

Application of Information Technology ■

Toward Semantic Interoperability in Home Health Care: Formally Representing OASIS Items for Integration into a Concept-oriented Terminology

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Abstract **Objective:** The authors aimed to (1) formally represent OASIS-B1 concepts using the Logical Observation Identifiers, Names, and Codes (LOINC) semantic structure; (2) demonstrate integration of OASIS-B1 concepts into a concept-oriented terminology, the Medical Entities Dictionary (MED); (3) examine potential hierarchical structures within LOINC among OASIS-B1 and other nursing terms; and (4) illustrate a Web-based implementation for OASIS-B1 data entry using Dialogix, a software tool with a set of functions that supports complex data entry.

Design and Measurements: Two hundred nine OASIS-B1 items were dissected into the six elements of the LOINC semantic structure and then integrated into the MED hierarchy. Each OASIS-B1 term was matched to LOINC-coded nursing terms, Home Health Care Classification, the Omaha System, and the Sign and Symptom Check-List for Persons with HIV, and the extent of the match was judged based on a scale of 0 (no match) to 4 (exact match). OASIS-B1 terms were implemented as a Web-based survey using Dialogix.

Results: Of 209 terms, 204 were successfully dissected into the elements of the LOINC semantics structure and integrated into the MED with minor revisions of MED semantics. One hundred fifty-one OASIS-B1 terms were mapped to one or more of the LOINC-coded nursing terms.

Conclusion: The LOINC semantic structure offers a standard way to add home health care data to a comprehensive patient record to facilitate data sharing for monitoring outcomes across sites and to further terminology management, decision support, and accurate information retrieval for evidence-based practice. The cross-mapping results support the possibility of a hierarchical structure of the OASIS-B1 concepts within nursing terminologies in the LOINC database.

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Studies have shown the impact of concept-oriented terminologies, not only on data sharing and reuse among heterogeneous health care information systems, but also on terminology management, decision support, and accuracy of information retrieval.^{1–3} Recently, there has been an effort to develop concept-oriented terminologies in which the concepts from each terminology are integrated into a reference terminology.^{4–7} As a prerequisite, the applicability of various existing terminology models for the representation of health

care concepts has been tested. Much of the model testing has focused specifically on terminology models of relevance to nursing, including the International Standards Organization (ISO) reference terminology models for nursing diagnoses and nursing actions and the Logical Observation Identifiers, Names, and Codes (LOINC) semantic structure.^{7–9} However, there has been little attention to evaluation of terminology models that could be used to formally represent and integrate into concept-oriented terminologies, standardized assessments such as the Outcomes and Assessment Information Set (OASIS-B1) that are mandated by regulatory or accreditation bodies.^{10,11}

Home health care represents a large proportion of health care activities; thus, it is vital that terms are integrated into concept-oriented terminologies that provide broad coverage for the domain of home health care. Current complex home health care documentation and the lack of standardized representation of these data discourage communication and data exchange efforts among various players (patient, physicians, and home health care providers) from remote locations and limit aggregate reporting, sharing, and reuse of data for further analysis. “Retrofitting” the OASIS B-1 with formal

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terminology structures and associated codes is one component of a strategy for facilitating data exchange of outcome assessments in home care and between home care and other clinical environments.

To explore this strategy, the authors undertook four related activities. First, we evaluated the utility of the LOINC semantic structure as a terminology model for representing OASIS-B1 items by dissecting items into LOINC axes. Second, to discover relationships between and potential redundancies of OASIS-B1 terms with existing LOINC terms, we compared the OASIS-B1 terms, as represented in LOINC, with three sets of nursing terms in LOINC: the Home Health Care Classification (HHCC),¹² the Omaha System,^{13,14} and the Sign and Symptom Check-List for Persons with HIV (SSC-HIV).¹⁴ Third, to illustrate integration of the "LOINCified" OASIS-B1 codes in a concept-oriented terminology, we assessed what changes were required and proposed the necessary modifications to integrate OASIS-B1 items formally represented in the LOINC semantic structure into an institution-specific, concept-oriented terminology, the Medical Entities Dictionary (MED). Fourth, to implement a user-friendly interface for data entry and retrieval of OASIS-B1 terms, we used Dialogix software, which integrates logical or fully deterministic dialogues between humans and computers.¹⁵

