Research Paper ■

The Adequacy of ICNP Version 1.0 as a Representational Model for Electronic Nursing Assessment Documentation

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Abstract **Objectives:** The purpose of this study was to evaluate the adequacy of the International Classification of Nursing Practice[1] (ICPN) Version 1.0 as a representational model for nursing assessment documentation.

Design and Measurements: To identify representational requirements of nursing assessments, the authors mapped key concepts and semantic relations extracted from standardized and local nursing admission assessment documentation forms/templates and inpatient admission assessment records to the ICNP. Next, they expanded the list of ICNP semantic relations with those obtained from the admission assessment forms/templates. The expanded ICNP semantic relations were then validated against the semantic relations identified from an additional set of admission assessment records and a set of 300 randomly selected North American Nursing Diagnosis Association defining characteristic phrases. The concept coverage of the ICNP was evaluated by mapping the concepts extracted from these sources to the ICNP concepts. The UMLS Methathesaurus was then used to map concepts without exact matches to other American Nursing Association (ANA) recognized terminologies.

Results: The authors found that along with the 30 existing ICNP semantic relations, an additional 17 are required for the ICNP to function as a representational model for nursing assessment documentation. Eight hundred and five unique assessment concepts were extracted from all sources. Forty-three percent of these unique assessment concepts had exact matches in the ICNP. An additional 20% had matches in the ICNP classified as narrower, broader, or "other." Of the concepts without exact matches in the ICNP, 81% had exact matches found in other ANA recognized terminologies.

Conclusions: The broad concept coverage and the logic-based structure of the ICNP make it a flexible and robust standard. The ICNP provides a framework from which to capture and reuse atomic level data to facilitate evidence-based practice.

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Introduction

As health care organizations transition from paper to electronic clinical documentation systems, it is vital that consideration be given to representing nursing data in ways that are sharable and that preserve the complexity, context, and richness of patient care. Standard vocabularies provide unambiguous and consistent representation of data for sharing and reuse,[2] but multiple vocabularies are needed to represent the complexity and variation that exist across domains of practice and levels of care.[3–5] Many members of the American Nursing Association (ANA) recognize that nursing vocabularies include lists of terms that were created to describe a particular domain of nursing practice.[a] These vocabularies are important because they ensure that diverse domains of nursing practice are represented. However, in addition to providing a rich set of atomic concepts, formal coordination rules are needed to support representation of more complex concepts. The concept coordination rules of some of the ANA accepted nursing terminologies lack sophistication and when used in isolation, may not support lossless data transformation.[6–9] The International Classification of Nursing Practice (ICNP) is a reference terminology. The ICNP includes both taxonomy of atomic level nursing concepts and the semantic relations needed to guide the ways that terms are used to represent nursing activity states

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[a]See ANA. Recognized terminologies at: http://nursingworld.org/npii/terminologies.htm.

in a clinical information system (CIS). However, the ICNP was not developed to represent nursing assessment. Most of the work to date with the ICNP has involved other phases of the nursing process (e.g., diagnosis, intervention, and evaluation). In this paper we evaluate the adequacy of the ICNP concepts and semantic relations for representing nursing assessment documentation.

The International Council of Nurses developed the ICNP[1] as a unified nursing language system to articulate the contributions of nursing to health and health care globally and to promote harmonization among existing nursing standards.[1] The ICNP Version 1.0 is a logic-based compositional terminology for nursing practice,[10]encompassing entities and relationships relative to the nursing process[b] across diverse care settings globally. While work to date suggests that the ICNP holds promise for representing nursing activity states in a CIS,[10–13] application in real clinical settings is needed to determine the degree to which it actually fulfills this potential and can be used in a CIS by healthcare organizations. Most of the work to date with the ICNP has involved other phases of the nursing process. We found we could not proceed with codifying and structuring Partners HealthCare's (PHS) nursing assessment documentation content for electronic documentation using the ICNP framework without first doing this evaluative work. Our ultimate goal through this work is to put in place a core infrastructure in our CIS to enable evidence-based nursing practice.

The specific aims for this study were as follows:

- to identify the key concepts and semantic relations necessary to unambiguously represent standardized and local patient assessment items,
- to evaluate the degree to which semantic relations necessary for nursing assessment documentation are unambiguously represented by the ICNP,
- to evaluate content coverage of the ICNP with respect to its expressiveness and flexibility for representing nursing assessment concepts,
- to propose a set of recommendations to ICNP for extensions necessary for electronically representing nursing assessment documentation.

