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NURSING INFORMATICS: SCOPE AND STANDARDS OF PRACTICE

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THE SCOPE OF NURSING INFORMATICS PRACTICE

Introduction

Nursing informatics (NI) is a specialty that integrates nursing science, computer science, and information science to manage and communicate data, information, knowledge and wisdom in nursing practice. Nursing informatics supports 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.

The goal of Nursing Informatics is to improve the health of populations, communities, families, and individuals by optimizing information management and communication. These activities include the design and use of informatics solutions and/or technology to support all areas of nursing, including, but not limited to, the direct provision of care, establishing effective administrative systems, managing and delivering educational experiences, supporting life-long learning, and supporting nursing research.

NI is one example of a discipline-specific informatics practice within the broader category of health informatics. NI has become well established within nursing since its recognition as a specialty for registered nurses by the American Nurses Association (ANA) in 1992. It focuses on the representation of nursing data, information, knowledge (Graves and Corcoran, 1989) and wisdom (Nelson, 1989; Nelson, 2002) as well as the management and communication of nursing information within the broader context of health informatics. Nursing informatics (1) provides a nursing perspective, (2) illuminates nursing values and beliefs, (3) denotes a practice base for nurses in NI, (4) produces unique knowledge, (5) distinguishes groups of practitioners, (6) focuses on the phenomena of interest for nursing, and (7) provides needed nursing language and word context (Brennan, 2003) to health informatics.

The purpose of this document is to delineate the current scope of NI practice and the standards for the Informatics Nurse Specialist (INS) and project possible future trends likely to impact NI. However, some sections of this work have application to the informatics needs of all nurses. This document expands upon earlier work within NI, building upon historical knowledge (ANA, 1994, 1995, 2001) and including new, state-of-the-science material for the specialty. Because of the rapid changes in related sciences, NI roles, and thinking within informatics, a new document was needed. This revision provides new material including: a) adding the concept of wisdom to NI metastructures, b) transitioning the roles section away from job titles to role functions that may be integrated within various NI roles and subspecializations, c)

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identifying commonalities between INSs and other informatics specialists d) providing a distinction between INs and INSs, e) expanding the work on NI competencies to describe typical NI competencies for typical NI functional areas, f) expanding the discussions in ethics, human-computer interaction and the future of NI, g) incorporating telehealth into NI and h) changing the section previously titled “Boundaries of Nursing Informatics” to a discussion about the interdisciplinary nature of NI acknowledging the blurring of boundaries among other informatics and nursing specialties.

This revised scope and standards document can be useful in several ways. First, the document outlines the attributes and definition of the specialty, describing and distinguishing NI from other health and nursing specialties. Second, the document can be useful to educational programs and NI practitioners as a reference and guide. Third, this work can serve as a reference for employers and regulatory agencies to assist with developing position descriptions, determining required informatics competencies and initiating NI positions in health organizations. Last, the material can serve as a source document for legal opinions, funding agencies and others seeking to improve health through NI.

Metastructures, Concepts, and Tools of Nursing Informatics

To understand NI, its metastructures, sciences, concepts and tools are first explained. Metastructures are overarching concepts used in theory and science. Also of interest are the sciences underpinning nursing informatics (NI), concepts and tools from information science and computer science, human–computer interaction and ergonomics concepts, and the phenomena of nursing.

Metastructures: Data, Information, and Knowledge

In 1989, Graves and Corcoran published a seminal work that described the study of nursing informatics (NI). The article contributed two broad principles to NI that will be acknowledged here. The first contribution was a definition of nursing informatics (NI) that has been widely accepted in the field.

The second contribution of Graves and Corcoran (1989) was an information model that identified data, information, and knowledge as key components of NI practice.

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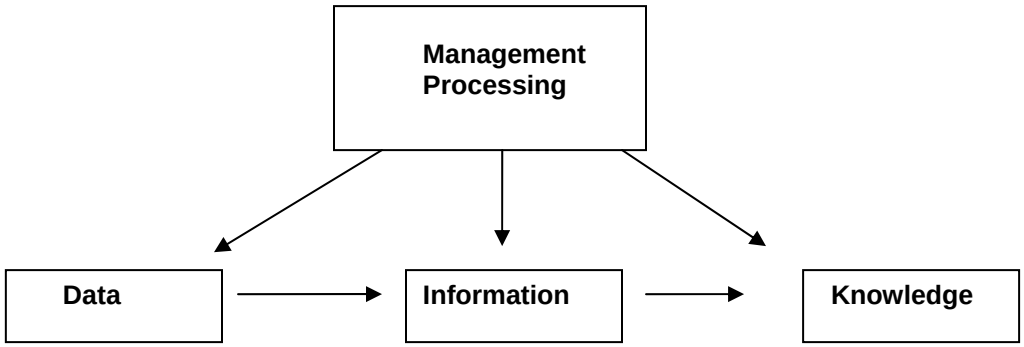

Figure 1. Conceptual Framework for the Study of Nursing Knowledge.
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Graves and Corcoran (1989) drew from Blum (1986) to define the three concepts as follows:

- Data are discrete entities that are described objectively without interpretation,
- Information is data that are interpreted, organized, or structured, and
- Knowledge is information that is synthesized so that relationships are identified and formalized.

Data, which are processed to information and then knowledge, may be obtained from individuals, families, communities, and populations. Data, information, and knowledge are of concern to nurses in all areas of practice. For example, data derived from direct care of an individual are described in the previous scenario. Data may then be compiled across persons and aggregated for decision-making by nurses, nurse administrators, or other health professionals. Further aggregation may address communities and populations. Nurse-educators may create case studies using these data, and nurse-researchers may access aggregated data for systematic study

As an example, an instance of vital signs for an individual—heart rate, respiration, temperature, and blood pressure—can be considered (a set of) data. A serial set of vital signs taken over time, placed into a context, and used for longitudinal comparisons is considered information. That is, a dropping blood pressure, increasing heart rate, respiratory rate, and fever in an elderly, catheterized person are recognized as being abnormal for this person. The recognition that the person may be septic and, therefore may need certain nursing interventions reflects information synthesis (knowledge) based on nursing knowledge and experience.

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Figure 2 builds on the work of Graves and Corcoran by providing a depiction of the relationship of data, information, and knowledge. As data are transformed into information and information into knowledge, each level increases in complexity and requires greater application of human intellect. The X-axis in Figure 2 represents the increasing complexity of the concepts; the Y-axis represents the increasing interrelationships and interactions within and between the concepts as one moves from data to wisdom.