Background

OASIS-B1

OASIS-B1 is a core set of screening and assessment elements, including standardized definitions and coding categories for the comprehensive assessment of all clients of home health agencies certified to participate in the Medicare or Medicaid programs. Registered nurses or therapists collect responses to the 106 OASIS-B1 questions for all adult, non-maternity patients at specified time points and transmit them electronically to the state. The data are then prepared to be transferred to the Center for Medicare and Medicaid Services for home health care agency reimbursement or to be used for outcome-based quality monitoring and benchmarking with other home health care agencies to identify target areas of services or care that need improvement.¹¹

OASIS-B1 encompasses the following domains of home health care: demographic and patient history, living arrangements, supportive assistance, sensory status, integumentary status, respiratory status, elimination status, neurological/emotional/behavioral status, activities of daily living/instrumental activities of daily living, medications, equipment management, therapy need, and emergent care. Several different forms are contained under the OASIS umbrella including Start of Care, Resumption of Care, Follow-Up, Transfer to an Inpatient Facility, and Discharge from Agency.¹⁰ The majority of the items are the same in each form with the exception of disposition, which can include discharge, transfer to inpatient facility, and patient death. For the purpose of this study, the master form with all required items was used.

LOINC

LOINC was created to name all observations related to a patient with universal, unambiguous, measurable entity identifiers for use in data exchange standards, such as Health Level 7 (HL7), with an initial focus on laboratory observations.¹⁶ Each measurable entity is classified across six axes, corresponding with six main fields within the LOINC table: compo-

nent, property, timing, system, scale, and method.¹⁷ Unique LOINC names and codes are assigned to items that have different clinical meanings, purposes, or reference ranges. Supplemental tables can store additional information.¹⁵

LOINC has gained acceptance in the health care community because of its broad content coverage, free access, and relevance to the Health Insurance Portability and Accountability Act of 1996.¹⁸ In addition, the National Committee on Quality Assurance recently announced that LOINC codes could be used in place of Current Procedural Terminology codes for selected Health Employee Data and Information Set measures.¹⁹

The LOINC semantic structure has been evaluated as a reference terminology model,^{8,9} and the LOINC database has continued to expand to include concepts from clinical measurements, especially in the areas of direct patient measurements and clinical observations (e.g., vital signs, symptoms).²⁰ Bakken et al.⁸ extended the clinical LOINC definitions of the six elements and demonstrated the utility of the LOINC semantic structure as a terminology model for standardized assessments. In their study, LOINC was extended to include aggregate units of analysis (e.g., family). Other definitions were refined by the addition of examples for clarification. With extended definitions, standardized assessment terms were successfully dissected into the semantic structure of LOINC. White et al.¹⁵ highlighted the limitations of the manner in which standardized assessments were represented in LOINC and suggested additional extensions that would capture the logic necessary for complex instruments (e.g., branching, tailoring) and clearly distinguish between versions of the same instrument. They proposed a relationship between LOINC tables and Dialogix as a strategy for overcoming some limitations.

Several nursing terminologies such as HHCC, the Omaha System, and the SSC-HIV have previously been integrated into the LOINC database.⁸ HHCC provides a framework and structure for coding home health care nursing services. This system consists of two interrelated taxonomies: 145 nursing diagnoses and 664 nursing interventions classified by care components that represent the functional, health behavioral, physiological, and psychological patterns of patient care.¹² Status (improve, maintain, deteriorate) codes are combined with nursing diagnoses to represent expected or actual patient outcomes. Only nursing diagnosis codes with status codes are included in LOINC. The Omaha System is a standardized vocabulary that includes 40 client problems, 62 targets of intervention organized into four intervention categories, and three outcome measures to assess the status of the selected problems.¹³ Outcomes of a client's problems may be evaluated based on three dimensions: knowledge, behavior, and status. Each dimension is rated on an ordinal scale of 1 to 5 (e.g., no knowledge to superior knowledge). It is this latter aspect, outcome dimensions, that is incorporated into the LOINC database. The SSC-HIV is a 26-item scale used to measure the patient's self-report of HIV-related signs and symptoms.¹⁴ All SSC-HIV items are integrated into LOINC.