Background

International Classification of Nursing Practice

The International Classification of Nursing Practice (ICNP) Version 1.0 is a logic-based compositional terminology developed by the International Council of Nurses to do the following:[1]

- serve as a unified nursing language system,
- articulate nursing's contribution to health and health care globally,
- promote harmonization among existing nursing standards.

The ICNP Version 1.0 represents nursing phenomena and actions and is designed to be comprehensible by both computers and humans. ICNP Version 1.0 is maintained in the Web Ontology Language (OWL). One public "view" of the OWL ontology is the so-called 7-axis model. In this representation, entities are arranged into one of seven axes: focus, judgment, means, action, time, location, and client.[1] A primary aim of the ICNP is "to provide nurses a unified nursing language system to represent and document what nurses do in a variety of nursing settings."[1] To fulfill this goal, the ICNP must support documentation across all phases of the nursing process. If successful, one would expect that the ICNP provides a means to capture atomic level data that can be employed to support the application of evidence to practice and the building (or extraction) of evidence and nursing knowledge from practice.

Nursing Assessment Conceptual Framework: the PHS Nursing Assessment Domain Model and Evidence Based Practice

Nursing assessment has been defined as "the way in which a nurse gathers and evaluates data about a client (individual, family, or community)."[14] Assessment is the first step in the nursing process. The primary purpose of the assessment phase of the nursing process is to gather data and information necessary to support identification of patient problems and symptoms that are sensitive to nursing care. Moreover, nursing assessment provides an evidence base from which communication and referrals to other disciplines are made.[15,16] The nursing assessment database provides the foundation of care planning and represents the basis on which patient status is evaluated. A complete database is essential for effective communication, problem identification, planning of interventions, and evaluation of patient progress towards recovery goals.[16] A detailed representational model of assessment data is critical for data quality, documentation consistency, and to support evidence-based nursing practice. While rich terminologies and guidelines are available to support the diagnosis, intervention, and outcome phases of the nursing process, few nursing terminology resources exist for representation of the assessment phase of the nursing process. This is despite the fact that assessment is intended to provide a foundation for the iterative cycles of the nursing process and to produce abundant fine-grained reusable data. Capture and reuse of assessment data are a prerequisite for decision support in knowledge-based CISs.

In recognition of the role that accurate, complete, and ubiquitous patient assessment data and information play in the delivery of effective care, automation of these data in non-acute settings has received significant support at the federal level. Electronic capture of these data is now mandated in long-term care facilities and home health agencies for Medicare reimbursement.[17,18] Moreover, accreditation bodies (The Joint Commission on Accreditation of Healthcare Organizations), patient advocacy groups (Leapfrog), payers (Centers for Medicare & Medicaid Services – CMS) and quality groups (American Nurses Credentialing Center/National Quality Forum – ANCC/NQF) are driving standardization of nursing assessment documentation to support tracking of the impact of nursing care on patient outcomes. Integration of standard assessment scales provides a means of standardizing content and data collection across sites, establishing a baseline, and providing comparative data for benchmarking. The Braden Scale (skin risk

[b]Nursing process: Assessment, diagnosis, outcomes/planning, implementation and evaluation See: http://nursingworld.org/EspeciallyForYou/StudentNurses/Thenursingprocess.aspx.

inventory) and the Morse Fall Scale (fall risk assessment scale) are examples of standardized data used in admission assessments. In 2005, a group of nurses from across Partners HealthCare sites collaborated to define a core set of assessment data and information necessary for providing quality care and tracking nursing sensitive patient outcomes across the healthcare system.[19] While many disparate documentation systems existed during the course of the study, the vision of this group was to lay the groundwork for ubiquitous access to assessment data and information within and across sites providing nursing care. To this end, a core set of assessment items was defined for use across Partners HealthCare's facilities, including standardized assessment scales when available (e.g., Braden and Morse). In the absence of standardized assessment scales, consensus was garnered regarding standardization of local assessment items.

