (is a parent of) the two more specific entities.

2.1.3 Indexing and decision support

ICNP can be used to support a number of knowledge resources such electronic books and decision support protocols through coding or indexing of an external knowledge resource with ICNP entities. This might allow the activation of ICNP-coded decision support protocols or context-sensitive access to an ICNP-indexed electronic reference book from within ICNP-enabled clinical applications.

2.1.4 Terminology tools

2.1.4.1 Browsing ICNP

OWL-enabled ontology browsers/editors allow users to explore the ICNP OWL ontology. Also, the distribution of derived products of ICNP allows users to explore ICNP either through a stand-alone browsing tool (such as ICN's web-based ICNP browser) or as part of a larger application (perhaps accessed via a standard Application Programming Interface).

Browsers will typically allow users to navigate the ICNP hierarchy, and to review information about ICNP entities such as preferred term, synonyms, code, axis and child and parent entities. This information is often represented in a choice of languages. Browsers that form part of larger ICNP-enabled applications may allow users to select ICNP entities, for example for entry into a clinical record or to access an ICNP-indexed external knowledge resource.

2.1.4.2 Authoring ICNP

ICNP relies on the input of many people across the world, for example via the entity submission and review process, through the catalogue development process, and through the work of translators. However, in order to ensure consistent version management, technical development of ICNP is the responsibility of ICN. All changes to ICNP are made under development and maintenance guidelines which form part of a broader quality improvement process. **Ad hoc changes to ICNP, without consultation with ICN, are strongly discouraged.**

At the core of ICNP is an OWL ontology (available only on request). Any meaningful exploration of the ICNP ontology therefore requires an OWL-enabled ontology browser/editor such as Protégé. In contrast, derived products of ICNP such as hierarchies, catalogues and translations are held and delivered as plain text in generic comma-separated values (.csv) files to ensure maximum compatibility with a range of applications. For example, comma-separated values files can be opened and used directly within common spreadsheet applications.

2.2 Approaches to implementation

ICNP can be implemented in applications in different ways and to different degrees depending to a large extent on the intended use of the captured data.

2.2.1 Scope of ICNP

ICNP seeks to cover nursing diagnoses (which may also be used to represent nursing outcomes) and nursing interventions in entirety, accepting that this is a formative process and that nursing covers a broad range of health care and is not a clearly bounded discipline. Elementary entities that help to define the diagnoses and interventions cover a much broader range of content:

- Characteristics, e.g. states such as severity.
- Entities, e.g. materials such as drug.
- Processes, e.g. body process such as thermoregulation.

2.2.2 Clinical context for ICNP entities

While ICNP covers diagnostic and interventional entities, it does not in general provide contextual information about those entities, for example the fact that a particular diagnosis is an intended outcome or goal, or the fact that a particular intervention is a planned intervention. This contextual information should be provided by the information model that is embedded within the application.

2.2.3 Extent of ICNP implementation

Applications can be developed to represent ICNP expressions as pre-coordinated entities only, post-coordinating[2] entities only, or a mixture of the two. Specific views on ICNP can be derived from the axial structure - each entity within ICNP is assigned to one organising axis: Focus (F), Judgment (J), Action (A), Means (M), Location (L), Client (C), and Timing (T). The total set of post-coordinating entities within ICNP form the so-called '7-axis model'. In addition to providing a framework for navigation, the 7-axis model has been used successfully by a minority of applications to guide data entry and support data analysis. The trend, however, has been toward the use of pre-coordinated entities. Pre-coordinated entities - entities that conform to ISO 18104 with respect to diagnosis and intervention statements - are also assigned to one of two special axes: diagnosis entities (DC) and intervention entities (IC). These may be used as implementable terminologies in their own right, independent of the larger ICNP, as the ICNP code provides a unique and stable anchor. Subsets of pre-coordinated entities, perhaps as found in ICNP catalogues, may be used to support data entry and analysis within specific contexts. Note that ICNP catalogues do not equate to ICNP subsets, as they may contain additional information such as organising categories and even entities drawn from other terminologies.

