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Applicability of the ISO Reference Terminology Model for Nursing to the Detailed Clinical Models of Perinatal Care Nursing Assessments

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Objectives: The purpose of this study was to examine the applicability of the International Organization for Standardization (ISO) reference terminology model for nursing to describe the terminological value domain content regarding the entities and attributes of the detailed clinical models (DCMs) used for nursing assessments. **Methods:** The first author mapped 52 DCM entities and 45 DCM attributes used for perinatal care nursing assessments to semantic domains and their qualifiers to the ISO model. The mapping results of the entity and attribute concepts were classified into four categories: mapped to a semantic domain qualifier, mapped to a semantic domain, mapped to a broader semantic domain concept, and not mapped. The DCM mapping results were classified into three categories: fully mapped, partially mapped, and not mapped. The second author verified the mapping. **Results:** All of the entities and 53.3% of the attribute concepts of the DCMs were mapped to semantic domains or semantic domain qualifiers of the ISO model, 37.8% of the attributes were mapped to the broader semantic domain concept, and 8.9% of the attributes were not mapped. At the model level, 48.1% of the DCMs were fully mapped to semantic domains or semantic domain qualifiers of the ISO model, and 51.9% of the DCMs were partially mapped. **Conclusions:** The findings of this study demonstrate that the ISO reference terminology model for nursing is applicable in representing the DCM structure for perinatal care nursing assessment. However, more qualifiers of the Judgment semantic domain are required in order to clearly and fully represent all of the entities and attributes of the DCMs used for nursing assessment.

Keywords: Reference Standard, Concept Formation, Nursing Assessment, Computerized Medical Record System, Terminology

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I. Introduction

Nursing assessment, in which nurses gather data and information about a patient's health status, is the first step in the nursing process. This step is crucial to identify patient problems and symptoms that are specific and sensitive to nursing care [1]. In addition, as health care organizations transition from paper-based to electronic documentation systems, it is vital that nursing data are shared in a way that preserves the context and richness of patient care [2]. In order to share and reuse data collected through nursing assessment, information models such as detailed clinical models (DCMs) representing information in a more detailed and consistent

manner are essential.

Information model expresses the classes of information required and the properties of those classes, including attributes, relationships, and states [3]. DCM is a relatively small, standalone information model designed to express a clinical concept in a standardized and reusable manner [4-6]. DCM consists of entity-attribute-value triplets. Entity is core or focus concept of data element. Attribute is qualifier that represents data entity in more detail, and is associated with possible values. Value set, in turn, represents uniquely identifiable set of valid concept representations of attribute. There have been several researches to model data elements of nursing assessment in Korea including DCMs for nursing assessment for breast cancer patients, perinatal care, and cancer survivors [7-9].

To use DCMs in the electronic nursing records system, a framework is necessary to generate compositional expressions from atomic concepts of entities, attributes, and values of DCMs in a manner suitable for computer processing. Reference terminology model (RTM) for nursing was established by International Standards Organization (ISO) providing this framework [10]. One of target group of the ISO RTM for nursing is the developers of models for health information management systems such as electronic health records to describe the expected content of terminological value domains for particular attributes and data elements in information models [10].

The ISO RTM for nursing provides a framework for the generation of compositional expressions from atomic concepts and the representation of nursing diagnosis and nursing action concepts and their relationships in a manner suitable for computer processing [11]. Nursing diagnosis in the ISO RTM is considered either as a judgment on a focus or as a judgment on a particular dimension (e.g., ability, knowledge) of a focus. A descriptor for Focus and Judgment are required elements for the intensional definition of a nursing diagnosis. The nursing diagnoses model includes nine elements: Focus, Dimension, Judgment, Degree, Potentiality, Acuity, Timing, Site, and Subject of information. Nursing actions in the ISO RTM is considered as an intentional act applied to a target. A descriptor for Action and Target are required elements for the intensional definition of a nursing action. The action model includes seven elements: Action, Timing, Target, Means, Route, Site, and Recipient of care.

Since the development of the ISO RTM for nursing, there have been works to test the ability of the ISO model for mapping terminologies from various nursing classification systems [11,12], representing existing nursing documentation [13,14], and describing nursing practice patterns [15]. These studies demonstrated that this model has utility for representing in the concepts in standardized nursing terminologies and has been used to formally define nursing concepts of nursing diagnoses and actions for integration into a reference terminology.