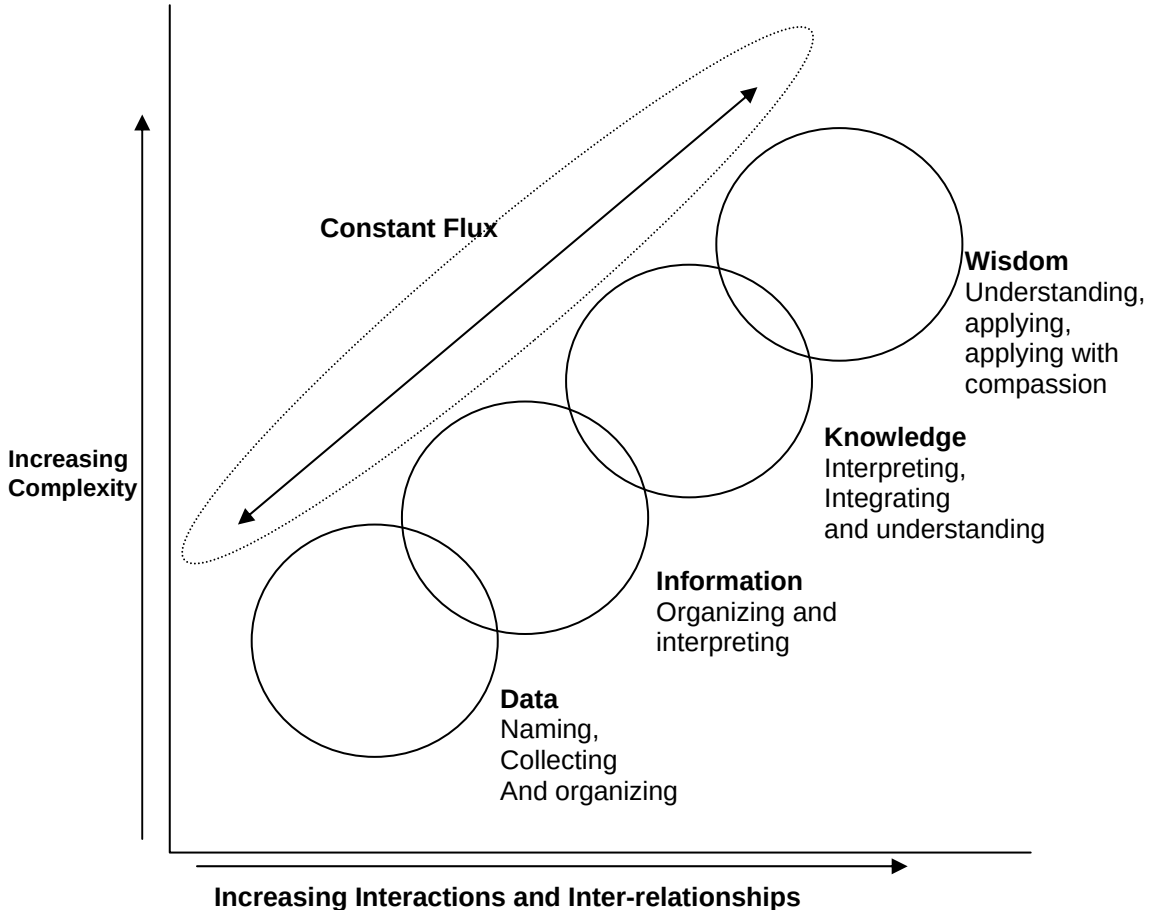

Figure 2. The Relationship of Data, Information, Knowledge and Wisdom

*Reprinted from Englebardt, S. 7 Nelson, R. Health Care Informatics: An Interdisciplinary Approach, Copyright (2002), Figure 1-4, page 13 with permission from Elsevier.

In the mid 1980's Blum (1986) introduced the concepts of data, information and knowledge as a framework for understanding clinical information systems and their impact on health care. He did this by classifying the then current clinical information systems by the three types of

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objects that these systems processed. These were data, information and knowledge. He noted that the classification was artificial with no clear boundaries; however, increasing complexity between the concepts existed. Graves and Corcoran (1989) built on this work by defining the scope and structure of the science of NI using these concepts of data, information and knowledge. In the 25 years since Blum published his classification a fourth concept has been added to this model. That concept was wisdom.

Wisdom is defined as the appropriate use of knowledge to manage and solve human problems. It is knowing when and how to apply knowledge to deal with complex problems or specific human need (Nelson, 1989; Nelson, 2002). Wisdom requires the synthesis of values and experience as well as empirical, ethical, personal and aesthetic knowledge. While knowledge focuses on what is known; wisdom focuses on the appropriate application of that knowledge. For example, a knowledge base may include several options for managing an anxious family, while wisdom would guide the decisions about which of these options are most appropriate with a specific family.

The scope of NI is based on the scope of nursing practice and nursing science. It is not limited by the current technology. If the study of NI was limited to what the computer can process, the study of informatics could not fully appreciate the interrelationships that exist between nursing science/practice and information science/technology. NI must consider how nurses impact the technology and how the technology impacts nursing. An understanding of this interaction makes it possible to understand how nurses create knowledge and how the make use of that knowledge in their practices. The appropriate use of knowledge reflects wisdom.

Two interrelated forces have encouraged the expansion of the NI model to include wisdom. First, the initial work was limited to the types of objects processed by automated systems in the mid 1980's. However, NI is now concerned with the use of information technology to improve the access and quality of health care that is delivered to individuals, families and communities. The addition of the concept of wisdom expands the focus of the model from the technology and the processing of objects to include the interaction of the human with the technology and resultant outcome(s). The concept of wisdom is not limited to NI practice, as is illustrated in Figure 3; however, there are differences in how the four concepts of data, information, knowledge and wisdom are presented in Figures 2 and 3. For example, the four concepts overlap in Figure 2 demonstrating the overlapping nature of these concepts but are separate

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circles in Figure 3. While the figures do differ it is clear that that both figures are demonstrating the same basic concepts. With the addition of wisdom new research questions are generated. For example, how can decision support systems be designed to support the effective application of knowledge by the expert as well as the novice practitioner?

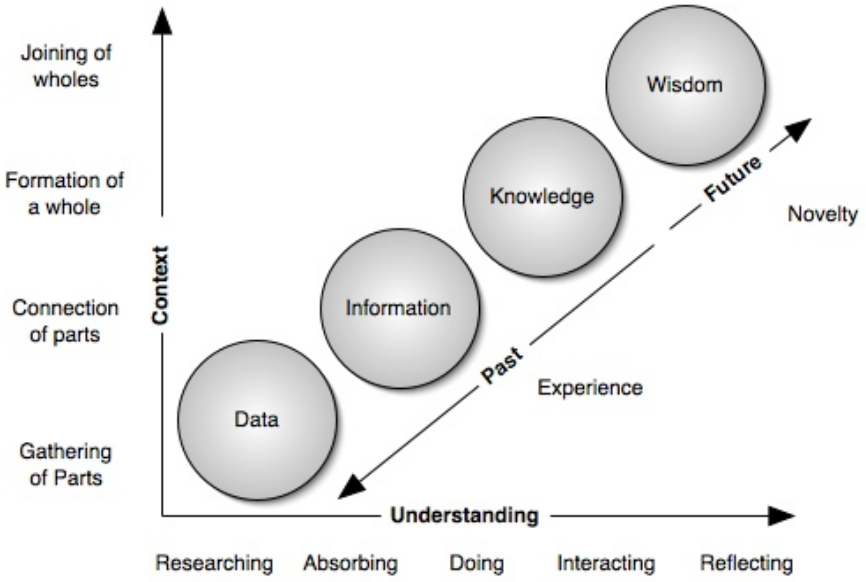

Figure 3. The Continuum of Understanding

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Nurses have been recognized as primary processors of information for over 40 years (Jydstrup and Gross, 1966; Zielstroff, 1981). Other authors have focused on the amount of time nurses actually spend administering direct care to patients or the time involved in documentation (Norrie, 1999; Jinks, 2000; Harrison, 2002). In fact, Jydstrup and Gross (1966) estimated that nurses in acute care spent 30% to 40% of their time in information processing activities in the 1960s. In her frequently cited article, titled, "How do nurses spend their time?" Hendrickson (1990) determined that nurses spend only 31% of their time with patients. Other aspects of the nursing role included information management with ancillary services.

Sciences Underpinning Nursing Informatics

A significant contribution of Graves and Corcoran (1989) was a description and definition of nursing informatics (NI) that was widely accepted in the field in the 1990s. It stated that NI is a combination of nursing science, information science, and computer science to manage and

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process nursing data, information, and knowledge to facilitate the delivery of health care. The central notion was that the application of these three core sciences was what made NI unique and differentiated it from other informatics specialties.

In addition to these three core sciences, other sciences may be required to solve informatics issues. James Turley expanded the model of NI to include cognitive science (1996). Certainly the cognitive aspect of humans is a critical piece for INSs and for INs to understand. However, other sciences may be equally as critical depending upon the issue at hand. For example, if the INS is dealing with a system's implementation in an institution, an understanding of organizational theory may be germane to successful implementation (Staggers & Thompson, 2002). As science evolves, it may be necessary to include other core sciences in future models.

