Review Paper ■

The Evolution of Definitions for Nursing Informatics:

A Critical Analysis and Revised Definition

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A b s t r a c t   Despite the fact that nursing informatics is entering its third decade as a specialty within nursing, many definitions still exist to describe the field. This paper offers a rationale for a definition for nursing informatics and a critical analysis of past definitions. An organizing framework of technology-oriented, conceptual, and role-oriented definitions is used to critique these definitions. Subsequently, a revised definition is proposed. This evolutionary definition integrates critical concepts from past work and adds components that are currently missing—patients, information communication, information structures, and decision making. A separate role specification for informatics nurse specialists is provided.

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Despite the fact that nursing informatics is entering its third decade as a specialty, many definitions still exist to describe the field.[1,2] In fact, authors have directed substantial efforts toward creating definitions for the specialty over the years.[3–6] As a consequence, informatics practice and education have often proceeded without consensus about this fundamental element.

This paper offers a critical analysis of the evolution of major nursing informatics definitions. It also presents a revised definition of nursing informatics and a role specification for the informatics nurse specialist. Portions of an early draft of this paper were incorporated into the work by an American Nurses Association expert panel, which assumed the task of revising the scope of and standards of practice for nursing informatics in the United States.

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The Need for a Definition of Nursing Informatics

"Medical informatics" is used as an overarching term both to describe any informatics efforts related to health care and also to describe a distinct specialty in the discipline of medicine. Consensus has not been reached about whether medical informatics, especially as the term is used in medicine, is the same discipline as what might more broadly be called health informatics.[7,8] Similarly, a lively debate in the literature underscores the disagreement about whether nursing informatics and medical informatics are separate disciplines.[7]

Regardless of the outcome of this debate external to nursing, nursing informatics is considered a distinct specialty within nursing. If for no other reason than that, a definition for nursing informatics is important for other nurses and for informatics nurse specialists, the label adopted by the ANA,[9] because informatics nurse specialists need to be able to succinctly define their practice.

A definition is a fundamental element for shaping a specialty. A definition for nursing informatics guides role delineation for nurses interested in informatics

and suggests directions for practice, education, training, and research. Also, a definition is one foundational element of national scope documents for the nursing informatics specialty. In particular, a national definition is used by funding agencies, such as the Division of Nursing in the Department of Health and Human Services and the National Institute for Nursing Research, to define projects and allocate monies to nursing informatics efforts.

Furthermore, a definition of nursing informatics may be useful to other disciplines as they define informatics practice within their own specialties. Finally, a definition for nursing informatics is needed to help others, within and outside nursing, understand the legitimacy of the practice and the general competencies of a nurse who specializes in informatics.

Definitions of Nursing Informatics

The authors reviewed work on definitions for nursing informatics. Other authors than those considered here have published important work related to facets of nursing informatics, such as defining requirements, designing nursing systems,[10–12] and nurse–computer interaction.[13] However, the focus of this analysis is on overarching definitions for the nursing informatics domain. A review of definitions of nursing informatics makes apparent three themes for analysis (revised from those suggested by Turley[2])—information technology–oriented, conceptually oriented, and role-oriented definitions.

Information Technology–oriented Definitions

The earliest series of definitions for nursing informatics highlighted the role of technology for what was a new specialty in nursing. An early definition by Scholes and Barber[6] stated that nursing informatics was "the application of computer technology to all fields of nursing—nursing service, nurse education, and nursing research." Ball and Hannah[3] modified an early definition of medical informatics, acknowledging that all health care professionals are part of medical informatics. Therefore, nursing informatics was "those collected informational technologies which concern themselves with the patient care decision-making process performed by health care practitioners." Shortly after this, Hannah[14] continued the emphasis on technology and added the concept of the nursing role within nursing informatics:

> The use of information technologies in relation to those functions within the purview of nursing, and that are carried out by nurses when performing their duties. Therefore, any use of information technolo-

gies by nurses in relation to the care of their patients, the administration of health care facilities, or the educational preparation of individuals to practice the discipline is considered nursing informatics.

Saba and McCormick[15] centered their first book on the notion of technology by outlining chapters related to "nursing information systems" and computer applications in the four areas of nursing. While the term "nursing informatics" did not appear in this book, the authors defined nursing information systems as systems that use computers to process nursing data into information to support all types of nursing activities or functions.

