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Guest Editorial

Building nursing knowledge through informatics: from concept representation to data mining

The need to manage and promulgate nursing knowledge has been among the primary motivations for the development and implementation of nursing terminologies since their inception. Seminal work on the design of classification systems in the 1970–1990s provided standardized ways for describing and documenting nursing diagnoses, nursing interventions, nursing outcomes, and nursing goals, in both paper-based and electronic systems. In recent years, efforts have turned toward concept-oriented terminologies that are computer-processible, and the integration of nursing concepts into broader healthcare terminologies. Notwithstanding pioneering work by a number of investigators, however, the possibility of enhancing nursing knowledge using the resulting rich sources of nursing data has yet to be fully realized.

Two significant events have brought that goal closer in 2003. The International Standards Organization (ISO) draft standard (FDIS 18104) on a reference terminology model for nursing diagnoses and nursing actions is the first international standard of its type in health care [1]. The model represents a consensus guideline for the development, evaluation, implementation, and integration of nursing terminologies worldwide. Second, a newly negotiated federal license for SNOMED Clinical Terms (CT), a concept-oriented terminology that includes nursing diagnoses, interventions, and outcomes, paves the way for widespread adoption in the United States, plus proposed use across the United Kingdom [2]. However, despite these advances, a number of significant challenges remain. These include:

- Expanding the coverage of terminologies to capture a broader domain of nursing practice.
- Promulgating approaches for creating concept-oriented nursing terminologies.
- Integrating nursing concepts into more comprehensive healthcare terminologies.
- Ensuring that evolving standards such as reference information models and electronic health record architectures support nursing practice data.
- Linking consumer and patient terminologies to nursing and other professional terminologies in order to facilitate information retrieval and communication.

- Incorporating concept-oriented nursing terminologies into clinical applications such as electronic health records and decision support systems.
- Creating nursing data repositories at local, national, regional, and international levels.
- Applying innovative data mining methods and tools to nursing and other data.
- Managing human and organizational issues.

The papers in this special issue provide insights into these challenges.

Four papers describe innovative approaches for determining the concepts clinicians use to describe their domain, and for incorporating these concepts into terminologies and lexicons for computer-based applications. Two of these papers use card sort techniques in the neonatal intensive care domain to determine requirements for decision-support systems. Panniers, Feuerbach, and Soeken describe how they developed a concept map for initiation of nipple feeds in premature infants from the literature and from subsequent sorting by an expert neonatal nurse practitioner, as a framework for a decision-support system [3]. Ewing et al. [4] describe how they used card sorting to investigate how differences in role and experience between nurses and physicians at different levels of seniority might influence the effectiveness of decision support systems. Harris and colleagues [5] report proof of concept on a term-extraction tool for expanding content in the domain of functioning, disability, and health. Travers and Haas [6] use natural language-processing techniques to build a concept-oriented terminology from patients' chief complaints in the emergency department.

To address the formal definition of nursing concepts, a necessary precursor to the development of concept-oriented terminologies, Moss, Coenen, and Mills test the ability of the ISO model for nursing actions to represent nurses' documentation of pain interventions in a clinical information system [7]. Hardiker [8] addresses a more fundamental issue by comparing the utility of nursing intervention labels and their discursive definitions as potential foundational sources.

In addition to the inclusion of nursing concepts in SNOMED CT, there have been significant efforts to

expand other healthcare terminologies with nursing concepts. Matney et al. [9] provide an overview of the Logical Observation Identifiers, Names, and Codes (LOINC), including assessments of relevance to nursing; they also illustrate linkages between LOINC concepts and nursing concepts from other terminologies.

Beyond foundational work to define nursing concepts and to populate concept-oriented terminologies, it is vital that other formal structures designed for health care in general are sufficient to support those concepts and terminologies. Danko et al. [10] analyze the extent to which the Health Level 7 Reference Information Model (RIM) Version 3 supports the expression of nursing interventions, considering both terminological and structural perspectives.

Standardized terminologies provide a foundation for the development of informatics tools to support nursing practice. Cho and Park [11] report on the development and evaluation of a terminology-based electronic nursing record system and Dykes et al. [12] compare the ability of evolving national terminologies for representing interdisciplinary concepts in an automated clinical pathway.

The most recent American Nurses' Association definition of nursing informatics practice includes the facilitation of data, information, and knowledge to support patients in their decision making [13]. Consequently, the terminology used by healthcare consumers is important and efforts that associate consumer terminology with that of healthcare professionals are a necessary prerequisite for effective communication and information retrieval. Zielstorff [14] provides an overview of controlled terminologies for consumer health and discusses knowledge gaps and resulting issues. The study by Brennan and Aronson [15] evaluates the extent to which concepts in the Unified Medical Language System are adequate to represent the terms used by patients in electronic mail messages.

Toward the goal of comparable data about nurse practitioners (NP), Jenkins [16] proposes data elements and a method for data collection for a national NP data repository. Effken and colleagues [17] focus on data re-use and describe their initial use of a theoretically based computational modeling program to transform organizational research data into actionable information for nurses.

We close this special double issue of *JBIM* with five methodological review articles. While the majority of papers in this issue focus on technical challenges, two papers highlight the importance of human and organizational issues in building nursing knowledge through informatics. Ozbolt [18] examines the structure and process of the Nursing Terminology Summit conferences using concepts, principles, theories, and strategies as they relate to managing technical change. Moen [19]

provides a methodological review and commentary on the challenges associated with electronic patient record design and implementation with a particular emphasis on those related to nursing practice and nursing leadership.

The next two reviews focus on data mining methods and tools that are essential to build nursing knowledge from large databases. Goodwin et al. [20] summarize selected data mining techniques and identify issues and opportunities for building knowledge through a case study in which they apply the techniques in the domain of preterm birth prevention. Lee and Abbott [21] provide an overview of Bayesian networks for knowledge discovery in large data sets.

Nurses in community-based or public roles require data and associated tools that not only assist with care of individuals or families, but also those that assist with assessment of communities or populations and subsequent deployment of relevant interventions. In the final methodological review paper, Alexander et al. [22] provide a perspective on geographical information systems (GIS). In addition, they describe GIS as a tool to evaluate marginalized groups including groups at higher risk for health disparities and provide a case study utilizing tools and maps as a means of assessing and visualizing marginal situations.

The papers in this special issue highlight the significant strides that are being made toward the goal of building nursing knowledge through informatics. They are intended to serve as a stimulus to further excellent work as our command of the relevant technologies, and their clinical impact, grow in the future.

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