Although the core sciences are foundational to the work in NI, the practice of the specialty is considered an applied science rather than a basic science. The combination of sciences creates a unique blend that is greater than the sum of its parts, a unique combination that creates the definitive specialty of NI. Further, informatics realizes its full potential within health care when it is grounded within a discipline; in this case, the discipline is nursing. Computer and information science applied in isolation will have less impact if not applied within a disciplinary framework. Through application, the science of informatics can solve critical health care issues of concern to a particular discipline.

Language as a Tool for Nursing Informatics

Many of the tools used by the informatics nurse and informatics nurse specialist are based on metastructures and concepts that incorporate knowledge from nursing and other health and information sciences. Nursing knowledge is gained by the ability to extract data that specifically defines nursing phenomena. Many different languages and ways of organizing data, information and knowledge exist based on different concepts.

The creation of nursing taxonomies and nomenclatures has occurred over the past years allowing these iterations to occur. The ANA has formalized the recognition of these languages/vocabularies through a review process of the Committee on Nursing Practice Information Infrastructure (CNPII). For more information, see Table 1 and http://nursingworld.org/npii/terminologies.htm. To promote the integration of standardized terminologies within information technology solutions, the ANA's Nursing Information and Data Set Evaluation Center (NIDSEC) conducts the following activities:

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- Develops and disseminates standards pertaining to information systems that support the documentation of nursing practice, and
- Evaluates voluntarily submitted information systems against these standards.

Table 1. ANA Recognized Terminologies and Data Element Sets

	Setting Where Developed	Content
Data Element Sets		
1. NMDS Nursing Minimum Data Set Currently Recognized	All Nursing	Clinical Data Elements
2. NMMDS Nursing Management Minimum Data Set Currently Recognized	All Settings	Nursing Administrative Data Elements
Interface Terminologies		
3. CCC Clinical Care Classification Currently Recognized	All Nursing Care	Diagnoses, Interventions, and Outcomes
4. ICNP® International Classification of Nursing Practice Currently Recognized	All Nursing	Diagnoses, Interventions, and Outcomes
5. NANDA NANDA International Currently Recognized	All Nursing	Diagnoses
6.NIC Nursing Intervention Classification Currently Recognized	All Nursing	Interventions
7. NOC Nursing Outcome Classification Currently Recognized	All Nursing	Outcomes
8. OMAHA SYSTEM Omaha System Currently Recognized	Home Care, Public Health, and Community	Diagnoses, Interventions, and Outcomes
9. PCDS Patient Care Data Set Retired	Acute Care	Diagnoses, Interventions, and Outcomes
10. PNDS Perioperative Nursing Data Set Currently Recognized	Perioperative	Diagnoses, Interventions and Outcomes

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Multidisciplinary Terminologies		
11. ABC Alternative Billing Codes Currently Recognized	Nursing and Other	Interventions
12. LOINC® Logical Observation Identifiers Names and Codes Currently Recognized	Nursing and Other	Outcome and Assessments
13. SNOMED CT Systematic Nomenclature of Medicine Clinical Terms Currently Recognized	Nursing and Other	Diagnoses, Interventions, and Outcomes

At a higher level of structure, several resources have developed to facilitate interoperability between different types of systems of concepts and nomenclature. For instance, the Systemized Nomenclature of Medicine (SNOMED-CT; http://www.snomed.org) is considered a universal health care terminology and messaging structure. In nursing, SNOMED enables terminology from one system to be mapped to concepts from another, e.g., North American Nursing Diagnosis Association (NANDA), Nursing Intervention Classification (NIC) and Nursing Outcome Classification (NOC). On a larger scale, the Unified Medical Language System of the National Library of Medicine (UMLS; http://www.nlm.nih.gov/research/umls) incorporates the work of over one hundred vocabularies, including SNOMED (http://www.nlm.nih.gov/research/umls/metaa1.html). The INS must be aware of these tools, and may be called upon to understand the concepts of one or more languages, the relationships between related concepts, and integration into existing vocabularies for a given organization.

The importance of languages and vocabularies cannot be understated. INSs must seek a broader picture of the implications of their work, and the uses and outcomes of languages and vocabularies for end users. For instance, nurses working in mapping a home care vocabulary with an intervention vocabulary must see beyond the technical aspect of the work. They must understand that there may be a case manager for a multi-system health organization or a home care agency who will be developing knowledge of nursing acuity and case mix based on the differing vocabularies that they have integrated. The INS must attempt to envision the differing functions that may be used with the data, information and knowledge that have been created.

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Concepts and Tools from Information Science and Computer Science

Informatics tools and methods from computer and information sciences are considered fundamental elements of NI, including:

- Information technology
- Information structures
- Information management
- Information communication

Information technology includes computer hardware, software, communication, and network technologies, derived primarily from computer science. The other three elements are derived primarily from information science: Information structures organize data, information, and knowledge for processing by computers. Information management is an elemental process within informatics in which one is able to file, store, and manipulate data for various uses. Information communication processes enable systems to send data, and to present information in a format that improves understanding. The use of information technology distinguishes informatics from more traditional methods of information management. Thus, NI incorporates the above four additional elements from computer and information science. Underlying all of these are human–computer interaction concepts discussed in the next section.

Human–Computer Interaction and Ergonomics Concepts

Human–computer interaction (HCI) and ergonomics concepts are of fundamental interest to the INS. Essentially, HCI deals with people, software applications, computer technology and the ways they influence each other (Dix, Finlay, Abowd, & Beale et al., 2004). Elements of HCI are rooted in psychology, social psychology and/or cognitive science. However, the design, development, implementation, and evaluation of applications derive from applied work in computer science, the specific discipline at hand (in this case nursing), and information science. For example, an INS would assess an application before purchase to determine whether the application design complements the way nurses cognitively process medication orders.

A related concept is usability which deals with specific issues of human performance during computer interactions for specific tasks within a particular context (Dix, et al., 2004). Usability issues address the efficiency and effectiveness of an application. For example, an INS might study the ease of learning an application, the ease of using an application, or the speed and

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errors committed during application use when determining which system or application would be best utilized on a nursing unit.

The term ergonomics typically is used in the United States to describe the design and implementation of equipment, tools, and machines related to human safety, comfort, and convenience. Commonly, the term “ergonomics” refers to attributes of physical equipment or to principles of arrangement of equipment in the work environment. For instance, an INS may have a role in ensuring that good ergonomics principles are used in an intensive care unit to select and arrange various devices to support workflow for multidisciplinary providers as well as patients’ families.

HCI, usability, and ergonomics are related concepts. Their goal is better design for software, devices and equipment to promote optimal task completion. These concepts are essential for the INS to understand to develop, select, implement, and evaluate information structures and information solutions for use by nurses in specific settings for persons in their care.

The importance of HCI, ergonomics and human factors to health care was elevated with the Institute of Medicine’s Quality Chasm reports (IOM, 2001). Before these reports HCI and usability assessments and methods were being incorporated into health at a glacial speed. However, in the past 5 years the number of HCI and usability publications has increased substantially, vendors have installed usability labs, and vendors have incorporated usability testing of their products into their systems lifecycles. The FDA has mandated usability testing as part of their approval process for any new devices (FDA, 2007). Thus, HCI and usability are critical concepts for INs and INSs to understand.

Phenomena of Nursing

The metaparadigm of nursing comprises four key concepts: nurse, person, health, and environment. Nursing actions are based upon the inter-relationships between the concepts and are related to the values nurses hold relative to them. Nurses make decisions about interventions from their unique perspectives. Decision-making is the process of choosing among alternatives. The decisions that nurses make can be characterized by both the quality of decisions and the impact of the actions resulting from those decisions. As knowledge workers, nurses make numerous decisions that affect the life and well-being of individuals, families, and communities. The process of decision-making in nursing is guided by the concept of critical thinking. Critical thinking is the intellectually disciplined process of actively and skillfully using

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knowledge to conceptualize, apply, analyze, synthesize, and/or evaluate data and information as a guide to belief and action (Scriven and Paul, 1997).