Standardized assessment content alone is insufficient to support evidence-based practice. The capture of atomic level data that reflects actual patient status is also needed.[20] Transfer of data to a structured, codified format is necessary for data storage, retrieval, and analysis. The use of the ICNP as a compositional vocabulary within the CIS provides a foundation for capture of atomic level data. Data can then be used as building blocks for evidence-based practice, triggering decision support for applying evidence to practice and for building evidence from practice.[21] Controlled terminologies and the information model provide an infrastructure that supports codified data. Both key atomic level concepts and the semantic relations that provide ways to associate concepts are necessary to unambiguously represent a domain. Both terminology models and information models of a domain carry aspects of key concepts and semantic linkages among them. The two models share a common goal: to provide an unambiguous representation of a domain. However, the lack of clarity regarding terminology model versus information model components has been a consistent confounder of earlier terminology work and has been identified as an important area for informatics research.[6,10,11,22] The literature suggests that, in general, an information model guides the types of data that will be represented in a CIS and the ways in which data and information relate to each other and are stored in that system. Definitional concepts and relationships are found in the terminology model, but the distinction is often blurry.[22–25] In this study we used the ICNP as a starting point for exploring terminology and information model requirements of the PHS nursing assessment domain (NAD) model. This method provided a means to identify the key concepts and the semantic relations that are needed to support electronic nursing assessment documentation without deliberation on the blurred distinction between the information model and the terminology model components. We aimed to evaluate the ICNP concepts and semantic relations against the total representational requirements of the PHS nursing assessment documentation. Through this work, we aimed to test the robustness of the ICNP and identify any extensions needed to support electronic nursing assessment documentation at PHS.

Figure 1 depicts the representational requirements of wound assessment documentation at PHS. The key components of wound assessment are collectively labeled "domain model." As illustrated in Fig 1, the PHS NAD model for wound assessment includes both information model and terminology model components. The information model specifies the properties of the target assessment concepts (e.g., defines what properties of the target assessment concepts are considered in a given context or CIS). The value concepts of the property are provided by the standardized terminology. The semantic relations link properties to their value concepts.

To better understand the adequacy of ICNP to support electronic nursing assessment documentation across PHS, it was necessary to evaluate the NAD model, focusing on both terminology and semantic relation requirements. Using ICNP as a standard provided a base set of concepts and semantic relations against which the total terminology and semantic relations requirements for patient assessment could be evaluated. Because the ICNP accommodates both terminology concepts at the atomic level and semantic

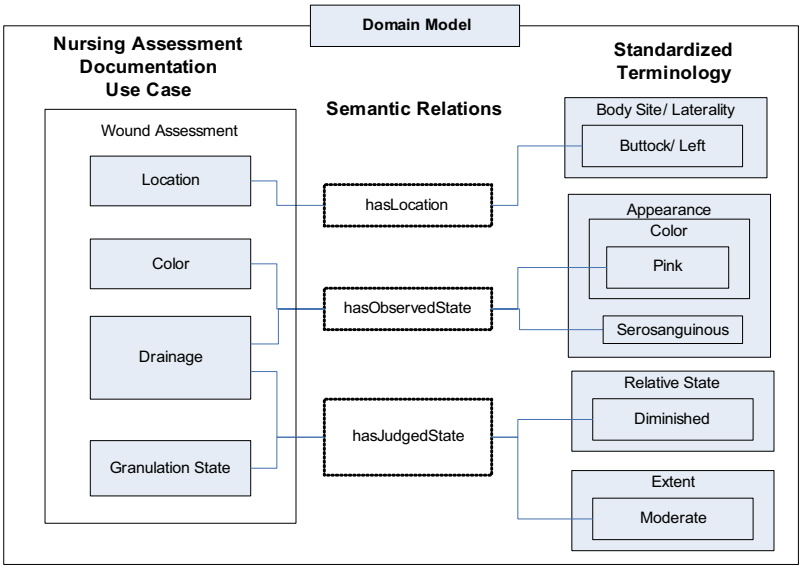

Figure 1. Key components of the PHS nursing admission assessment domain model for wound assessment. The PHS NAD model does not distinguish between information model and terminology model components.

linkages, it provides the infrastructure for representing the PHS NAD model. The focus of this study was on identifying gaps in the ICNP semantic relations and concept coverage for representing nursing assessment documentation.

Methods

Model Formulation

1. Materials

To identify key concepts and semantic relations required to represent assessment concepts, we manually parsed the contents of existing admission assessment documentation items from across levels of care at partners healthcare system (PHS). We first parsed the set of core nursing assessment items used at all sites and the nursing admission assessment documentation templates adopted at four PHS affiliated hospitals (two academic medical centers, one Community Hospital and one rehabilitation hospital). The set of core nursing assessment items contain 223 items considered essential for capturing on all patients who receive nursing care in PHS Hospitals. Additional population-specific assessment items are included on the site-specific admission assessment documentation templates. Together these items (223 core + 915 site-specific), encompass the nine functional health domains used for admission assessment documentation across PHS: health perception–health management, nutritional–metabolic, elimination, activity–exercise, sleep–rest, cognitive–perceptual, self-perception–self concept, role–relationship, sexuality–reproductive, coping–stress tolerance, and value–belief patterns.[15] Nurses use the data derived from the admission assessment as the basis for identifying problems and formulating a plan of care.