The augmentation of pre-coordinated entities with post-coordinating entities is permissible, for example to ascribe a severity to a diagnosis. However, any framework to guide the qualification of entities would need to be developed locally. Also, developers should bear in mind that, in common with applications that use pre-coordinating entities only, the normalisation of pre-coordinated entities to which qualifiers have been added would not be easy, thereby impacting on data analysis. For example, it would not be easy to reconcile *pain* that is qualified by *acute* at the point of data entry with the pre-coordinated entity *acute pain*. In this situation the pre-coordinated entity would have to be first decomposed into its discrete post-coordinated parts before the reconciliation could occur.

2.2.4 Building ICNP hierarchies

In order to build ICNP hierarchies, whether it is for individual axes, or for ICNP in entirety, two files are needed. The asserted.csv file provides information about the entities themselves, and the inferred.csv file provides the parent-child hierarchy.

Note that, in common with other OWL ontologies, ICNP is poly-hierarchical in nature - a child entity may have more than one parent entity. This should be borne in mind when developing a specification for hierarchical display - a traditional simple indented listing may not lend itself on its own to poly-hierarchical ordering.

[2] Post-coordinating entities are the building blocks of post-coordinated entities. For example the entities acute and pain are post-coordinating entities. Together they make up the post-coordinated entity acute + pain.

Note also that the axial structure does not necessarily follow the inferred OWL hierarchy - a child entity within the OWL hierarchy may be within a different axis to its ancestors, for example drug (M) is in a different axis to entity (F). As the axes themselves are organising categories, they do not form part of ICNP itself - they do not appear in the ICNP OWL ontology and are not coded. This means that certain entities within an axial representation will have no root (no uppermost entity in the ICNP hierarchy). These rootless entities are included in a file, *roots.csv*, as part of the ICNP distribution. In an application that is based on the 7-axis representation, each of the entities in the file would need to be associated within the application itself to a locally-defined axis entity, which would form the upper level from which each axis would 'hang'. For example, in such an application, an axis entity corresponding to Means would need to be locally defined – ICNP entities within the ICNP Means axis such as drug (M) would then need to be associated with the locally-defined Means axis entity.

2.2.5 Entry, rendering, storage, retrieval and communication of ICNP

Each entity within ICNP has an associated code that uniquely identifies the entity. There may be cases, for example in certain types of message, where human interpretation is not necessary. However, in many cases, data transferred under ICNP is intended to be read. While entities will have a preferred term in the particular language of use, they may also have a synonym or set of synonyms. As synonyms, the meaning of terms associated with entities will be equivalent. However, it might be important to capture the original 'flavour' of the entered data. For example, a particular user group may be accustomed to a particular vernacular – the use of less familiar terms, even if they are the preferred terms, might make those terms more difficult for particular users to read. Therefore, where ICNP data is intended for human interpretation, it is recommended that both the code and original term (either the preferred term or the synonym, along with a language code) are stored and communicated. For many applications, both for data entry and for retrieval, only the term itself will need to be displayed on the user interface but a link must be maintained to the original code (and possibly the language).

In post-coordinating systems, such as those based on the 7-axis model, the use of techniques to generate naturalistic language might make it easier for users to interpret data that has been entered, stored and communicated. In such systems, a locally-defined underlying data model should be developed to ensure that the original intended meaning of the post-coordinated expression is preserved – this may include not only the storage and transmission of all post-coordinating entities, but also the relationships between entities. The precise ways in which pre-coordinated and post-coordinated entities are stored is not covered in this guide except to note that:

- if a pre-coordinated entity (IC or DC) is selected to represent a clinical entity, then the entity code should be stored, perhaps with the original term used for the selection;
- if a pre-coordinated entity is augmented with a post-coordinating entity, or if an expression is post-coordinated (as in the 7-axis model), then all entity codes should be stored, again perhaps with the original term used for the selection, in a manner that represents the original intended relationships between them.