Clinical wisdom is the ability of the nurse to add experience and intuition to a situation involving the care of a person (Benner, 1999). Wisdom in informatics is the ability of the NIS to evaluate the documentation drawn from a Health Information System (HIS) and the ability to adapt or change the system settings or parameters to improve the workflow of the clinical nurse.

Nurses' decision-making is described as an array of decisions that include specific behaviors, as well as cognitive processes surrounding a cluster of issues. For example, nurses use data transformed into information to determine interventions for persons, families, and communities. Nurses make decisions about potential problems presented by an individual and about appropriate recommendations for addressing those problems. They also make decisions in collaboration with other health care professionals such as physicians, pharmacists or social workers. Decisions also may occur within specific environments such as executive offices, classrooms, and research laboratories.

As Blum demonstrated in the mid 1980's it is possible to use the concepts of data, information, knowledge and wisdom to classify different levels of automated systems. An information system such as its name indicates takes in data/information, processes that data/information and outputs information. An automated decision support system uses knowledge and a set of rules for knowledge to interpret data and information and produce recommendations or guidelines. With a decision support system, the user decides if the recommendations will be implemented. Thus, a decision support system relies on the wisdom of the user. An automated expert system goes one step further. An expert system will implement the decision of the computer system without control by the user. The relationships among the concepts of data, information, knowledge and wisdom as well as information, decision support and expert automated systems are represented in Figure 4.

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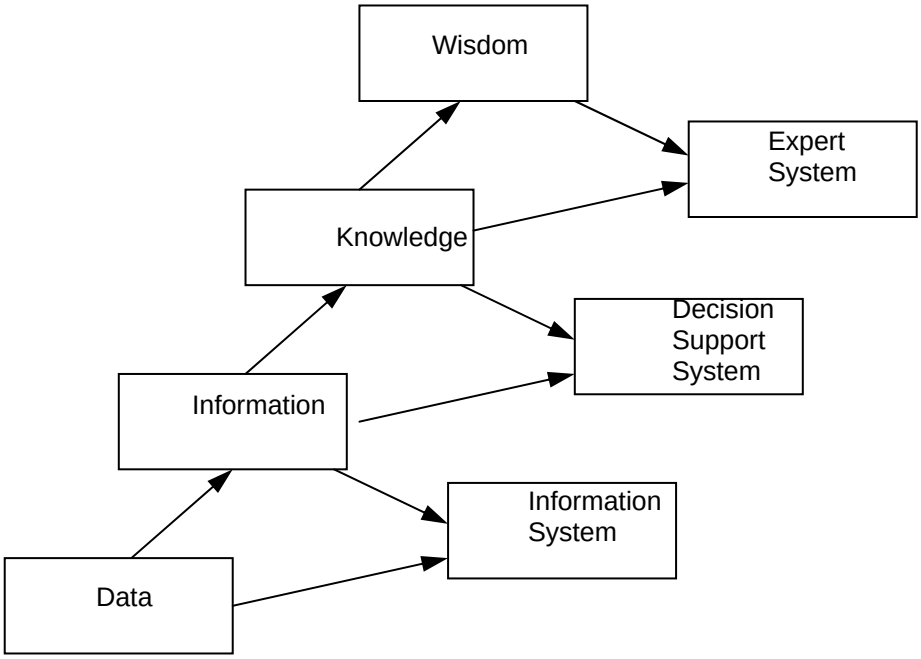

Figure 4. Levels and Types of Automated Systems

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In summary, the NIS must be able to navigate the complexity of the relationships between the following elements and understand how they facilitate decision-making:

- Data, information, knowledge and wisdom
- Nursing science, information science, computer science and other sciences of interest to the issue at hand (e.g., cognitive science,
- Nurse, person, health and environment, and decision-making
- Information structures, information technology, managing and communicating information

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Definition and Goal for Nursing Informatics

The following Nursing Informatics definition and goal of the INS are continued from the 2001 ANA NI Scope and Standards document with the addition of the concept of wisdom. This definition and the goal of NI was based upon work done by Staggers and Thompson (2002), accepted for publication before the 2001 ANA document was available but actually published after the ANA document appeared in print in 2001. Currently, both the ANA and the Canadian Nursing Informatics Association use this NI definition. As we move forward in time, perhaps additional discussion and international consensus about NI definitions will occur.

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The Definition for Nursing Informatics

Nursing informatics is a specialty that integrates nursing science, computer science, and information science to manage and communicate data, information, knowledge and wisdom in nursing practice. Nursing informatics supports 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.

The Goal of Nursing Informatics

The goal of nursing informatics is to improve the health of populations, communities, families, and individuals by optimizing information management and communication. These activities include the design and use of informatics solutions and/or technology to support all areas of nursing – including but not limited to the direct provision of care, establishing effective administrative systems, managing and delivering educational experiences, supporting life-long learning, and supporting nursing research.

Distinguishing Between the Informatics Nurse Specialist and Informatics Nurse

After much discussion, the panel of NI experts writing this document decided to distinguish between informatics nurse (IN) and INS. The IN is a term used to reference an RN who works in the area of informatics. This RN is not formally prepared in informatics but has an interest and/or experience working in the area. In contrast, the INS is an RN with advanced, graduate education in nursing informatics or a related field such as health informatics, biomedical informatics or information management. This language is consistent with that used to describe clinical nurse specialists within the ANA.

Functional Areas of the Informatics Nurse Specialist

There are many activities inherent in informatics nursing (Wilson, et al., 2000). Nurses working in the area of informatics typically perform in various functional capacities that facilitate healthcare delivery and quality. A current issue with nursing informatics titles is that there is no national standardization. The titles utilized by INSs and INs are numerous and inconsistent. As a consequence, INSs and INs with different titles may be actually performing the same functions. Conversely, there may be two with completely different job titles but performing similar functions. A 2004 Health Information Management and Systems Society (HIMSS) NI

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survey of 537 INs categorizes the work INs perform according to “job responsibilities” as opposed to job titles (HIMSS, 2004). In addition, a database of job titles for nurses working in Nursing Informatics (NI) was created by Newbold (2006) in the early 1980s. As of early 2006, the database includes titles for 6338 members of nursing and informatics organizations, as well as conference attendees and participants on electronic discussion lists. The top 50 NI job titles can be seen in the Appendix (Newbold, 2006). Because of the confusion inherent in job titles, it is expedient to look at the work of informatics nursing from the standpoint of *functions*.

Not only are there varied titles and functions within nursing informatics, the environments in which INSs and INs practice are numerous and evolving. Initially, nursing informatics was focused exclusively in the hospital setting. Currently, INSs and INs are working in and with hospitals, home health and hospice agencies, nursing homes, public and community health agencies, physician offices and ambulatory care centers. They also are also employed with medical device vendors, software companies, web healthcare content providers, disease management companies, government agencies and a host of other settings (Sensmeier, West and Horowicz, 2004). The concept of the INS and IN practicing in interdisciplinary healthcare environments is common to all functional areas. INSs and INs are expected to interact with information technology (IT) professionals during all phases of the information systems lifecycle.

There are also multiple constituencies/stakeholders of nursing informatics services, such as physicians, nurses, health care consumers, information technology professionals, health care agencies and organizations. INSs nurses are particularly well suited to work in environments involving multiple disciplines. They plan, implement and/or coordinate projects involving these multiple constituencies. The 2004 HIMSS survey (HIMSS, 2004) reported that of nurses working in nursing informatics, “Two-thirds of respondents (67 percent) indicated that systems implementation, which includes training, supporting and preparing users, was one of their top informatics nursing job responsibilities.” Nurses are particularly well suited for IT implementation, as it essentially follows the nursing process of assessment, planning, implementation and evaluation (ANA, 2004a). It is iterative, organized and systematic, and customized to the organizations’ or consumers’ needs. This background enables the INSs to be adept in both the nursing and IT cultures. The INS frequently serves as a bridge between information technology providers and technology recipients. INSs use scientific principles, but many times are called upon to exercise creative strategies and solutions to benefit health care recipients. These efforts may involve cognitive as well as behavioral strategies. INSs move in and out of both arenas, while keeping at the forefront their primary perspective of advocacy on

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behalf of the healthcare consumer. Multidisciplinary work, nursing process and advocacy are concepts nursing brings to informatics work that is unique from other informatics professionals.