The nursing admission assessment documentation templates are part of a structured documentation system. Because electronic nursing documentation is not available at all sites, the templates exist both in paper and electronic formats. Most of the assessment items are structured (e.g., each item includes a set of standard responses) however, some items are associated with a free text response. Ongoing research and development work within PHS aims to produce an integrated electronic nursing documentation system that includes admission nursing assessment documentation. Although nursing admission assessment templates were developed individually at each site, some overlap exists in the items across the human functional health patterns. Nine hundred fifteen (915) assessment items were collected from the four admission assessment documentation forms/templates.

2. Building the Model

a. Ensuring the Consistency in Capturing the Key Concepts and Semantic Relations. Four reviewers (PCD, HK, DG, JC) with graduate level informatics training and significant clinical nursing experience parsed the assessment items into key concepts and semantic relations required for capture and reuse of assessment data without loss of context. As noted previously, the process of capturing key concepts and semantic relations is not an exact science; consensus building and preprocessing is required to ensure consistency.[26] Therefore, to ensure consistency with the way that the reviewers parsed the assessment items and to identify an initial set of semantic relations that are not included in the ICNP Version 1.0 but are required for the parsing, the 223 high-level core assessment items were parsed through open discussion.

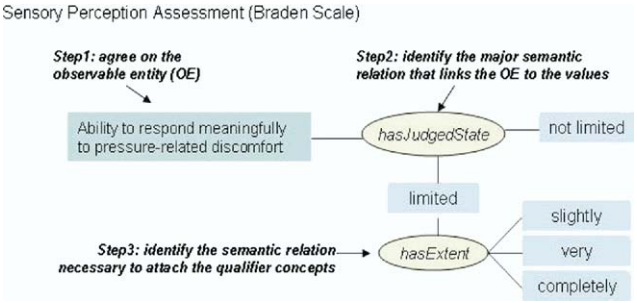

Figure 2. Parsing method for sensory perception status from the Braden scale.

Because the web version of the ICNP Version 1.0[c] (i.e., the 7-axis model) does not explicitly identify the semantic relations that it provides, we obtained the OWL version of the ICNP from the ICN wherein the semantic relations are explicitly listed. To build consensus, the reviewers agreed first on the observable entity or focus of each assessment item. Next, the semantic relations needed to represent context were identified and mapped to available relations in the OWL version of the ICNP. For example, sensory perception status on the Braden Scale is depicted in Fig 2. The reviewers agreed that the observable entity or "focus" was "ability to respond meaningfully to pressure related discomfort." Because this item was derived from a validated assessment scale, the entire item was used as the observable entity. The nurse decision-making process related to a patient's ability to respond meaningfully to pressure related discomfort requires a semantic relation to represent a nursing judgment (e.g., hasJudgedState) and often requires further qualifiers. In this example, if the nursing judgment of the patient's ability is "limited," then an additional qualifier is needed to describe the extent of the limitation. The ICNP semantic relation "Has extent" was used to associate the qualifier values (e.g., slightly, very, completely).

Because of the initial parsing exercise of the 223 high-level core admission assessment items, we added 14 semantic relations to the 30 semantic relations in the OWL version of the ICNP. In addition, this exercise allowed the reviewers to reach consensus on parsing procedures. The reviewers then independently parsed 40 additional assessment items randomly selected from the admission assessment templates from the four PHS hospitals. Inter-rater agreement for these 40 items was 0.6513 ($p < 0.0001$) when assessed by calculating intraclass correlation using SPSS v10.1.

b. Capturing key concepts and the semantic relations from the initial nursing assessment templates and patient data. The reviewers then parsed the remaining 875 assessment items collected from the admission assessment documentation forms of the four hospitals. After obtaining approval from the PHS institutional review board (IRB), we conducted a review of 120 records to capture the contents documented in the admission assessment templates as free-text. Thirty

[c]http://www.icn.ch/icnpweb.

charts were randomly selected from lists of patients discharged from four PHS hospitals in Mar 2006 and divided into two sets of 15 records from each hospital. The first set of 60 records was reviewed to harvest concepts and semantic relations appearing in the free-text fields. The remaining set of 60 records was used as a validation set. The reviewers entered the key concepts and the semantic relations comprising the nursing assessment concepts into excel spreadsheets for review and further analysis. From this activity, 714 key concepts and 3 new semantic relations were obtained. This brought the total of new semantic relations to 17. The semantic relations obtained from the ICNP and the assessment documentation templates are presented in Table 1.

c. Extending the Existing ICNP Conceptual Structure. The existing ICNP was extended in two ways: semantic relations and major concept classes. First, we added newly identified semantic relations to the existing conceptual structure of the ICNP. This was done through open discussion among the reviewers who each had experience in nursing practice and formal training in informatics. Linking the new relations to the existing ICNP semantic relations was generally straightforward and involved finding an appropriate location for each new semantic relation. Second, we placed the concept classes that linked to the existing ICNP concept classes within the new semantic relations. The extensions to the ICNP conceptual structure needed to support nursing assessment documentation are presented in Fig 3. Each box represents the seven major concept axes of the ICNP. The Client axis was changed to Actor to better represent its role as a performer of actions such as judgment and observation. The Judgment axis was changed to State to represent observed state as well as judged state.