The Medical Entities Dictionary

The MED is concept-oriented terminology that serves as the institutional data dictionary at New York Presbyterian Hospital and the Columbia University Medical Center.²¹ The MED uses a semantic network model that includes a

classification hierarchy. Each node in the network is a concept in the MED that is viewed as a slot-based frame. The slots and their values are defining properties of the concepts. There are two possible types of slots: string slots, whose value is intrinsic to the concept (e.g., its preferred name) and semantic slots, which relate a concept to other concepts in the MED. A semantic slot is always paired with a second, inverse slot. For example, the inverse of "Has Part" is "Part Of."

The LOINC semantic structure was used previously to represent laboratory terms in the MED. Several studies have reported on the integration of nursing concepts into the MED using reference terminology models. Cieslowski and colleagues⁹ demonstrated the necessary revisions to hierarchies and semantic slots of the MED to incorporate the nursing assessment concepts from HHCC and Omaha. The revisions were (1) "Standardized Assessment Entities" was added as a new child of "Measurable Entity," (2) "Assessment Procedures" was introduced as a generalization of "Diagnostic Procedures," (3) "Sample Entity" was introduced as a generalization of "Specimen," and (4) "System Sampled by Standardized Assessment" was added as a new child of "Sampleable Entity." Currie et al.²² used the LOINC semantic structure to integrate concepts from an automated fall and injury risk assessment instrument into the MED. Hwang et al.⁷ examined the utility of the ISO reference terminology model for the integration of nursing diagnostic concepts into the MED.

Dialogix

Dialogix²³ is a software tool with a set of functions that supports complex data entry and has been used to computerize and deploy a wide variety of survey instruments used in large epidemiological trials,²⁴ Web-enabled decision trees, clinical guidelines, and consumer-oriented decision support tools.^{15,25} The framework includes a schema and syntax for defining instruments, an engine for deploying them, and a schema for storing the results and timing information collected when an instrument is used.

Instruments used in human-computer dialogues vary in the types of data that they collect and in the degrees to which they require complex validation, calculations, branching, and tailoring. The Dialogix schema supports all these activities by setting up the validation criteria (e.g., ranges of allowable values or lists of valid choices) and by codifying all the branching rules in a single Boolean equation to support complex conditional follow-up, looping, and backtracking to change answers. By these means, Dialogix improves the detection and management of data entry errors, thereby enhancing the validity of documented health information data.

The Dialogix schema includes eight fields: the unique identifier for the variable within the scope of the instrument (*UniqueName*); the conceptual definition (*Concept*), which describes the construct being measured by a question; the *Relevance*, which indicates when the action should be performed; the type of action to be performed (*ActionType*); the text of the question (*ActionPhrase*); the type of data (*DataType*) (e.g., number, date); the criteria to check responses against expectation (*Validation*) (e.g., range of allowable values, list of valid choices); and the enumerated list of allowable answers (*AnswerOptions*).

The Dialogix schema and LOINC semantic structure overlap in conceptual definition (Concept in Dialogix and

Component in LOINC). In addition, two descriptive fields in the LOINC database that support the text of a question and the allowable answers map directly to two fields in the Dialogix schema. The LOINC semantic structure formalizes definitional aspects not incorporated in the Dialogix schema and the Dialogix schema supports dialogue functions. Consequently, LOINC and Dialogix are considered complementary approaches to operationalizing complex data entry and management in a manner that supports semantic interoperability and the Clinical LOINC Committee and Dialogix developers are working together to synergize efforts.

Methods

The study methods comprised four major activities.

Dissection of OASIS-B1 Terms into the LOINC Semantic Structure

OASIS-B1 is composed of structured narrative items (attributes) with associated responses (values). Item responses were treated as values associated with attributes. However, when it was possible for an individual to select more than one response, each response was considered an attribute associated with the value of either *present* or *absent*. For example, in item M0175, "From which of the following inpatient facilities was the patient discharged during the past 14 days? (Mark all that apply)," each response, "hospital," "rehabilitation facility," "skilled nursing facility," or "other nursing home," was treated as a separate attribute with possible values of "yes" or "no." To ensure that terms were new (e.g., there were not preexisting ones), each term was checked for any redundancies using the Regenstrief LOINC Mapping Assistant (RELMA®) windows-based mapping utility.²⁶ Each OASIS-B1 term was entered into a Microsoft Excel database and dissected into the elements of the Clinical LOINC semantic structure with extended definitions for standardized instruments (Table 1).