However, there has been no work to explore the applicability of ISO RTM for nursing for describing the content of terminological value domain for attributes and data elements in information models. Therefore, the purpose of this study was to examine an applicability of the ISO RTM for nursing to describe the content of terminological value domain for entities and attributes of DCMs for nursing assessment.

II. Methods

Source of mapping was 52 entities and 45 attributes of DCMs developed by the authors of this paper for nursing assessment in perinatal care [16]. DCMs for nursing assessment in perinatal care include physical domain such as respiration, labour pain, and dyspnea and psychological domain such as depression and parental role.

Target of mapping was semantic domains and qualifiers of semantic domain of the ISO RTM for nursing. The nursing diagnosis in the ISO RTM includes four semantic domains such as Focus, Judgment, Site, and Subject of information and four qualifiers of semantic domain serving to qualify semantic domains such as Degree, Potentiality, Acuity, and Timing.

Table 1 shows the relationship between elements of DCMs and semantic domains with qualifiers of semantic domain of the ISO RTM for nursing. Entities of DCMs conform to Focus semantic domain in the ISO model. Attributes of DCMs conform to Judgment, Site, and Subject of information semantic domains and Degree, Potentiality, Acuity, and Timing qualifiers of semantic domain in the ISO model.

The first author conducted mapping using the definitions of the semantic domains of the ISO models. Entities and at-

Table 1. Relationship between DCMs elements and ISO RTM semantic domains

Element of DCM	Semantic domain and qualifiers of semantic domain of the ISO RTM
Entity	Focus
Attribute	Judgment: *Degree, Potentiality, Acuity, Timing*
	Site
	Subject of information

DCM: detailed clinical model, ISO: International Organization for Standardization, RTM: reference terminology model.

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tributes of DCMs were mapped to semantic domains and qualifiers of semantic domain of the ISO RTM for nursing. First, we determined if each entity or attribute of DCMs were equivalent to qualifiers of semantic domain of the ISO model such as Degree and Timing. If an entity or attribute of DCM mapped to a qualifier of semantic domain of the ISO model exactly, then we classified this as mapped to qualifier of semantic domain. Second, if an entity or attribute did not map to any qualifiers of semantic domain of the ISO model, we determined if they were equivalent to semantic domains of the ISO model such as Judgment and Site. If an entity or attribute of DCMs mapped to a semantic domain of the ISO model exactly, it was classified as mapped to semantic domain. If an entity or an attribute of DCMs mapped to a semantic domain of the ISO model generally, it was classified as mapped to broader concept of semantic domain. Otherwise, it was classified as not mapped. Thus, at the entity and attribute concept level, mapping results of the entities or attributes of DCMs were classified into four categories: mapped to qualifier of semantic domain; mapped to semantic domain; mapped to broader concept of semantic domain; and not mapped. If an attribute of DCM did not mapped to either semantic domain or qualifier of semantic domain of the ISO, then new semantic domain or qualifier of semantic domain is suggested.

At the DCM level, if all entities and attributes of a DCM were mapped to semantic domains or qualifiers of semantic domain of the ISO model, then we classified this as fully mapped. If any entities and attributes of a DCM were not mapped to semantic domains or qualifiers of semantic domain of the ISO model, then we classified this as partially mapped. If none of entities and attributes of a DCM were mapped to semantic domains or qualifiers of semantic domain of the ISO model, then we classified this as not mapped. Thus, at the model level, mapping results of DCMs were classified into three categories: fully mapped; partially mapped; and not mapped.

The second author who is an expert of the ISO model verified the mapping. If there was any discrepancy between the first author and the second author, a meeting was convened to resolve the discrepancy.

III. Results

All of 52 (100%) entities of DCMs were mapped to semantic domains of the ISO RTM. All entities were mapped to the Focus semantic domain of the ISO RTM.