No transformations should be made of the entities or set of entities that might change the original intended meaning.

3 Structure and content of ICNP

3.1 ICNP Technical Overview

3.1.1 Components

At the heart of ICNP are entities. These are representations of entities that may be of interest to nurses, other health care workers, patients, carers, and so on. Entities are accessed or interpreted by labels:

- Knowledge names, written in pseudo-English that uniquely describe the entity in a single word (using camel back notation *likeThis*), are intended primarily for the developers and translators of ICNP.
- Preferred terms, written in a relevant spoken language, identify (not necessarily uniquely) and bring to life the entities for the majority of users of ICNP.
- Synonyms, again written in a relevant spoken language, provide any number of alternatives to preferred terms.

Entities have additional unique associated identifiers which are 8-digit numerical entity codes. These are meaningless codes, with a checksum[3], that are assigned in sequential order as new entities are represented (any hierarchical relationships between entities can be derived from the *inferred.csv* release file – see Release file specification).

Many entities have legacy entity descriptions. Newer entities tend to have the asserted parent preferred term as the description. In order to prevent misinterpretation of entities, the goal is for preferred terms to be self-explanatory – therefore ICNP entity descriptions are no longer being maintained and may be removed locally as appropriate.

3.1.2 Derivative and related products

There are two main derivative products for ICNP:

1. Catalogues
   ICNP entities and and/or other informational resources that are relevant for a particular context, purpose, domain, patient group, and so on.
2. 7-axis model
   This is essentially a catalogue that provides an alternative representation of ICNP in which post-coordinating ICNP entities are organised into one of seven so-called axes: Focus (F), Judgment (J), Action (A), Means (M), Location (L), Client (C), Timing (T). As mentioned previously, while there have been some successes with the 7-axis model, the trend has been to use pre-coordinated entities (made manifest through the IC and DC axes).

There are two additional related ICNP products:

1. Translations
   ICNP (both English preferred terms and descriptions) is translated into a number of different spoken languages and these translations form their own related ICNP products.

2. Mappings

[3] A checksum is derived from the code itself and is appended to the code. The checksum can be used to detect errors in transcription, storage or transmission.

Semantic equivalencies between ICNP entities and entities in other terminologies have been developed in order for ICNP to fulfill its role as a 'unifying framework'.

3.1.3 Formal model

The Web Ontology Language (OWL) representation (in OWL/RDF) of ICNP comprises active classes (labeled with knowledge name) and any associated properties and restrictions. Classes and properties are arranged in a mono-hierarchy. While this representation embodies rich formal definitions for ICNP classes, the representation as released has not yet been subjected to automated reasoning (although it has been checked for consistency in modeling). This representation is commonly referred to as the 'asserted OWL representation' (available on request), in contrast to the 'inferred OWL representation' which has been subjected to automated reasoning. The inferred OWL representation is used internally to validate ICNP itself and to derive the tabular representation of ICNP. However, users of ICNP can construct the inferred OWL representation by subjecting the asserted OWL representation to automated reasoning.

It is assumed that users of ICNP make most use of the tabular representation, the OWL representation being used primarily as a reference to validate formal definitions or hierarchical placement, or for other research. It should be noted that changes to the OWL representation are tracked and logged as part of the change management process. However, unlike for the tabular representation, no change sets are available for the OWL representation. Updating the OWL representation for users of ICNP would consist of replacement of the OWL file in entirety.

The OWL representation is used by ICN to derive a tabular representation. Note that certain aspects of the OWL representation - properties (with characteristics such as transitivity), conditions, disjunction, covering axioms, and so on - are not represented in the tabular representation; these are relevant to ICNP development only.