Table 1 ■ The Semantic Relations Required for Representing Nursing Assessment Data*

Semantic Relations Required for Representing Nursing Assessment Data	
actsOn	Has state
hasRecipientOfCare	hasObservedState
hasInterventionalTarget	hasObservedState-Texture
isStatusAppliedTo	hasObservedState-Odor
Has location	hasObservedState-Appearance
isAggregateOf	hasObservedState-Color
isManifestationOf	hasObservedState-Clarity
Has cause	hasObservedState-Shape
hasAssociatedFactor	hasObservedState-moistness
hasAggravatingFactor	hasPattern
hasAlleviatingFactor	hasPositionState
hasRole	hasCentralPerpheralPositionState
hasTime	Has laterality
ExistsDuring	hasAbsoluteLevelState
OccursAfter	Has amount
OccursAt	Has frequency
OccursBefore	hasJudgedState
OccursDuring	hasExtentState
OccursAround	hasPotentialityState
isPerformedBy	hasNormalityState
hasPurpose	hasRelativeLevelState
Isa	hasProgress
isPerceivedBy	Has onset
hasSubjectOfInformation	(implicit)

*Semantic relations added in this study are shaded.

3. Testing and Validating the Extended ICNP Conceptual Structure

The extended conceptual structure with the newly identified semantic relations and concept classes was tested against the remaining 60 initial patient assessment records and 300 randomly selected defining characteristics phrases from the North American Nursing Diagnosis Association (NANDA) taxonomy. NANDA defining characteristics are lists of observations that assist the nurse in assigning a specific nursing diagnosis. We used these as a proxy for assessment data because, like the defining characteristics, the purpose of nursing assessment is to assist nurses with identifying patient diagnoses and problems that are sensitive to nursing care.[15] The reviewers parsed the assessment data and NANDA phrases into key concepts and semantic relations using the extended ICNP model (Fig 3). The reviewers identified no new semantic relations, but found 91 additional key concepts. These new concepts were added to the 714 key concepts obtained in the initial parsing activity. A pictorial summary of the ICNP evaluation methods and findings are included in Fig 4.

4. Requirements in the Concept Coverage (Term Mapping)

The 805 key concepts retrieved from the nursing assessment documentation were mapped to standardized terminology systems. We first mapped the concepts to the ICNP. If appropriate matches for the concepts were not found in the ICNP, we used the ANA recognized terminology systems[27] as found in the Unified Medical Language System Version 2007 AC as supplemental terminology sources. Two reviewers trained a research assistant in concept mapping. Upon reaching an acceptable inter-rater reliability in the mapping of 30 concepts (0.7147, $p < 0.0001$)[d] the research assistant mapped the remaining 775 concepts. The four nurse reviewers reviewed the initial mapping and categorized each match as exact, narrower, broader, or other, as done in other studies.[3,28,29] To ensure consistency with use of the matching levels, four reviewers first performed the concept mapping and matching level assignment of 10 concepts as a group and successfully achieved consensus. After completing this exercise, each reviewer was assigned 40 randomly selected mappings to evaluate independently. Inter-rater agreement on assigning a matching level was 0.8362 ($p < 0.0001$).

The mapping results are presented in Table 2. Exact matches were found in the ICNP for 43% of assessment concepts and partial matches for an additional 20%.

Among the 459 terms that had no matching ICNP concept, 81% had exact matches in the UMLS (particularly SNOMED CT). Examples of concepts necessary to represent wound assessment with no match or a less than perfect match in the ICNP include color (e.g., brown, red, and yellow), pale, depth, width, wound appearance, skin tear, sanguineous, serous, edge approximated, and clean. While many of these concepts had exact matches in the ANA recognized terminologies, no matches or less than perfect matches were found for the following concepts: wound appearance and edge approximated.

[d]intra-class correlation.