To assess intercoder reliability of the dissections across terms from OASIS-B1, two coders (JC and MLJ) dissected a subsample of items composed of at least one item per OASIS-B1 domain. To ensure that items represented different types of scale, time aspect, system/sample, and property, more than one item per domain was placed into the subsample when multiple types (e.g., patient and caregiver as system/sample) occurred in one domain, resulting in a sample of 20 items. Intercoder reliability was calculated using the percentage of agreement.

Relating OASIS-B1 Terms to Home Health Care Classification, Omaha System, Sign and Symptom Check-List for Persons with HIV Terms within LOINC

One author (MLJ) examined the relationship between OASIS-B1 items and assessment terms from HHCC, Omaha System, SSC-HIV, as represented in LOINC. To assess intercoder reliability, two authors (MLJ, JC) judged a subset of 20 items. The relationships were coded as:

- 0 = no match
- 1 = vague association between OASIS-B1 and LOINC nursing term
- 2 = LOINC nursing term more broad than OASIS-B1
- 3 = LOINC nursing term more specific than OASIS-B1
- 4 = exact match

Table 1 ■ Examples of OASIS B-1 Terms Dissected into LOINC Semantic Structure

Component	Property	Timing	System/Sample	Scale	Method
Discharged from hospital	Finding	2 wk	Patient	Ordinal	Observed.OASIS
Overall prognosis	Impression	Point	Patient	Ordinal	Observed.OASIS
Primary caregiver	Finding	Point	Caregiver	Nominal	Observed.OASIS
Primary diagnosis	Impression	Point	Patient	Narrative	Observed.OASIS
Pressure ulcer	Impression	Point	Skin	Ordinal	Observed.OASIS

OASIS = Outcomes and Assessment Information Set; LOINC = Logical Observation Identifiers, Names, and Codes.

Table 2 ■ Sample Entries in the Assessment Instruments

Column Name	Example 1	Example 2	Example 3
Unique name	Prior condition; urinary incontinence	Primary caregiver assistance type	Primary caregiver
Concept	Prior condition.urinary incontinence	Primary caregiver assistance.ADL	Primary caregiver
Relevance	1*	M0350= =1 M0350= =2 M0350= =3†	1
Action Type	q	q	q‡
Data Type	Number	Number	Number
Validation§			
Action phrase	Conditions prior to medical or treatment regimen change or inpatient stay within past 14 days: 1-Urinary incontinence	Type of primary caregiver assistance: 1-ADL assistance (e.g., bathing, dressing, toileting, bowel/bladder, eating/feeding)	Primary caregiver taking lead responsibility for providing or managing the patient's care, etc.
Answer Options	Check 1 Yes	Check 1 Yes	List 0 No one person 1 Spouse or significant other 2 Daughter or son 3 Other family member 4 Friend or neighbor or community or church member 5 Paid help 77 Unknown¶

ADL = Activities of Daily Living.

*A relevance of 1 means that the question is always asked.

†The question is asked only if the previous question M0350 is checked as "1" or "2" or "3."

‡The action type "q" indicates that a question should be asked.

§None of these items required validation criteria, so that field is blank.

||A "Check" indicates answer options are presented in check box format.

¶A "list" indicates answer options are presented in list box format.

Assessment and Modification of the Medical Entities Dictionary Semantic Structure to Integrate OASIS-B1 Items

The MED hierarchies that were developed for incorporation of standardized assessments were analyzed for their appropriateness for representing the OASIS-B1 terms.⁹ A research team member (SB) experienced in formal representation of nursing concepts reviewed proposed revisions to the MED hierarchies and slots. Differences were resolved through discussion between the coder (JC) and the reviewer (SB).

Implementation of the OASIS-B1 Terms into the Dialogix Format

To implement the OASIS-B1 terms into a Dialogix-based user interface, the terms were represented using the eight fields of the Dialogix schema (Table 2).

Results

Dissection of OASIS Items into the LOINC Semantic Structure

Of the 209 terms, 204 were successfully dissected into the elements of the clinical LOINC semantics structure. The other five terms had elements that did not fit into current defini-

tions. For example, one OASIS-B1 term, Discipline of Person Completing Assessment, had "clinician" as a system element. The other four items regarding dates of assessment, inpatient discharge, last home visit, or discharge/transfer/death had "date" as a scale element in "month/day/year" format. These elements did not clearly fall into current LOINC system and scale categories.