The emphasis on technology is not limited to early definitions. Zielstorff et al.[16] also supported technology's significance in nursing informatics. More recently, Hannah et al.[17] and Saba and McCormick[5] continue to stress the role of technology in nursing informatics as it supports the functions of nursing. Hannah et al. continued with their original definition for nursing informatics, and Saba and McCormick provided this new definition:

> The use of technology and/or a computer system to collect, store, process, display, retrieve, and communicate timely data and information in and across health care facilities that administer nursing services and resources, manage the delivery of patient and nursing care, link research resources and findings to nursing practice, and apply educational resources to nursing education.[5]

All these authors make a salient point about the principal role that technology plays in informatics. For institutions installing clinical systems, technology can even seem to dominate all other issues during implementation. Some authors[17] even argue that technology has been the primary driver of clinical processes, rather than the other way around.

The information technology–oriented view of nursing informatics may be critiqued for overstating the role of technology and underemphasizing the need for the informatics nurse specialist to support the cognitive interaction between the nurse, the nursing process, nursing data, patients and the technology. More important, emphasizing technology discounts the fact that informatics does not require the aid of a computer or other technology.[8] Examples include reorganizing data presentation in a paper document to increase its information content, developing taxonomies to increase data sharing across sites, and conducting research related to the nursing minimum data set. These are essential informatics activities that are not centered on computer technology.

The technology-oriented definitions do not easily suggest the informatics functions a nurse might assume in a health care organization apart from the nurse's role in patient care. Specifically, informatics theories, principles, methods, and tools are not evident. These activities include, in part, needs analysis, requirements determination, structured system analysis, design, selection, implementation, and evaluation.

Although patients were mentioned by a few authors in technology-oriented definitions, the role of patients implicit in these early definitions was as more passive receivers of nursing care rather than as active partners involved in decisions related to their own care. Even this notion of the passive role of patients dropped from visibility in later nursing informatics definitions.

During the years since nursing informatics began, the role of patients in health care and in informatics has expanded greatly. It is common knowledge now that the Internet provides patients with an unparalleled amount of information about health, and the use of computers by patients in the home is more ordinary.[19] Past definitions were constructed with patients as implicit rather than explicit players in health computing.

Conceptually Oriented Definitions

A shift from technology-focused definitions to more conceptually oriented definitions began during the mid 1980s. However, this approach did not gain acceptance until nearly 1990.

Schwirian. Schwirian[20] moved away from technology and stressed the need for a "solid foundation of nursing informatics knowledge [that] should have focus, direction, and cumulative properties." She emphasized the need for informatics research to be "proactive and model-driven rather than reactive and problem-driven."

Schwirian cited Hannah's[14] more technology-oriented definition of nursing informatics but produced a model that expanded thinking about the definition of nursing informatics beyond just a focus on technology. Her research model outlined a pyramid of users, nursing-related information, goals, and computers (hardware and software) interconnected with bi-directional arrows. Nursing informatics activity lies in the intersection of the other elements.

Meant as a stimulus for research in nursing informatics, the model could have been used to guide thinking about nursing informatics definition and practice

as well. As was typical of earlier definitions, the roles of patients, nurse informatics specialists, and theories, concepts, methods, and tools are not made explicit. However, the model depicted the interrelationships among interacting components and included new concepts of nursing-related information, goals, and context. Schwirian's emphasis on research was prescient, given the role research currently plays in informatics.

Graves and Corcoran. Graves and Corcoran[4] provided the first widely cited definition downplaying the role of technology and incorporating a more conceptually oriented viewpoint:

> A combination of computer science, information science, and nursing science designed to assist in the management and processing of nursing data, information, and knowledge to support the practice of nursing and the delivery of nursing care.[4]

This definition broadened the horizon from technology and placed nursing informatics firmly within the practice of nursing. It also provided the first acknowledgment in nursing of an information-knowledge link, using concepts borrowed from Blois,[21] and provided the foundation for Graves' work in knowledge building in the Sigma Theta Tau library.

Graves and Corcoran discussed the need to understand "how clinical nurses structure clinical problems and how they ask questions of the information system." These views drew researchers involved in the study of decision making under the rubric of nursing informatics. In addition, these views accented the need to consider the clinical decision-making process in the design of information systems. With an understanding of how captured data are used in decision making, designers can create systems that better meet the needs of nurses during their clinical decision-making processes. Graves and Corcoran's definition allowed a concentration on the purpose of technology rather than on the technology itself. Their transformation of the definition for nursing informatics changed the focus from technology to information concepts by expressly incorporating information science.

Graves and Corcoran's emphasis on nursing data, information, and knowledge was a novel change in direction in the late 1980s, and others immediately adopted the definition. The conceptual aspects of this definition of nursing informatics have been incorporated into many authors' works, including a review of the state of the science of nursing informatics by Henry[22] and the National Institute of Nursing research priorities.[23] Other authors supported this theme by

stating that the main issues in nursing informatics are conceptual and information-related[24–29] or by building on the initial work of Graves and Corcoran.[4,22] In fact, Henry's review of the state of the science in nursing informatics[22] is organized using the concepts of nursing data, information, and knowledge.