Because of the tendency to confuse *Role* with *Title*, and due to the vast number of and lack of standardization of nursing informatics titles, this section will focus on describing the functional areas in which the INS or IN performs, with examples from various environments. In part because of the strong influence that emerging technology has in directing the work of the INS, functional areas are, and will be, continually evolving. While most INSs and INs concentrate their work in a primary functional area, many do not work exclusively in one area but perform in multiple functional capacities. For example, an INS or IN may be responsible for system-wide implementation of IT while also being involved in development of specific database applications. The following are the general functional areas of Informatics Nursing:

- Administration
- Analysis
- Compliance and integrity management
- Consultation
- Coordination, facilitation and integration
- Development
- Educational and professional development
- Policy development and advocacy
- Research and evaluation
- Telehealth

In subsequent sections, each of these functional areas will be explored.

Administration

As is true in nursing administration in general, administrative functions in nursing informatics consist of both higher-level and mid-level administrative functions (ANA, 2004b). Increasingly, INSs nurses are attaining senior leadership positions. Titles may include “Vice President,” “Director,” “Chief Information Officer” (CIO) or similar leadership titles (AMIA NI Working Group, 2006; Staggers and Lasome, 2005; Greene, 2004). In this functional capacity, nursing informatics leaders are expected to be visionary, and establish the direction of large-scale technology projects. The nursing informatics leader also serves as a catalyst for developing and revising strategic plans, policies and procedures based on system design, workflow reengineering, and input from disparate system users.

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In mid-level administration, INSs manage and supervise personnel and activities for all components of the organization's IT systems life cycle. These activities is may include analysis, design, development, selection, testing, implementation, and evaluation of systems that support nursing and delivery of consumer care. Management functions combine the skills of communication, change management, process analysis, risk assessment, scope definition and team building, in conjunction with business and application knowledge in the management of projects involving informatics solutions. INSs serving in this functional area provide input to the organization's strategic plan, evaluate the effectiveness of their projects and continually strive to improve the quality and efficiency of their informatics solutions. Examples of administration functions might include:

- INS at a large hospital system, with supervision of an implementation and training team, representing nursing interests on various IT committees, performing project management for multiple nursing documentation projects and having oversight of nursing standards and vocabularies utilized within applications.
- Project Manager for a clinical software company, managing implementation teams for various client projects (hospitals to ambulatory facilities) and consulting with clients on all aspects of systems selection, customization, adoption and use of software.
- Grants Administrator for an information science research agency seeking and writing grants that would fund Nursing Informatics (NI) related projects, designing budgets and ensuring optimal allocation of resources.

Analysis

Data can be aggregated and analyzed in an infinite number of ways in order to synthesize knowledge, informing decision support and outcomes management activities, and advancing the science of nursing informatics. The INS may use a number of tools to accomplish these activities. For instance, taxonomies and clinical vocabularies may be used to tag consumer data so that higher level analyses may be performed. For groups of data, meta-analyses may be employed to identify large scale trends. Systems and requirements analysis may track the flow of data within a system, customized to end-user needs. Workflow analysis may detail steps taken for a number of different tasks.

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The INS must understand process flows and how they may impact nursing actions. Processes must be designed so that interactions between users and computers are successful. Competency in formal systems analysis techniques and use of statistical software also may be required. These techniques compare the capabilities and limitations of systems to be installed, and where changes must be designed. Discrepancies between the current and ideal systems must be identified, and redundancies must be removed. The clinical analysis process also may include components such as process redesign (add Nancy's job descriptions; citations: U Utah). A plan based on usability principles, using structured systems analysis techniques must be implemented and evaluated.

INSs also may engage in the process of knowledge discovery in databases (KDD) Using sounds methodologies and practical evidence-based recommendations, the INS can discover information and knowledge related to diverse areas of nursing practice. Knowledge discovery methods, including data mining and machine learning methods, can be applied along with statistical analysis and data visualization techniques, to enumerate and understand patterns in very large data stores, such as enterprise data warehouses (Fayyad, 1996).

Analysis also is required with languages and taxonomies. Nursing languages such as Nursing Intervention Classification (NIC) and Nursing Outcomes Classification (NOC) as well as medical vocabularies must be periodically re-evaluated for their applicability and currency (Center for Nursing Classification and Clinical Effectiveness, 2004). Analysis of a meta-database such as the Unified Medical Language System (UMLS; National Library of Medicine, 2006) requires knowledge of nursing as well as medical vocabularies in order to analyze groups of taxonomies.

Outcomes of analysis may be related to any domain of nursing practice—clinical, education, research or administration – and the complexity and levels of outcomes must be determined for health care consumers, populations and institutions. Analysis of HCI involves the interface of users with actual hardware and software. Analysts use system tools to maintain data integrity and reliability, facilitate data aggregation and analysis, identify outcomes and develop performance measurements, enabling nurses to contribute to the development of a knowledge base consisting of the data, information, theories and models that are used by nurses in decision-making and support of the nursing process. Examples of analysis might include:

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- Nursing analyst in a hospice setting where health care consumer data is tracked to establish a case mix weight that will determine allocation of nursing personnel.
- Quality improvement (QI) Specialist in a hospital system who aggregates multi-site research data related to diagnosis and nursing procedures performed.
- Quality Assurance (QA) Analyst who retools current methodologies to incorporate use of existing system data to generate customized QA reports
- An analyst who applies knowledge discovery methods to warehoused electronic nursing record data, within the process of knowledge discovery in databases, to build a predictive model of patient falls.

Compliance and Integrity Management

With the emergence of national laws advocating for the protection of health information, INSs are responsible for ensuring the ethical use of data, as well as data integrity, security and confidentiality of protected health information. Part of the function of the INS is knowledge and application of these standards. The advent of the Health Insurance Portability and Accountability Act (HIPAA) of 1996 (U.S. Congress, 1996) regulations has required that healthcare organizations revise operational procedures for staff, as well as technical processes to maintain compliance. INSs must be fluent in these new requirements, and are involved in creating, implementing and assuring organizational change to meet new legislative mandates in this area. Compliance also includes adherence to national and international standards. These standards may include government agencies, for instance the Food and Drug Administration (FDA) and National Institutes of Health (NIH), as well as accreditation organizations such as The Joint Commission.

There also are ethical issues related to consumer privacy. One such issue occurs with knowledge discovery in databases, where in some cases, prediction of outcomes based on individual characteristics and past behavior or usage may be used to stratify groups of persons. Although used in a variety of industries, the process of knowledge discovery in databases remains controversial in health care. Adequate HIPAA protections must be in place, and relevant ethical issues must be considered in all phases of data retrieval and analysis. For example, analysis of genomic data may result in sensitive predictions of disease susceptibility. Given the explosion of large data stores and enterprise data warehouses, knowledge discovery in databases is a process important for extraction of useful information and knowledge while

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considering and protecting consumer privacy. The INS can ensure a balanced view of data access and information privacy is assured.

In health care, the emerging sciences of genomics and bioinformatics could be used to predict risk for certain diseases, and thus insurability risk. There are also ethical issues surrounding new products such as embedded technologies and radio-frequency identification (RFID), for instance as it might be applied in persons with Alzheimer's Disease. As the profession matures, some of these issues will be resolved and associated standards will be established. Upcoming requirements will continue to evolve, some of which are mentioned in the section of this document called The Future of Nursing Informatics.