There was agreement between coders on all elements in 14 of the 20 items composing the subsample for intercoder reliability. The percentage of agreement for each element was as follows: component, 95%; property, 95%; timing, 80%; system, 90%; scale, 90%; and method, 100%.

Relationships between OASIS-B1 Terms and Home Health Care Classification, Omaha System, and Sign and Symptom Check-List for Persons with HIV Terms in LOINC

Table 3 lists the number, frequency, and relationship between OASIS-B1 terms and HHCC, Omaha System, and SSC-HIV terms in LOINC. A total of 151 OASIS-B1 terms were related to one or more of the three nursing terminologies. Only two exact matches were found: (1) OASIS-B1, M0590, "depressive feelings reported or observed in patient: hopelessness," and

Table 3 ■ Relationship between OASIS-B1 Items and HHCC, Omaha System, and SSC-HIV Terms in LOINC (N = 209)

Terminology	Exact Match	Nursing Term		Vague Association	No Match	Totals
		More Specific	Less Specific			
HHCC	1	19*	75*	4	113	212*
Omaha System	0	9	121	9	70	209
SSC-HIV	1	6	8	0	194	209
Totals	2	34	204	13	377	

OASIS = Outcomes and Assessment Information Set; LOINC = Logical Observation Identifiers, Names, and Codes; HHCC = Home Health Care Classification; SSC-HIV = Sign and Symptom Check-List for Persons with HIV.

*OASIS term had two matches in HHCC and two additional terms were added as section headings.

HHCC, 28118-8, "hopelessness," and (2) OASIS-B1, M0610, "behaviors demonstrated at least once a week: memory deficit" and SSC-HIV, 28389-5, "memory loss." The vast majority of LOINC nursing terms were less specific than OASIS-B1 terms. However, some were more specific. For example, OASIS-B1 item, M0590, "depressive feelings, sense of self-reproach" was judged to have two matches in HHCC: 28206-1, "situational self-esteem disturbance," and 28152-7, "chronic self-esteem disturbance." In this case, the nursing term includes a modifier (situational or chronic) for the concept "self-esteem disturbance." Overall, the Omaha System had the most matches with OASIS-B1 terms (139), followed by HHCC (99) and SSC-HIV (15).

The percentages of agreement between coders were 75% (HHCC), 65% (Omaha), and 90% (SSC-HIV) for equivalent code and 86% (HHCC), 77% (Omaha), and 100% (SSC-HIV) for equivalent extent of match.

Evaluation and Modification of the Medical Entities Dictionary Semantic Structure

The MED semantic structure requires modifications to incorporate OASIS-B1 items. Suggested revisions are as follows (Fig. 1). New concepts "Clinician Assessed at a Point in Time," "Patient Assessed for 24 Hours," "Patient Assessed for 1 Week," "Patient Assessed for 2 Weeks," "Urinary System Assessed for 2 Weeks," and "Bowel System Assessed for 2 Weeks" are added as children of "Sample for Standardized Assessment." "Home Health Care Entity" is added as a new child of "Standardized Assessment Entities" and has new descendants. "Home Health Care Instruments" is added as a new child of "Standardized Assessment Instruments" and now has a new child, "OASIS." The new concept "Response Item for Standardized Assessment" is a generalization of "Categorical Result for Standardized Assessment Item." The latter is now a sibling of the new concept "Narrative Result for Standardized Assessment Item" and has two children, "Nominal Result for Standardized Assessment Item" and "Ordinal Result for Standardized Assessment Item." The names for the semantic slot pair that connect "Standardized Assessment Instruments Items" and "Response Item for Standardized Assessment" have been changed to reflect the generalization of the root concept. "Home Health Care Instruments Items" is added as a new child of "Standardized Assessment Instrument Item" and has new descendants.

Dialogix Implementation

OASIS-B1 items were implemented in Dialogix and deployed as a series of Web pages. Each page contains instructions

and/or questions with associated answer options. Figure 2 shows two sample screenshots.

