Abstract
The purpose of this study was to translate and integrate nursing diagnosis concepts from the Clinical Care Classification (CCC) System Version 2.0 to DiagnosticPhenomenon or nursing diagnostic statements in the International Classification for Nursing Practice (ICNP®) Version 1.0. Source concepts for CCC were mapped by the project team, where possible, to pre-coordinated ICNP terms. The manual decomposition of source concepts according to the ICNP 7-Axis Model served to validate the mappings. A total of 62% of the CCC Nursing Diagnoses were a pre-coordinated match to an ICNP concept, 35% were a post-coordinated match and only 3% had no match. During the mapping process, missing CCC concepts were submitted to the ICNP Programme, with a recommendation for inclusion in future releases.


Introduction
Structured nursing terminologies are needed to drive, document, and evaluate nursing practice. This requires terminologies with formalized and expansive models (ontologies) and formal definitions of meaning.1 Nursing documentation systems use different standardized nursing terminologies within electronic health records (EHR). These standardized nursing terminologies need to be aligned in order to provide interoperable and comparable data. The long-term solution is to translate and integrate nursing terminologies to a terminology with formal semantic structures.

Case Description
The intent of this project was to map the Clinical Care Classification System (CCC) Nursing Diagnoses into the International Classification of Nursing Practice (ICNP) DiagnosticPhenomenon. The CCC system is a nursing terminology with a broad coverage of pre-coordinated nursing diagnoses.2 The ICNP was developed by the International Council of Nurses (ICN) which represents 126 countries. It is intended to be used worldwide.3 The ICNP is a reference terminology for nursing with established semantic rules, for creating nursing problems using atomic level values. The semantic rules, or formal definitions, can be used to map and accommodate existing terminologies. The ICNP is an ontology and the nursing diagnostic statements are represented formally as classes and properties.4

The components needed to conduct the study were the source terminology (CCC), the target terminology (ICNP), the ICNP 7-Axis terminology model and the ICNP 1.0 Web Ontology Language (OWL) based ontology. The two ICNP representations provided references for the mapping. It was essential to have the active participation of the terminology developers to understand the semantic intent of both the pre-coordinated concepts in the source terminology and the atomic values in the target terminology.

Method
The methodology for the project comprised four steps: education, translation, validation, and integration. Education consisted of developing an understanding of the semantics of the CCC model. This was primarily lexical with some informal definitions and dialogue with the developer. Education for ICNP involved developing a clear understanding of the elements of the formal semantic definition of the ICNP ontology. This required a review of the lexical tags with all relationships and their defining attributes and instruction from ICNP experts.

The translation began with the assessment of the CCC concept meaning within the scope and definitional model of ICNP to determine if the ICNP ontology had sufficient expressive power to represent the semantics of the source concept. Each CCC Nursing Diagnosis was dissected into the ICNP atomic level values using the CCC name and (informal) definition to establish concept meaning. We determined if a pre-coordinated concept existed within ICNP. If no match to the pre-coordinated concept existed, we evaluated if the ICNP ontology had adequate classes, defi-
nitional relationships, and attributes to express the source concept in a post-coordinated expression.

The formal definition (decomposition) for each Nursing Diagnosis was reviewed by members of the team and discussed until consensus was reached. The CCC to ICNP mappings were reviewed by experts involved in the development of both terminologies. Final validation of the mappings was made by consensus of the terminology developers.

The CCC concepts that could be matched were integrated into ICNP (Figure 1). When required, the additions of ICNP DiagnosticPhenomenon or atomic level values were requested from ICN for inclusion in the next ICNP version.

Example

The ICNP contains pre-coordinated diagnostic and interventional statements. A nursing diagnosis appears in the ICNP hierarchy as a DiagnosticPhenomenon. DiagnosticPhenomenon always include a value in two of the seven axes: Focus (the area of attention) and Judgment (clinical opinion). The Knowledge Name is a structured concatenation of the atomic level values in the ICNP ontology.

The CCC problem concepts (n = 182) were mapped to ICNP concept(s), where possible, and the mapping was assigned one of the three types: 1) pre-coordinated match (Table 1) (62%); 2) post-coordinated match (Table 2) (35%); or 3) no match (3%). Four sets of CCC nursing diagnoses were considered duplicates because they decomposed identically. There were seven CCC concepts which could not be mapped. The reasons for these mapping failures were 1) in 5 cases ICNP did not contain Focus values related to non-compliance nursing diagnoses and 2) the CCC definitions of “Polypharmacy” and “Contraceptive Risk” were deemed to be ambiguous and could not be fully defined. The following tables provide an example of the mapping.