3.2 Release file specifications

Most users of ICNP will use the tabular representation. The tabular representation of ICNP is released as a compressed file comprising the following 6 files along with *roots.csv* (see previously) and README, VERSION and LICENSE text files:

a. Entities table (labeled asserted.csv)
b. Hierarchy table (labeled inferred.csv)
c. Changes table (labeled editorial_changes.csv)
d. Inactivated entities table (labeled inactivated.csv)
e. Replacement entities table (labeled replaced.csv)
f. New entities table (labeled new.csv)

Table 1 details the content of each of these files and of the files associated with other internal and external releases. Note that there is no prescribed length for elements within the tables.

Table1. Data Elements Included in ICNP Release Files

	Concept Code[3]	Knowledge Name[4]	Preferred Term	Description	Axis[5]	Originating Version	Old code	Parent code	Parent Preferred Term
Tabular representation									
Entities table (asserted.csv)	X	X	X	X	X	X			
Hierarchy table (inferred.csv)	X		X					X	X
New entities table (new.csv)	X	X	X	X	X	X			
Replacement entities table (replaced.csv)	X	X	X	X	X	X	X		
Inactivated entities table (inactivated.csv)[1]		X	X		X		X		
Changes table (editorail_changes.csv)	X		X		X				
Roots table (roots.csv)	X								
OWL representation: Asserted	X	X	X	X	X	X			
Catalogues (PDF version)	X		X						
Translated entities table[2]	X	X	X	X	X	X			

[1] The inactivated table is derived from the manually maintained change logs. The OWL representation does not include inactivated concepts.
[2] The translated entities table includes an additional three columns – preferred/synonym, translated term and translated description.
[3] Each concept code is a unique numeric number.
[4] Each knowledge name presents a unique textual description of a concept.
[5] Primitive concepts are assigned to one of seven axes (F, J, M, A, T, L, C) while pre-coordinated concepts are presented as either DC (diagnosis and outcome concept) or IC (intervention concept).

4 ICNP in health records

ICNP seeks to provide content. In relation to health records it is important to note that ICNP consciously does not attempt to represent contextual information such as 'history of' or instance-level data such as dates, times, other numerical information such as points on a numerical scale, the specific person recording or receiving care (other than general entities such as yesterday or child). To represent these entities would be out of scope for the terminology.

Also, while pre-coordinated entities are identifiable through the DC and IC axes, this does not mean that they are confined to health record sections corresponding to 'Diagnosis' and 'Intervention'. For example a DC entity might just as likely appear in a 'Goal' section or an 'Outcome' section. An IC entity might be planned, postponed, abandoned, carried out, and so on. ICNP does not seek to provide such context. The designation of an entity as DC and IC therefore should act as a guide to indicate only that the entities are either diagnostic or interventional in nature.

5 Change Management

A robust change management process is in place to direct and guide any necessary changes (the vast majority of which are new pre-coordinated entity additions). The ICNP development team may delete (inactivate) or make minor amendments to (change) existing classes and properties or add new classes or properties in the OWL representation of ICNP (which are cascaded to the tabular representations). The majority of changes require inactivation (with replacement as appropriate) of a class or property. However, minor changes to terms, descriptions, capitalisation, punctuation, spelling or style that do not affect the underlying meaning of a component are permitted. However, the default is inactivation with replacement as appropriate (remove/delete and add/new).

While it would be possible for implementers of ICNP to make changes from release to release of ICNP using information from all of the files other than the entities table (i.e. *asserted.csv*), a more practical solution, depending for example on local adaptations and/or extensions, would be to replace both the *asserted.csv* and *inferred.csv* files in their entirety, using the additional files, particularly the *changes.csv* file to ensure the value of historical data. The same applies also for the OWL representation. This does not apply to translations of ICNP. Translation is an ongoing process and there may be occasions where translations need to be updated mid-cycle without the need for changes to ICNP itself.

6 Contact

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