Discussion

The results of dissecting OASIS-B1 terms into LOINC semantic structures support the adequacy of the LOINC as a terminology model for standardized assessment tools such as OASIS-B1. Using the extended definitions,⁸ most of the items were reliably and validly dissected into LOINC semantic structures. However, five items suggest additional extensions of current elements definitions. The definition related to System/Sample in this study needs to include persons other than the patient, family, or caregiver, e.g., "clinician." All these suggested refinements of definitions are simply to clarify classification.

Although the results of intercoder reliabilities are promising, they raise some significant issues for clarification and development of a consistent approach. Several terms do not include any time aspect in the questions text, but the value options imply a certain period of observation. For example, item M0370 is "How often does the patient receive assistance from the primary caregivers?" and the value options are "several times during day and night," "several times during day," "once daily," "three or more times per week," "one or two times per week," "less often than weekly," and "unknown," suggesting an observation period of at least one week. This issue may bring inconsistent interpretations among different coders and may be one of the reasons for somewhat lower intercoder reliability (80%) of the Timing element. Because standardized assessment items are composed of structured questions with associated response values, considering the answer options as well as the text of questions would improve the consistency of representation within the LOINC semantic model.

Cross-mapping results showed the majority of LOINC nursing terms from HHCC, Omaha System, and SSC-HIV to be less specific than OASIS items. This suggests the possibility of building a hierarchical structure of nursing concepts within LOINC to facilitate information retrieval of related terms and to identify potentially synonymous concepts.

The MED hierarchies and slots were modified while maintaining the same slots and slot instantiations for existing concepts. For example, when a new concept, "Narrative Results for Standardized Assessment Item (Narrative Results)," was introduced, a more general concept, "Response Item for Standardized Assessment (Response Items)," was created as subclass of "Findings." This allowed for the introduction of "Narrative Results" as a subclass of the new organizing