Examples of compliance and integrity management might include:

- Security Officer for a hospital, ensuring that HIPAA standards are met by software vendors within the organization, periodically monitoring software audit logs for breaches; ensuring that passwords are not shared and backup and disaster procedures are in place and operational.
- Compliance Officer for a state health agency writing and enforcing policies that conform to state and national laws as they relate to records retention.
- Care Coordinator Administrator for a hospital system who ensures the confidentiality of data transmitted via telehealth and telemedicine devices

Consultation

INSs apply informatics knowledge and skills to serve as a resource to clients both formally and informally, in external and internal settings. Consultants are experts in the areas of process redesign, strategic/IT planning, system implementation, writing informatics publications, reviewing clinical software products, performing market research, and assisting in the planning of conferences, academic, and professional development programs. These expert INSs may work for a consulting firm, be employed as staff of the organization where they consult, own an independent practice, or write about nursing informatics subjects and speak at nursing informatics-related events. Flexibility, good communication skills, breadth and depth of clinical and informatics knowledge, and excellent interpersonal skills are needed to respond to what can be rapidly changing projects and demands. Examples might include:

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- Consultant with individuals and groups in defining health care information problems and identifying methods for implementing, utilizing and modifying IT solutions and data structures that support health care access, delivery and evaluation.
- Consulting as the Project Manager or assistant to the Project Manager for an informatics-related project, ensuring that team members are performing duties as assigned, and the project is completed under budget.
- Consulting with clients in writing requests for proposals to elicit vendor bids for informatics solutions and in evaluating vendor responses.

Coordination, Facilitation and Integration

INSs may be asked to coordinate a vast array of projects in multiple settings. In many instances an IN or INS serves as the liaison between the software engineer and the end-user. In this capacity, the INS or IN would ensure that the necessary testing or research was performed to determine the end-user's needs, and would then convey this information to the software engineer in terms the engineer could understand. Once the engineer has created a product, the INS would then evaluate the utility of the product from the viewpoint of the end-user. This "liaison" type of facilitation and coordination is now being seen in multiple environments, the foregoing being just one example. Ensuring the integration of nursing vocabularies and standardized nomenclatures within applications is another example. INSs in this functional capacity are also acting as usability experts and making recommendations on ideal formats for the utilization of technology. Examples of consultation might include:

- Project Coordinator for a statewide electronic medical record implementation coordinating a team that trains public health nurses how to utilize the new documentation system and coordinating all aspects of the training plan.
- Clinical Liaison for a telehealth software vendor communicating with providers and consumers to ensure that all parties are agreeable to development and implementation plans and assure that providers using the system receive adequate technical training.
- Usability Expert on a software development team advising software engineers on screen design from the standpoint of nursing documentation needs, performing and/or coordinating testing of iterative revisions of the system and validating clinical requirements with the users.

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Development

Knowledge development should be differentiated from application development. Knowledge is developed when data are transformed into information to which meaning is attached, and is distilled from an aggregation of information from multiple systems. In order for system-generated knowledge to be of value and impact patient outcomes, INSs ensure strategies that transform data into information, information is transformed into knowledge, and all is disseminated at appropriate times to appropriate users in the health care continuum. At a higher level, wisdom, or an understanding of principles embodied in knowledge (Bellinger, Castro and Mills, 2004), may be the result of informatics nursing actions. However, although wisdom may result from the transformation of data, information and knowledge, there will be no ultimate value to the health of the consumer unless end-users receive the correct the functionality and products they are expecting. Evaluation of development needs occurs at a systems level, and leads to new knowledge. New knowledge, and subsequent application research and diffusion must then in turn be integrated into higher level development, such as knowledge engineering and meta-analysis.

Adherence to national standards is also essential to any development work. In order to ensure interoperability between systems, INSs and INs involved in system development must be knowledgeable about international standards requirements. For instance, existing standards such as Health Level Seven (HL-7), International Standards Organization (ISO) Common Procedural terminology (CPT), International Classification of Disease (ICD), and Digital Image COMmunication (DICOM) as well as Section 508 accessibility standards (Hammond, 1995; U.S. General Services Administration, 2006) may be of importance in different types of informatics work. INSs are involved in a vast array of development activities, from software and hardware design, to design of training manuals to design of complex technology networks. As part of this function, INSs and INs participate in the process of designing, iterative development, testing, and dissemination of quality informatics solutions for nurses, interdisciplinary providers, and consumers. Understanding the information needs of nurses and the nursing profession, consumers and consumer care processes, as well as knowledge of business, client services, projected market directions, product design, product development methods, market research, contemporary programming, systems design, and modeling language are essential for practicing in a development environment. Examples of development might include:

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- Developer with a telehealth software vendor creating user-friendly feedback screens for consumers to enter information and interfaces for nurses that display graphs and allow viewing and interpreting of consumer data.
- Database administrator with a large multi-site teaching organization managing an ever-growing nursing vocabulary set that would represent inpatient, ambulatory and home health nursing documentation needs and integrating nursing vocabulary with enterprise databases.
- Content Management Developer for a telehealth consortium creating and validating content for educational handouts and help/tool tips for user interfaces that would display national guidelines.
- Programmer in a hospital I.T. Department coding the portion of the software that enables nurses to document diabetic education.

Education and Professional Development

Education is a critical component of many NI functions, and may directly impact the success or failure of any new/modified IT solution. Vendors of information systems frequently utilize the term "training," however in nursing, the broader concept of "education" is employed in this functional area. Adherence to solid educational principles is a component of this functional area (American Nurses' Association, 2000). Teaching nurses and nursing students, health care consumers and other interdisciplinary health team members about the effective and ethical uses of information technology, as well as NI concepts and theories, is essential for encouraging the optimal use of informatics solutions in nursing practice. Because of ever-changing requirements in health information technology, continuing education is also essential. INSs and INs in this functional capacity develop, implement and evaluate training curriculum and educational technologies that meet the educational needs of learners. In this role, educators and trainers assess and evaluate informatics skills and competencies while providing feedback to learners regarding the effectiveness of the learning activity and the learner's ability to demonstrate newly acquired skills. Educators and trainers manage, evaluate, report and utilize data and information related to learners and the educational delivery system. These INSs are innovators in defining and developing educational technologies, integrating the solutions into the educational and practice environments, and challenging the systems and organizations to consider and embrace innovative informatics processes and solutions.

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The INS must also consider information competency as well as literacy issues. Computer literacy is a core competency needed in health care, and should be taught in nursing curricula at all levels. It is also the foundation of informatics competency. In addition, information literacy must be integrated into practice and used to support knowledge management.

Education and professional development includes not only INSs and INs as well as end-users, but also consumers. With the advent of distance technologies such as telehealth and internet-based consumer-accessible applications, new competencies are needed to ensure that the delivery of health information to consumers is displayed at an appropriate level of understanding, since there may not be face-to-face feedback associated with encounters where the consumer is physically present. Cultural issues, language considerations and literacy level of consumers may not be apparent, and materials may need to be more fully assessed for appropriate presentation and understanding. INSs may need to ensure presentation of content for web-based knowledge portals of private and government health organizations that may exist in multiple locations, or only virtually. Health information many need to be distilled for consumer consumption. Thus, the education and professional development function involves not only training INS and INs, but also developing interfaces that are appropriate to the consumer.

Examples of education and professional development function might include:

- Professor of Nursing at a major university teaching graduate nursing students enrolled in a nursing informatics degree program, overseeing NI research projects and teaching nursing students at all levels the basic principles and foundations of NI.
- Clinical Preceptor for newly hired nurses and students providing orientation about the telehealth program, engaging the learners in using the telehealth technology, and role modeling various telehealth nurse responsibilities with regard to monitoring of physiologic parameters and provision of consumer education through the telephone or video.
- Trainer for a telehealth technology vendor traveling internationally to train nurses on the product's operations, capabilities, troubleshooting, limitations and benefits.
- Staff Development Liaison for a large hospital training nurses and other end users how to use the computer systems.