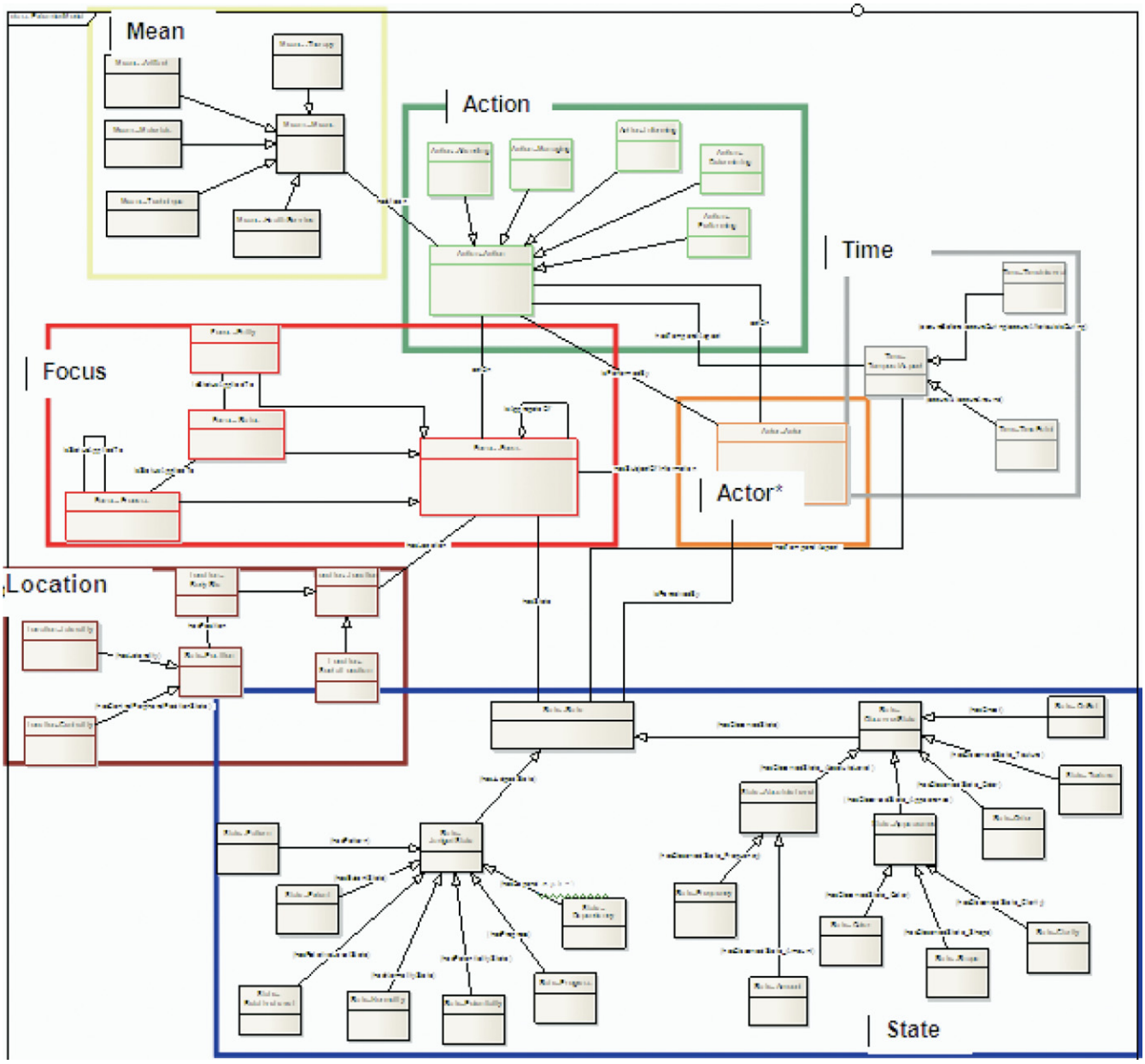

Figure 3. Proposed extensions to the ICNP 7-axis model to support nursing assessment documentation (the illegible type in this figure is not relevant to the current discussion). Please contact the corresponding author for the figure in full size.

Discussion

A detailed representational model of nursing assessment documentation is critical for evidence-based nursing practice. Although other phases of the nursing process are supported by a large body of work,[5,6,30–32] relatively few nursing terminology resources exist for representing data and information relative to assessment, despite the fact that data captured during assessment provides the foundation for all other phases in the nursing process.[15,16] Building on earlier work with the ICNP,[11–13,32–36] in this study we evaluated the adequacy of the ICNP as a representational model for nursing assessment documentation. We found that, with extensions to existing semantic relations and key concepts, the ICNP provides the formal structure and defines the properties needed to represent the PHS NAD model and to support electronic nursing assessment documentation.