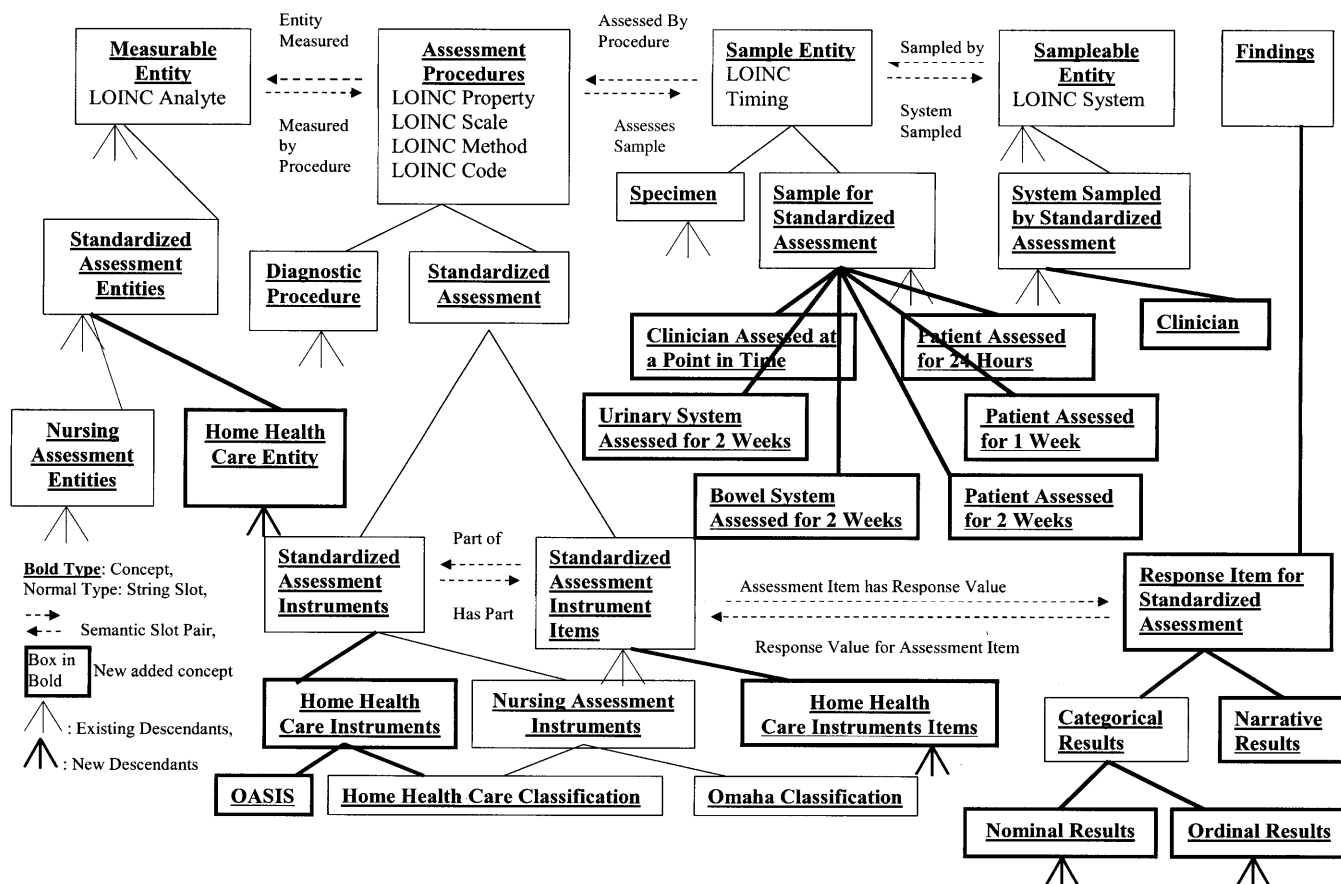


Figure 1. Relevant hierarchies in the Medical Entities Dictionary after incorporation of Outcomes and Assessment Information Set B1. LOINC = Logical Observation Identifiers, Names, and Codes.

concept. The origination points of LOINC-related slots and semantic slots were moved up from “Categorical Results for Standardized Assessment Item (Categorical Results)” to the more general concept “Response Item.” As a result, all existing “Categorical Results” remained unchanged, but the slots in question were inherited by all categorical and narrative results items that will be added to the MED. In addition, two new concepts, “Nominal Results for Standardized Assessment Item” and “Ordinal Results for Standardized Assessment Item,” were added for further refinement of “Categorical Results for Standardized Assessment Item.”

A new concept, “Home Health Care Instruments,” was added to a new child of “Standardized Assessment Instruments” and was given two children, OASIS and HHCC. It allows HHCC to have two parents, “Home Health Care Instruments” and “Nursing Assessment Instruments,” resulting in multiple hierarchies. All other modifications involved simple additions of new child(ren) to existing concepts (Fig. 1).

Dialogix implementation of OASIS-B1 terms illustrates how home health care instruments could be successfully integrated and deployed using a Web-based interface. In addition to the several advantages of Web-based instruments in general (e.g., easy to access via Internet, direct data entry, and quick feedback for comparisons with benchmarks and with other sites), the Dialogix schema supports customizing the order (branching) of questions and validation of data entry. In

OASIS-B1, the respondent registered nurse or therapist has a different set of questions according to the time point of assessment being completed. For example, if assessment is being completed for a reason of “transfer to an inpatient facility” (M0100), the respondent could go directly to the next relevant question, M0830, skipping questions between M0100 and M0830. Another branching example is that only those patients who responded as having a primary caregiver (M0350) are asked follow-up questions (M0360 to M0380) such as frequency and type of primary care assistance. An example of validation is that a question asking the date of assessment (M0090) must ensure that the response of date of last home visit (M0903) or last discharge/transfer/death (M0906) date should be earlier than the date of assessment. If the respondent provides valid answers for the questions, he or she is advanced to the next set of relevant ones. If not, he or she is given error messages that reflect the validation criteria. In this case, he or she could backtrack and change the answer. Dialogix performs all the necessary validation and branching, and the clinicians are not forced to handle these tasks. By these means, Dialogix improves the detection and management of data entry errors, thereby enhancing the reliability and validity of documented health information data.