Table 2 shows mapping results of the attributes of DCMs. Out of 45 attributes of DCMs, 18 (40.0%) attributes were mapped to qualifiers of semantic domain of the ISO RTM, six (13.3%) attributes mapped to semantic domains, 17 (37.8%) attributes mapped to broader concepts of semantic domains, and four (8.9%) attributes not mapped. For example, 'interval' attribute in 'Labour pain' DCM was mapped to Timing qualifier of the Judgment semantic domain, 'effectiveness' attribute in 'Breastfeeding' DCM mapped to

Table 2. Mapping results of the attributes of DCMs

Mapping result	No. of attribute	Semantic domain: Qualifier of semantic domain of the ISO RTM	Attributes of DCMs
Mapped to qualifier of semantic domain	5	Judgment: Severity	Grade, level, stage, intensity, severity
	11	Judgment: Timing	Duration, external condition, frequency, rate, interval, cycle of menstruration, regularity, time sequence, occurrence, last menstrual period, time of menarche
	2	Judgment: Acuity	Onset, progression
Mapped to semantic domain	2	Judgment	Normality, effectiveness
	4	Site	Anatomical site, direction, position, tilt
Mapped to broader concept of semantic domain	17	Judgment	Amount, circumference, characteristic, color, depth, diastolic pressure, glucose, odor, pattern, size, symmetry, type, state of dress, systolic pressure, temperature, weight, volume
Not mapped	4		Cuff size, device, instrument, method
Total	45		

DCMs: detailed clinical models, ISO: International Organization for Standardization, RTM: reference terminology model.

Judgment semantic domain, 'pattern' attribute in 'Fetal movement' DCM mapped to a broader concept, Judgment semantic domain, and 'instrument' attribute in 'Fetal heart sound' DCM not mapped. Out of 24 mapped attributes of DCMs, five attributes were mapped to Degree qualifier of the Judgment semantic domain, 11 attributes mapped to Timing of the Judgment semantic domain, two attributes mapped to Acuity qualifier of the Judgment semantic domain, two attributes mapped to Judgment semantic domain, and four attributes mapped to Site semantic domain.

Table 3 shows the mapping results of DCMs. Out of 52 DCMs, 25 (48.1%) DCMs were fully mapped and 27 (51.9%) DCMs were partially mapped. For example, 'Labour pain' DCM was fully mapped and 'Fetal movement' DCM was partially mapped to semantic domains or semantic domain's qualifiers of the ISO RTM.

Table 4 depicts 'Labour pain' DCM as an example of the fully mapped DCMs. 'Labour pain' DCM has five attributes including 'interval', 'duration', 'regularity', 'severity', and 'occurrence'. Out of these five attributes, 'interval', 'duration', 'regularity', and 'occurrence' attributes were mapped to Timing qualifier of the Judgment semantic domain and 'severity' attribute mapped to Degree qualifier of the Judgment semantic domain of the ISO RTM. Therefore, attributes of 'Labour pain' DCM were fully represented by the ISO RTM for nursing.

Table 5 depicts 'Fetal movement' DCM as an example of the partially mapped DCMs. 'Fetal movement' DCM has four attributes including 'intensity', 'frequency', 'duration', and 'pattern'. 'Frequency' and 'duration' attributes were mapped to Timing qualifier of the Judgment semantic domain and 'intensity' attribute mapped to Degree qualifier of the Judgment semantic domain of the ISO RTM. However, 'pattern' attribute was not mapped to any qualifier of the Judgment semantic domain of the ISO RTM. Therefore, attributes of 'Fetal movement' DCM were partially represented by the ISO RTM for nursing.

Table 3. Mapping results of detailed clinical models (DCMs)

Mapping result	No. of DCM	DCMs
Fully mapped	25	After pain, blurred vision, bowel incontinence, breast engorgement, constipation, deep tendon reflex, depression, diarrhea, dyspnea, dysuria, falling, flat nipples, grief, guilt, Homan's sign, inverted nipples, labour pain, laceration of perineum, parents role, proteinuria, seizure, syncope, tremor, urinary frequency, urinary incontinence
Partially mapped	27	Abdominal circumference, abscess, allergy, arrhythmia, blood sugar, blood pressure, bleeding, blush, body temperature, body weight, breastfeeding, fetal distress, fetal heart sound, fetal movement, flatulence, gas emission, hemorrhoid, ketonuria, lochia, menstrual history, noncompliance, pain, pulse, respiration, rupture of membrane, show, uterine contraction
Total	52	

Table 4. 'Labour pain' DCM as an example of the fully mapped DCMs

DCM		ISO RTM
Entity	Attributes	Semantic domain: Qualifier of semantic domain
Labour pain		Focus
	Interval	Judgment: Timing
	Duration	Judgment: Timing
	Regularity	Judgment: Timing
	Severity	Judgment: Degree
	Occurrence	Judgment: Timing

DCMs: detailed clinical models, ISO: International Organization for Standardization, RTM: reference terminology model.