While parsing the nursing assessment items and the NANDA defining characteristics, we identified the need to expand the ICNP semantic relation "hasJudgedState" and the added relation "hasObservedState" to include judgments and observations of others (e.g., patients and nurses). In the ICNP, the judgment axis was developed for nursing diagnosis and by default, the judged state refers to the view of nurses. However, our work suggests that the judgment axis needs to be expanded. The nursing admission assessment includes many instances where the nurse asks the patient, family member or other caregivers to make judgments about health status; and this judgment is recorded in the admission database. For example, all of the admission

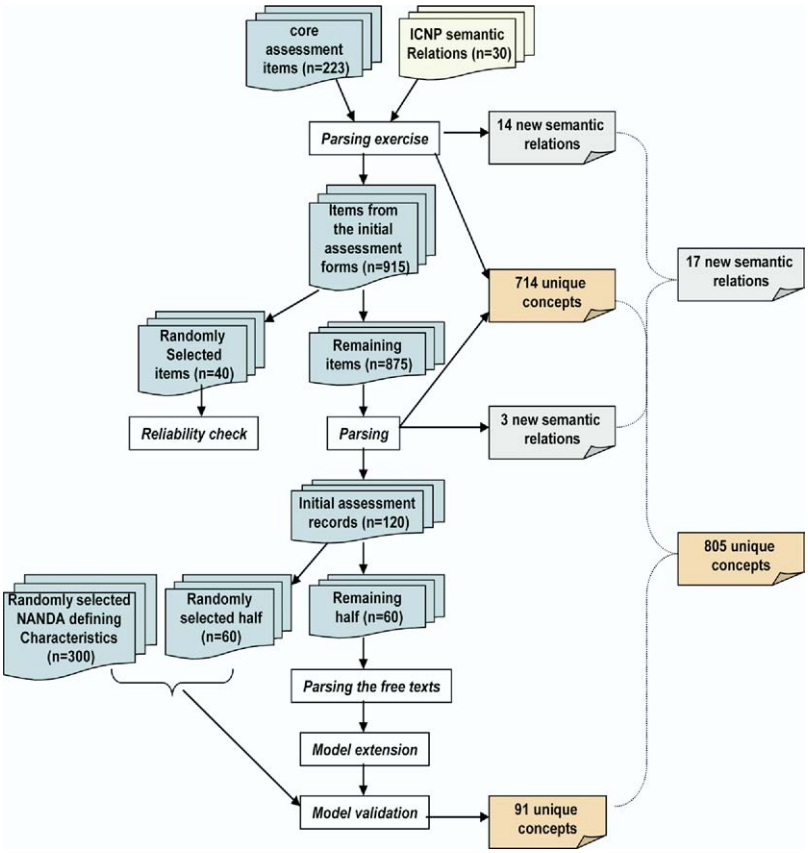

Figure 4. Summary of the ICNP evaluation methods and findings.

assessment templates that we evaluated included an item about whether the patient considers their alcohol consumption to be problematic. The patient is asked to make a "judgment" about his/her own consumption. The same situation applies to observed states. For example, many assessment items require patients' self report; and nurses often depend on patients' family members for observational data. Amount of oral intake, number of hours of sleep, and urine color are just a few examples of such observational data. In each case, the added semantic relation "isPerceivedBy" can differentiate the source of the information (i.e., nurses' direct observation and/or judgment v. data and information obtained from an interview of a patient or a patient's family members). Our findings suggest that the domain model for nursing assessment documentation must include these semantic relations, but we did not assign them specifically to the information or terminology model components. Some of the missing semantic relations may be best represented by an information model. Additional research is needed to evaluate the extent to which semantic relations not covered by the ICNP can be represented by a standard information model such as the HL7 RIM.

There were several challenges associated with completing this work. Consistent with earlier work done to evaluate the concept coverage of the ICNP,[22,32,37–39] less than half of the key assessment concepts had exact matches in the ICNP. Although many of the higher-level assessment concepts were found in the ICNP, the more detailed, descriptive concepts needed to represent patient assessment states at a more granular level (e.g., color, wound bed appearance, characteristics of wound drainage and pain descriptors) were not found in the ICNP. This is not surprising because the ICNP was not developed to represent nursing assessment; and most work to date with the ICNP has involved other phases of the nursing process. By including "broader," "narrower," and "other" matches, we found matches for about two-thirds of key assessment concepts. For those concepts without an exact match in the ICNP, we turned to