One reason for the extensive acceptance of this new approach may have been that managing information (i.e., data, information, and knowledge processing) is at the core of nursing practice with or without technology. Therefore, the heart of the Graves and Corcoran definition[4] resonated with practitioners, and an immediate connection was established between nursing practice and nursing informatics. The centrality of nursing practice in the Graves and Corcoran definition also supported the need for nursing informatics as a distinct specialty within health informatics. Although informatics nurse specialists use many of the same tools and processes as practitioners in other areas of informatics, the data, information, and knowledge have elements unique to nursing.

The 1989 paper by Graves and Corcoran[4] contrasted with their earlier work on the "Design of Nursing Information Systems."[30] The earlier paper placed the concepts of nursing data, decisions, and processes in a theoretical model showing the flow of data, information, and knowledge and the relationships among these key nursing processes. The model described how both research and clinical decision making affect patient care and serve to build domain knowledge. In the earlier paper,[30] Graves and Corcoran identified how information technology could be used to facilitate each of the identified processes and transformations.

By changing their focus from this model in their second paper,[4] Graves and Corcoran in effect narrowed the definition of nursing informatics, from the entire framework of nursing practice to the conceptual movement of data, information, and knowledge. This movement shifted the emphasis away from technology but also removed the context of nursing and deemphasized the interrelationships among technology, nurse, and patients.

Turley. Turley[2] analyzed previous nursing informatics definitions and then proposed a new nursing informatics model. Although he did not propose a new definition[1] in this paper, by focusing on model development, he continued a conceptual approach to the definition of nursing informatics.

Turley's major contribution was the addition of cognitive science to a model comprising the original three sciences proposed by Graves and Corcoran.[4]

Cognitive science includes such topics as memory, problem solving, mental models, skill acquisition, language processing, and visual attention.[2] These concepts can help informatics nurse specialists understand the decision-making and information processing done by nurses and, subsequently, assist in the creation appropriate tools to support nursing processes. Therefore, cognitive science is most helpful to informatics nurse specialists concentrating on informatics issues related to users, such as decision making and the construction of computer interfaces for nurses.

Although cognitive science is certainly a useful cognate for nursing informatics, the addition of a single science to a model may give prominence to one cognate and underplay the need for multiple cognates to support nursing informatics. For instance, if innovation diffusion is studied, the pertinence of cognitive science may fade in comparison with organizational politics. Turley's work represents a conceptual framework for the nursing informatics specialty and suggests that cognitive science should be added to the three core sciences included in definition of nursing informatics by Graves and Corcoran.[4]

Role-oriented Definitions

In the late 1980s, informatics nurse specialists were becoming more prevalent. Individuals were bootstrapping themselves into jobs related primarily to the insertion of computer technology into health care settings. The early information technology definitions suited these individuals, because the definitions emphasized the technology aspects of their job descriptions. Also, chief information officers at many institutions were most interested in persons who had a focus on technology.

As nursing informatics gained recognition as a nursing specialty, the Council of Computer Applications in Nursing, of the American Nurses Association (ANA),[31] provided a new definition for the field. The ANA expanded the previous definitions by incorporating the role of the informatics nurse specialist into the earlier Graves and Corcoran definition[4]:

> A specialty that integrates nursing science, computer science, and information science in identifying, collecting, processing, and managing data and information to support nursing practice, administration, education, and research and to expand nursing knowledge. The purpose of nursing informatics is to analyze information requirements; design, implement and evaluate information systems and data structures that support nursing; and identify and apply computer technologies for nursing.[31]

The second sentence addresses concepts that represent the life cycle of information systems, more commonly called the "systems life cycle." This particular definition represents the first time concepts from an informatics method, the systems life cycle, appear in a definition.

While this one tool is important to informatics nurse specialists, other tools are as well. Why this one tool was singled out is not specified. In fact, informatics nurse specialists employ a variety of informatics theories, principles, methods, and tools. In the end, however, this particular ANA definition was not been frequently cited, as is evident in later informatics work.[2,5,22]

In 1994, the ANA modified their definition in an effort to legitimize the specialty and guide efforts to create a certification examination:

> Nursing informatics is the specialty that integrates nursing science, computer science, and information science in identifying, collecting, processing, and managing data and information to support nursing practice, administration, education, research, and expansion of nursing knowledge. It supports the practice of all nursing specialties, in all sites and settings, whether at the basic or advanced level. The practice includes the development of applications, tools, processes, and structures that assist nurses with the management of data in taking care of patients or in supporting their practice of nursing.[32]

Although the 1994 ANA definition continued to provide information on the role of the informatics nurse specialist, the concepts from the systems life cycle were replaced with a more generic discussion of the role of the informatics nurse specialist.