Table 5. 'Fetal movement' DCM as an example of the partially mapped DCMs

DCM		ISO RTM
Entity	Attributes	Semantic domain: Qualifier of semantic domain
Fetal movement		Focus
	Intensity	Judgment: Degree
	Frequency	Judgment: Timing
	Duration	Judgment: Timing
	Pattern	Judgment

DCMs: detailed clinical models, ISO: International Organization for Standardization, RTM: reference terminology model.

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IV. Discussion

To represent nursing assessment data in a way to be shared and reused, it is essential to model data elements [17] and bind them with standardized terminologies [14,18]. In this study, we evaluated the ability of the ISO RTM for nursing to mediate the transformation of data model components into standardized terminologies. For this we mapped entities and attribute of DCMs for nursing assessment to semantic domains and qualifiers of semantic domain of the ISO model. All of entities and 53.3% of attributes of DCMs were mapped to semantic domains or qualifiers of semantic domain of the ISO model. Entities of all DCMs were mapped to Focus semantic domain and at least one attribute of all DCMs was mapped to Judgment semantic domain or at least one qualifier of the Judgment semantic domain of the ISO model. Therefore entities and attributes of DCMs for nursing assessment conform to the ISO RTM requirement that descriptors of Focus and Judgment are mandatory in defining a nursing diagnosis. These findings demonstrate that the ISO RTM for nursing is applicable to describe the content of terminological value domain for entities and attributes of DCMs for nursing assessments.

There were seventeen (37.8%) attributes mapped to broader concept of semantic domain. Examples are 'weight', 'systolic pressure', 'color', 'odor', 'pattern', 'symmetry', and 'state of dress' attributes. To describe nursing assessment clearly and unambiguously, new qualifiers of the Judgment semantic domain to represent these attributes are required. Examples are Quantity qualifier to represent 'weight' and 'systolic pressure', and State qualifier to represent 'symmetry' and 'pattern'. Although quantity qualifier is one of characterizing concepts of conceptual framework for patient finding and problems [19] and State qualifiers are required to representational model of nursing assessment documentation [2,17], it is debatable whether these qualifiers should be included in the model or dealt with in information models as suggested by Bakken et al. [14] and Hwang and Park [13]. However, we would like to suggest at least adding 'pattern' of respiration and fetal movement as new qualifiers of the judgment semantic domains to describe the content of terminological value domain for entities and attributes of DCMs for nursing assessment.

Data of nursing assessment are gathered through observing or measuring physical health states and observing or inquiring intellectual and emotional health states. Data of patient health states may have different meaning depending on patient condition and point in time, device, and scales of measurement or observation. Therefore, nursing assessment data need to have not only the result of assessment but also the context of assessment. Examples representing assessment context are 'cuff size', 'instrument' such as Fetal Doppler, and 'method' such as arterial pressure monitoring. However, these attributes were not mapped to any semantic domains of the ISO RTM because we mapped entities and attributes of nursing assessment DCMs to semantic domains and qualifiers of semantic domain of the ISO RTM for nursing diagnosis in this study. This problem could be resolved if the two separate models of the ISO RTM, nursing diagnosis and nursing action models, are integrated as suggested by Hwang and Park [13].

This study explored the possibility of using the ISO model to describe the content of terminological value domain for entities and attributes of DCMs. The findings of this study indicate that the ISO RTM for nursing is applicable to describe the structure of the entities and attributes of DCMs for nursing assessments. Therefore the ISO model will be useful as a framework for mediating the transformation of entities and attributes of DCMs into standardized terminologies, and utilized as a framework for database design and management of the nursing documentation systems. Furthermore, findings of this study will contribute to improving and refining the semantic domains and qualifiers of the semantic domains of the ISO model. However, the ISO RTM needs to have more qualifiers of the judgment semantic domains to fully represent entities and attributes of DCMs. The addition of more qualifiers will be useful to represent nursing assessment more clearly and fully.

This study has some limitations. First, elements of DCMs for only nursing assessment were evaluated. Second, scope of nursing assessment was limited to perinatal care. Therefore future studies on the DCMs for nursing assessment in other areas of nursing care and for nursing actions are required.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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