Table 2 ■ Coverage of the Key Patient Assessment Concepts

ICNP: All Key Assessment Concepts (N = 805)			UMLS: All Key Assessment Concepts Without Exact Matches in the ICNP (N = 459)		
	N	%		*N*	%
Exact match	346	43%	Exact match	371	81%
Narrower match	4	0.50%	Narrower match	8	1.7%
Broader match	120	15%	Broader match	31	6.8%
Other match	37	4.6%	Other match	22	4.8%
No match	298	37%	No match	27	5.9%

the ANA accepted supplemental terminology sources in the UMLS. Broader, narrower and "other" matches were found for an additional 13% of concepts. This is "good news" from the perspective that most assessment concepts needed to represent nursing assessment documentation already exist in the ANA recognized terminologies. However, it is unclear whether the conceptual hierarchies found outside of the ICNP are consistent with the ICNP terminology model. Evaluating the degree to which the ICNP accommodates existing vocabularies and serves as a reference terminology for nursing assessment are important areas for future research. This work may be addressed in the current SNOMED and ICNP collaboration.[e] and/or in the Apr 2008 release of the UMLS which will include the ICNP.[f] In the interim, the list of key assessment concepts without matches in the ICNP will be submitted to the ICNP program for review and potential integration in a future release. Common representational requirements needed to support electronic documentation of nursing assessment data in the PHS CIS will be shared with our local information model developers.

Other authors have commented that continued work is needed to evaluate whether the ICNP fulfills its initially intended functions to be "sufficiently flexible and extensible to summarize high-level data while including lower-level details where appropriate."[12] The results of our study suggest that additional concepts and semantic relations are needed before the ICNP will fully support electronic nursing assessment documentation. The ICNP has established "catalogues" as a means to make the terminology more usable at the point of care by precoordinating complex statements related to specific topics.[1,39] Incorporation of the ICNP catalogs into the dictionaries of CISs will likely facilitate rapid identification and documentation of complex concepts such as standardized assessment scales and NANDA diagnoses where the entire item may represent a single concept or is linked to the item's validity. While catalogs are one approach for improving the usefulness and usability of the ICNP, additional work is needed to define and make available rules to facilitate post-coordination of atomic concepts. Explicit post coordination rules would enable capture of the atomic portions of assessment data and reuse over all phases of nursing process. Previous work focused on parsing and mapping standardized assessment items has highlighted the importance of considering how items are represented in the CIS using standardized terminologies as part of the development process.[26]

Although the evaluation methods described here were developed to support nursing assessment documentation work at PHS, we hope that they will also be applicable to other hospitals and healthcare systems. Future work is needed to evaluate the degree to which the PHS domain assessment model is generalizable to other settings. Many of the core assessment items evaluated in this work were adopted from standard assessment scales, such as the Morse Falls Scale (fall risk assessment), the Braden Scale (pressure sore risk), United States Preventive Services Task Force Depression Inventory, and the CAGE Assessment (alcohol abuse). Using the ICNP as a starting point for exploring terminology and information model requirements of the PHS NAD model was an efficient approach to identifying the key concepts and the semantic relations that are needed to support electronic nursing assessment documentation at PHS. It is clear that the current ICNP needs extensions to adequately represent nursing assessment data and facilitate data capture and reuse without loss of context. We intend to submit the necessary extensions that we found in this study to the ICN to be considered in the future release of the ICNP. Given the heavy reliance on content and terminology standards, we are hopeful that our work will be transferable or at least serve as a starting point for other health care systems involved in similar work. Additional work is needed to establish consensus around parsing and concept mapping methods for standardized assessment items.[26] We encourage others to critique and if appropriate to apply our methods. Our hope is that others will leverage this work, to evaluate the domain requirements for other standardized risk assessment scales. By building on existing terminology standards such as the ICNP and content standards (e.g., Braden Scale), PHS can begin to represent the domain of nursing assessment consistently across otherwise diverse systems. Standards work is costly; it requires an investment of resources and time and many organizations do not have this luxury. However, more of this work is needed if we are to advance towards the end goal of practice based on evidence beyond the local organizational level.

Conclusions

A detailed representational model of nursing assessment documentation is critical for evidence-based nursing practice, but limited work has been done on developing and evaluating nursing terminologies to represent concepts associated with the assessment phase of the nursing process. In this study, we found that, with concept and semantic relation extensions, the ICNP can serve as a representational model for electronic nursing assessment documentation. With our recommended extensions, the ICNP can capture atomic level data and reuse without loss of context, thus serving as a core building block for evidence-based practice. Future work is needed to determine the generalizability of the PHS NAD model and to more fully test and apply these methods so that nursing assessment documentation becomes reusable across sites and levels of care.

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