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- Help Desk Trainer for a large oncology center performing ongoing software training as product upgrades are released, answering user questions on the phone or in person and trouble-shooting user problems.
- Patient Education Coordinator facilitating electronic consumer health resources. Development, and maintenance and presentation of disease content for a hospital web portal

Policy Development and Advocacy

INSs play a key role in development of health policy, particularly bringing expertise regarding the data and information content, the structure of data, and the IT solutions with those attributes. Policy development may be at any level — international, national, state, institution or a work unit. INSs are experts in defining the data needed and the structure, management, and availability of those data for decision-making, and as such they advocate for consumers, providers, and the enterprise, and articulate relevant issues from a nursing perspective. Functions include evaluating, developing, writing and implementing nursing and/or organizational policies. Regardless of the level or activity, INSs are active partners in the development of health policy, particularly related to information management and communication, infrastructure development, and economics.

The advocacy function of the INS or IN also encompasses consumer health. INs may be part of initiatives such as promoting the adoption of telehealth programs for groups that may not have access to health services, such as the underserved and underrepresented, and those in rural areas. Advocacy may include educating legislators regarding increasing telecommunication access, and expanding reimbursement for consumer services, as well as educating the public on ways they might access health-related materials. Examples of policy development and advocacy function of the INS or IN might include:

- A Policy Writer developing and implementing policies to ensure adequate compensated training time is provided to nursing staff for implementation of new IT systems
- A Vice President of Informatics for a health information management organization who represents nursing on a national information standards task force.
- A lobbyist participating in advocacy efforts on behalf of consumers for increased government funding for telehealth and telehomecare demonstration or pilot projects,

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- A President of a nursing informatics organization writing letters to elected officials to obtain their support for reimbursement of nursing services by telehealth providers.

Research and Evaluation

INSs conduct research that underlies the design, development, implementation and impact of technology solutions upon users, to include healthcare organizations, providers, consumers and payers. INS nurse researchers utilize systematic methods of inquiry, including traditional research techniques and newer techniques such as evaluating or searching data in informatics solutions and data repositories. Research and evaluation functions include, but are not limited to:

- Research related to symbolic representation of nursing phenomena
- Evaluation of clinical decision-making in nursing
- Applied research in development, implementation, usability and outcomes impact of prototype systems
- Consumers' and interdisciplinary providers' use of health information tools and resources
- Evaluating effective methods for information systems implementation, acceptance and utilization
- Human factors or ergonomics research about the design and impact of systems on interdisciplinary providers, consumers, nurses, and their interactions
- Evaluation research on the effects of systems on the processes and outcomes of consumer care
- Usability testing of nursing and consumer applications
- Evaluating how consumers utilize computerized health care products
- Research in clinical vocabularies
- Interaction of consumers, providers and technology
- Consumer communication and usage of technology-based support groups

Research in nursing informatics can span a range of activities, from experimental research to process improvement and informal evaluation to evidence-based practice. Much of the work is innovative. It may be initiated by INSs, or conducted at the request of an organization or agency. INSs working in this functional area might conduct research projects to develop and

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refine standardized nursing vocabularies, or link nursing interventions to outcomes in large data sets. This work is essential in defining, describing and evaluating data, information and knowledge relative to the value of nursing care. It might include evaluation of organizational attributes facilitating successful implementation of nursing documentation systems, or investigation of the impact and efficacy of hardware and software solutions.

Nursing informatics research may also include a consumer orientation. It could include the elements of effective nurse-consumer interactions in telehealth contexts or research conducted on the consumer use of electronic information and support systems. Research could also include evaluation of Internet-based interventions and other telehealth initiatives. It may include variables such as system usage and communication and also psychological variables such as quality of life and coping with health obstacles. Questions must be asked about how research is translated into practice, and how it is integrated in the work environment. Patient reaction to technology must also be considered. Examples of the research function of the INS might include:

- Nursing Informatics Scientist working for a large software company aggregating data to determine outliers related to adherence of standard nursing protocols.
- Nursing Informatics Analyst in a hospital information technology (IT) department aggregating data for dealing with incidence of decubiti, creating trend reports and predictive models for nurse managers and analyzing outcomes against quality indicators.
- Nurse Researcher conducting a usability study related to consumer entry of information at a clinic-based kiosk versus in-person interview.

Telehealth

Telehealth, as defined by the U.S. Office for the Advancement of Telehealth, is “the use of electronic information and telecommunications technologies to support long-distance clinical health care, patient and professional health-related education, public health and health administration” (U.S. Office for the Advancement of Telehealth, 2003). Telenursing is the use of distance or telecommunications technologies by nurses (Milholland, 2000; National Council of State Boards of Nursing, 2003) or nursing personnel to monitor consumer and public health and administrative functions, as well as deliver health care education. Because of the widespread expansion of telehealth technologies, standards have been developed that take into account

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differing countries' cultures and governance standards (Milholland Hunter, 2001). Standards may relate to the transmission of data and information as well as protocols for providing care.

There has been some confusion on the overlap between nursing informatics and telehealth. Nursing informatics is a discipline primarily fulfilling a clinical support role, as opposed to a direct clinical practice role. In the job titles database described in Appendix 1, only 71 out of the 1835 positions were Staff Nurse or Staff RN, implying a small percentage of INSs or INs were involved in primarily patient care roles. The remainder of the position titles are *clinical support* roles, such as administration and research, dealing with technology aspects and other clinical support aspects of care delivery.

Telehealth is primarily a *clinical practice* role, with technical aspects required in order to execute delivery of care, but not as the focus. The 2004 International Telenursing Survey (Grady, Schlachta-Fairchild and Elfrink, 2005) surveyed international telenurses worldwide. Of the 719 participants, only 18 telenurses have informatics in their job titles. Within this group, over half of telenurses were advanced practice *clinicians*. Ten of the clinicians have the term informatics in their titles. Thus, the interface between nursing informatics and telehealth nursing primarily occurs at the technical aspects or technical support level.

Standards for telehealth nursing *clinical practice* are located within the *ANA Core Principles on Telehealth* (1998) and *ANA Competencies for Telehealth Technologies in Nursing* (1999) documents. This version of the *Scope and Standards for Nursing Informatics* document pertains to the interface area between telehealth and informatics that refers to the technical aspects of telehealth *clinical support*, as opposed to telehealth *clinical practice.*

Examples of the telehealth function of the IN might be:

- Telehealth Network Coordinator for a rural telehealth program, assuring the appropriate deployment of technology, and customization for distance-related needs.
- Program Manager for Telehealth in a home health agency, organizing the integration of telehealth into the agency's operations, supporting the alignment of telehealth technology with the overall technology strategy of the agency, assuming leadership in the adoption and implementation of the program, and evaluating and maintaining telehealth outcomes and accountability for those outcomes (Starren et al., 2005)

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- Telehealth Nurse Researcher conducting a program evaluation comparing the impact of an online cardiac education program versus an in person support group on level of depression and adherence to diet.

Other Functional Areas of the Informatics Nurse Specialist

With the expected continued growth of technology and ever-increasing increases in capacity, size and speed of systems as well as portable devices, it can be anticipated that nursing informatics functions will also expand in the future (Stanford University, 2005). As new devices are developed, INSs and INs will be responsible for functions that are not yet able to be forseen. Sciences of the future such as embedded technologies and GPS systems will enable facilitation of consumer care at disparate locations.

The future for informatics nursing is limitless. INSs must be both visionary and innovative. There are many other evolving functional areas of the INS and IN, for instance entrepreneurial activities and consumer health. INSs and INs are taking the challenges of entrepreneurial opportunities and engaging in marketing information technology services and product lines or becoming innovators in information technology related to solving health-related issues. Many are starting new businesses. Because technology will be ever-evolving, new functional areas for the INS will continue to emerge. As trends such as telehealth, Regional Health Information Organizations (RHIOs), consumer health records and consumer ehealth portals evolve, INSs and INs will be called upon to continually assess and incorporate trends in the marketplace for their applicability in their own health care settings. INSs and INs will require additional knowledge in telecommunications, networking, consumer interaction and use of online information, remote monitoring device standards and capabilities, and new standards and guidelines for emerging technologies.