Conclusion

This study illustrates an approach to integrating home health care concepts from an established standardized home health

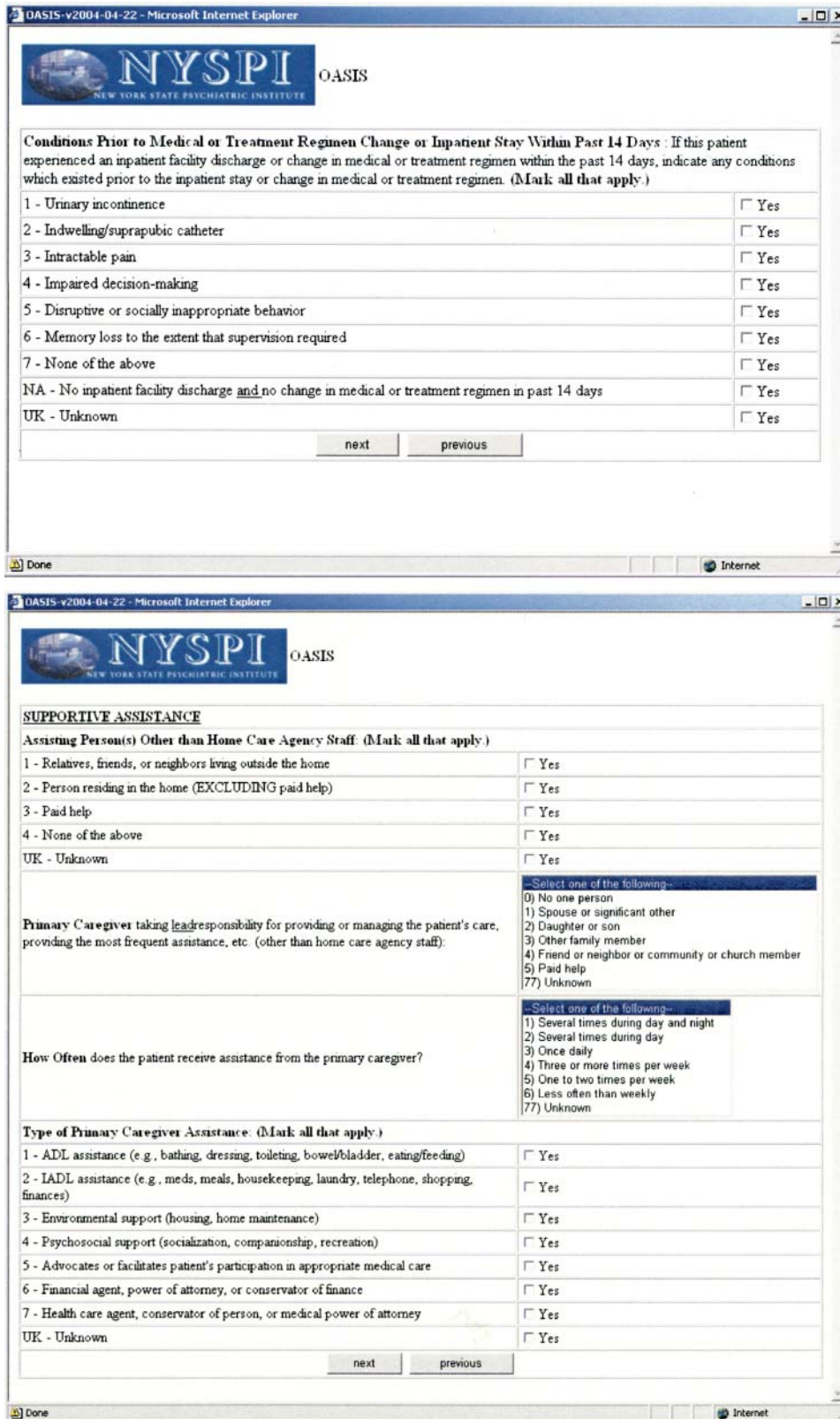


Figure 2. Sample Dialogix screenshots.

care instrument (OASIS-B1) into a concept-oriented terminology (MED) in a manner consistent with evolving standards for reference terminology models. The ability to incorporate a standardized home health care instrument, OASIS-B1, into an existing semantic structure such as LOINC is an im-

portant first step toward adding home health care concepts to concept-oriented terminologies. Although the MED is used only in a single health care system, it meets the terminology requirements espoused in the Desiderata.¹ Thus, the approach may be applied to other concept-oriented

terminologies. Web-based systems possessing the characteristics of Dialogix are appropriate for data entry of complex instruments such as OASIS-B1. Further studies are needed to test the subsequent impact of the illustrated approach on data aggregation and reuse, information retrieval, and decision support.

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