Discussion

The different approaches used for ICNP and CCC development resulted in some challenging and stimulating discussions among the researchers. The atomic level values identified for the decomposition of the CCC Nursing Diagnosis needed to be validated after a possible ICNP match was identified. The ontology provided a Knowledge Name that represents a formal, structured concept and decomposition syntax.

It became apparent to the researchers that the descriptions, the formal ontology definitions, and the preferred term (display name) were essential to understand the ICNP concept meaning. However, some 7-Axis Model concepts were missing descriptions. Also, the preferred term name did not match the ontology Knowledge Name (e.g., ‘Caregiver Role Strain’ = ‘ActualCaregiverStress’). Without consistent clarity and agreement between the ICNP preferred term, the concept description in the 7-Axis Model and the Knowledge Name in the ontology, the researchers needed to create a new description. Consultation was required with ICNP experts to resolve concept meaning discrepancies. The presence of clear and clinically relevant descriptions would assist in future mapping and use of ICNP.

It also was recommended to ICN that they provide a more comprehensive synonym list for use in searching and matching. For example, the word ‘Compliance’ in CCC appeared to be synonymous with the word ‘Adherence’ in ICNP concepts. The definition for ‘Compliance’ and description for ‘Adherence’ were compared and validated to be synon-
ymous. Therefore, CCC Compliance-related problems were mapped to ICNP Adherence-related concepts.

In discerning concept meaning, the researchers interpreted several CCC words in the problem names as being synonymous with the ICNP ‘Negative’ Judgment. The researchers needed to ensure that words such as Imbalance, Impairment, and Ineffectiveness were truly equivalent to an ICNP ‘Negative’ Judgment. After detailed discussions with ICNP experts, the conclusion was that Impairment, Imbalance, and Ineffectiveness are equivalent, at least within this particular context and purpose of mapping from CCC to ICNP ‘Negative’ Judgment.

The use of ‘Unspecified’ concepts was noted in three CCC Nursing Diagnoses; ‘Unspecified Pain’, ‘Unspecified Constipation’, and ‘Unspecified Infection’. The researchers mapped them to the corresponding ICNP DiagnosticPhenomenon. For example, the CCC Nursing Diagnosis ‘Unspecified Pain’ was mapped to ‘Actual Pain’ in ICNP. It was recommended that CCC remove the ‘Unspecified’ concepts in the next release. This resulted in removing two problems from CCC source list because the concept without the word ‘unspecified’ already existed.

Issues of granularity were addressed. In at least one case, the CCC Nursing Diagnosis name was very specific and ICNP had a more general Focus value. For example, the CCC Nursing Diagnosis ‘Verbal Impairment’ did not match the ICNP Focus value of ‘Negative Communication’. The ICNP class name and description were not specific to verbal communication. No match was defined. The researchers worked with ICN to add a more specific value, Ability to Communicate by Talking. When this new concept was used as a Focus value with a Judgment of Impairment (e.g., ‘Negative’), a match could be made.

In one case, there was ambiguity in the CCC definition. ‘Contraception Risk’ which is defined as: “Increased chance of harm by preventing the conception of an offspring/child.” The researchers could not determine the nature of the problem from the CCC definition because they did not know if it referred to risk due to oral contraceptives, latex allergy or other possible contraceptives. Therefore, it was not possible to decompose and subsequently match the concept to ICNP.

Conclusion
This study demonstrated that some modification is required of each terminology in order to accommodate the concepts of the other. Even though the two terminologies compared in this study have differences in their structure, CCC could still be mapped to ICNP with a high degree of success because ICNP provided an ontology-based reference terminology with syntactic consistency and the ability to post-coordinate.

The findings correspond with conclusions from previous work (e.g., Hardiker 2003) that lexical problem name comparison is useful, but not sufficient on its own, to determine semantic equivalence. The approach employed in this study all but guarantees a meaning match, when such a match exists, between the CCC Nursing Diagnosis and the ICNP DiagnosticPhenomenon. Decomposition was important to establishing unambiguous concept meaning.

The purpose of this study was to integrate CCC Nursing Diagnoses into ICNP. This collaborative effort has the potential to enhance healthcare terminologies and to improve interoperability across EHR systems that may use these terminologies independently or in association. Efforts such as this, while labor intensive, suggest a feasible means to use multiple nursing terminologies to support the data needed to accommodate decision support, research, and clinical functions.

References