Discussion

The early theoretic work of nursing informatics concentrated on three general themes—information technology, conceptual foundations, and the role of the informatics nurse specialist. The more technology-oriented definitions were a reflection of their era, and the definitions matched the task at hand. Schwirian's early work on a conceptual definition[20] was largely ignored as practical issues rather than more theoretic work guided definitions.

As informatics became more integral to the practice of health care, formal programs of education were developed, and the specialty sought more conceptual definitions and models to underpin curricular development. Graves and Corcoran[4] answered this need, and their thoughts became central to many authors' works. Their 1989 work[4] narrowed the focus

from the broader conceptualization of nursing informatics given in 1988[30] to the core concepts of managing and processing nursing data, information, and knowledge. Yet, it is the broader conceptualization outlined in the earlier Graves and Corcoran article that served as the foundation for nursing informatics curricular development at the University of Utah.[33]

As the specialty expanded in a complex practice arena, both technology-oriented and conceptual themes were deemed pertinent to nursing informatics. The ANA[31,32] offered a blend of these somewhat differing positions and added concepts related to the role of the informatics nurse specialist. These definitions first acknowledged the role of informatics nurse specialists and chose, from the suite of possible concepts, theories, and methods available to informatics nurse specialists, a single informatics method, the systems life cycle, as integral.

The evolution of definitions for the specialty of nursing informatics will undoubtedly continue into the near future at least. Endeavors directed toward refining the definition of nursing informatics should address the following issues.

First, even in this amalgam of definitions, the role of patients is underemphasized. As technology has become more widely available, patients are taking a more active role in their health care. Therefore, definitions of nursing informatics will need to consider this increased involvement in a refinement of a definition for the specialty.

Second, in the clinical setting, nurses are information integrators at the patient level. This close connection between nurse and patient in clinical settings has not been evident in past definitions, and the role of the nurse as information integrator has not been explicated. The role of nurses as they integrate data from and communicate data to other providers, such as other nurses, physicians and pharmacists, has not been highlighted. In a revised definition, nurses should be identified as information integrators among patients and other providers.

Third, other salient elements and their inter-relationships need to be addressed in a revised definition—support for decision making by nurses, technology, and context.

Fourth, the role of knowledge building through research is essential to include. This acknowledgment would begin to address the critical role of informatics research in current endeavors, such as evidenced-based practice, genomics, and neuroscience.

Finally, a new definition needs to consider pertinent theories, concepts, tools, and structures that are useful to the informatics nurse specialist—information structures (taxonomies and other meaningful organization of information), information technology, and the communication of information.

A Revised Definition of Nursing Informatics

From this analysis, it is clear that continued refinement of a definition of nursing informatics is required as the specialty of nursing informatics matures. However, a careful evolution of definitions is needed. There is danger in piecing together definitions from various fragments of work. For instance, if new definitions are created piecemeal and curricula are based on these pieces, resulting definitions and programs may end up being a collection of "hot topics."

Therefore, the previous analysis of the historical foundations of definitions of nursing informatics has been used to develop a revised definition. The revised definition for nursing informatics acknowledges the expanded role of patients in their own health care, the role of the informatics nurse specialist, the broad concepts of nursing and nursing informatics, and the inter-relationship of critical elements within nursing informatics.

The revised definition is as follows:

> Nursing informatics is a specialty that integrates nursing science, computer science, and information science to manage and communicate data, information, and knowledge in nursing practice. Nursing informatics facilitates the integration of data, information, and knowledge to support patients, nurses, and other providers in their decision making in all roles and settings. This support is accomplished through the use of information structures, information processes, and information technology.

Beyond the definition, the goal of nursing informatics is to improve the health of populations, communities, families, and individuals by optimizing information management and communication. This includes the use of information and technology in the direct provision of care, in establishing effective administrative systems, in managing and delivering educational experiences, in supporting lifelong learning, and in supporting nursing research.

A formal specification of the role of the informatics nurse specialist is also offered. A separation of role from definition may provide stability for the definition of nursing informatics, as the practice component is more susceptible to change in rapidly evolving technology and health care environments. The role of the informatics nurse specialist is:

> To employ informatics theories, concepts, methods, and tools to analyze information and information system requirements; design, select, implement, and evaluate information systems, data structures, and decision-support mechanisms that support patients, nurses, and their human–computer interactions within health care contexts; and to facilitate the creation of new nursing knowledge.

Conclusion

This paper provides a critical analysis of definitions for nursing informatics. Three organizing elements form the structure for analysis—technology-oriented definitions, conceptually oriented definitions, and role-oriented definitions. Based on the critique of definitions, a revised definition for the specialty is proposed. This definition represents an evolutionary approach to defining nursing informatics, a logical step as the specialty matures.

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