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Informatics Competencies

Because of the increased visibility of information and technology within healthcare settings and complementary educational programs, many stakeholders are being faced with a need to define informatics competencies for nurses. Human resource managers and educational planners are just two examples of stakeholders who have an interest in competencies for nursing informatics.

Since the year 2000, researchers and professional organizations have completed substantial work toward defining nursing informatics competencies (Androwich et al., 2003; Curran, 2003; Desjardins, et al., 2003; HIMSS, 2005; Jiang, Chen & Chen, 2004; Staggers, Gassert & Curran, 2000, 2001, 2002). Various lists of informatics competencies are available, especially those geared toward nurses' educational levels (see references).

A keen interest has emerged for identifying informatics competencies for various nursing roles. Stakeholders, such as employers and educators, are requesting clarification about these competencies. For the discussion here, competencies for typical nursing informatics roles are especially pertinent. To this end, a matrix has been developed, based upon a thorough literature review and the work from a consensus panel. This text and accompanying matrix suggests competencies for typical nursing informatics functional areas (as discussed earlier in the document.)

The Intersection of Informatics Competencies and NI Functional Areas

A review of the literature was conducted to examine work on informatics competencies, concentrating on the inter-relationship of nursing roles and informatics competencies. Staggers, Gassert and Curran (2000, 2001, 2002) published initial work in this area, defining and validating informatics competencies for nurses at these four levels of practice: beginning, experienced, INS and informatics innovator. This research and framework can more closely aligns to educational requirements for all nursing specialties at the beginning and experienced levels, and then identifies specific competencies for the specialty roles of INS and the informatics innovator. The work by Staggers et al (2001, 2002) incorporated into educational curricula and policy documents.

To date, the majority of authors have focused on the competencies needed for nursing curricula. For example, Curran (2003) and faculty colleagues identified informatics

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competencies for nurse practitioners at Columbia University School of Nursing. Desjardins, Cook, Jenkins and Bakken (2005) focused on beginning nurse competencies, expanding them to include the knowledge and skills for information literacy to support evidenced-based practice. Similar to Staggers et al. (2002), this study also categorized competencies into four levels of nursing practice. Barton (2005) echoed a similar view of informatics competencies for the beginning nurse, identifying a need for competencies in both technology or computer literacy as well as information literacy for undergraduate nursing programs.

Educational content areas for required informatics competencies has been examined by several authors. McNeil, Elfrink, Pierce, Beyea, Bickford and Averill (2005) asked the Deans and directors of 672 baccalaureate and higher programs to identify informatics content taught in their undergraduate and graduate programs. Twenty-five unique content areas were identified for undergraduate (i.e., beginning nurse) and graduate (i.e., experienced nurse) levels of practice. Among the top-ranked competencies for both programs were: a) accessing electronic resources, b) ethical use of information systems, c) evidence based practice skills and d) skills for computer-based patient records. The undergraduate program respondents more often identified basic hardware and software skills while the graduate program respondents included competencies related to innovation and change theory, national health data database knowledge and general systems theory.

Jiang, Chen and Chen (2004) surveyed Taiwanese nursing education programs ranging from non-vocational and vocational nursing programs to collegiate programs for 2-, 4-, 5-year and graduate-level programs. The authors identified seven domains of competencies and linked them to differing levels of nursing education in Taiwan. In contrast to work in the US, these authors identified domains mostly related to computer versus information literacy, including hardware, software and network concepts; principles of computer application; skills in computer usage; program design; limitations of the computer; personal and social issues; and attitudes toward the computer.

New categories and concomitant competencies for education as well as practice are also available. Androwich, I. M., Bickford, C. S., Button, P. J., Hunter, K. M., Judy, M., & Sensmeier, J. (2003) described NI competencies needed to improve patient safety and expand nursing practice. Garde, Harrison, and Hovenga, (2005) reported specific competencies for:

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- Nursing informatics knowledge and skills (e.g., Health Information Systems, Electronic Patient records, Telehealth)
- Information technology knowledge and skills (e.g., programming principles, software development, methodologies and processes, system analysis and design, database design and management)
- Knowledge and skills in organizational and human behavior (e.g., project management, inter-professional communication, risk management, policies and procedures).
- Clinical and health-related knowledge and skills (e.g., evidence based practice, clinical guidelines, care pathways).

HIMSS (Health Information Management Systems Society) as a member of the Healthcare Leadership Alliance (HLA) announced the creation of the HLA Competency Directory in the fall of 2005. This directory identifies 300 competencies across multiple healthcare management roles categorized in five domains: a) leadership: b) communications and relationship management, c) professionalism; d) business knowledge and skills, and e) knowledge of the healthcare environment. This comprehensive list of competencies can be downloaded from the HLA site at http://www.healthcareleadershipalliance.org/directory.cfm. This directory may be especially pertinent for those working in interdisciplinary settings.

Developing a New Competencies Matrix

A competencies matrix was derived from the initial work of Staggers, Gassert and Curran (2002). Evidence was also found in the review of literature and the content areas described in the ANCC NI Certification exam located at: (http://www.nursingworld.org/ancc/cert/eligibility/informatics.html). Unique competencies were abstracted from each of the references and included into a comprehensive list. These competencies were subsequently categorized by a panel of reviewers into three overall areas: Computer Literacy, Information Literacy, and Professional Development/Leadership (see Appendix X). These categories may be found on the vertical axis of the matrix. Computer literacy competencies relate to the psychomotor use of computers and other technological equipment (Barton, 2005). Information literacy competencies deal with information retrieval knowledge and skills: knowing when there is a need for information; identifying the information needed to address a given problem or issue; finding the needed information and evaluating the information; organizing the information; and using the information effectively to address the

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problem or issue at hand. (American Library Association, 2006). Professional development and leadership competencies refer to the ethical, procedural, safety and management issues for informatics solutions in nursing practice, education, research and administration.

The horizontal section of the matrix was based upon the four educational levels from the literature as well as the NI functional areas defined earlier in this document. It is important to recognize that informatics competencies need to be integrated in all educational levels. The panel identified competency foci for each particular functional area indicated by an "X." As seen in the matrix, competencies cross the different Nursing Informatics functional areas. Although each sub-heading includes more granular competencies beneath it, nurses would not necessarily be expected to achieve every competency within a sub-heading. The areas identified by the "X" merely indicate an area of emphasis. The lack of an "X" does not mean that the skill is completely absent for that given role nor does it mean that someone in that role is required to have every skill indicated in the matrix; rather it means that the skill may not be emphasized in a particular functional area or NI role. For example, a *quality improvement (QI) specialist* is used as an example of an IN role that would emphasize the *analysis functional area*. A QI INS would require competency in many of the indicated computer literacy skills including administration, communication, desktop, systems, and quality improvement, but would not likely need the simulation skills identified in the matrix. A *quality assurance specialist,* listed in the same functional area, would, however, need knowledge and skills about simulations, especially if the IN in this role works in an institution using simulation for staff development or for a vendor using this product.

The Functional Area-Competency Framework provides an example of the nursing informatics competencies for different functional areas within NI roles. The list is not exhaustive, but presents beginning guidance for the essential NI competencies across computer literacy, information literacy, and professional development skills and knowledge. Currently the identified competencies are at different levels. In the future they may be re-evaluated, expanded or collapsed.

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Table 2. Informatics Competencies by NI Functional Areas

Competency Categories	Knowledge and Skills	Beginning Nurse	Experienced Nurse	Informatics Specialist	Informatics Innovator	Administration	Analysis	Compliance and Integrity Management	Consultation	Coordination, Facilitation, and Integration	Development	Education and Professional Development	Policy Development and Advocacy	Research and Evaluation	Telehealth
Computer Literacy															
	Computer Skills - Administration	X				X	X	X	X	X		X			X
	Computer Skills - Communication	X	X			X	X	X	X						X
	Computer Skills - Data Access	X													X
	Computer Skills - Documentation	X	X							X		X			X
	Computer Skills - Education	X	X									X			X
	Computer Skills - Monitoring	X	x	X						X	X	X	X		X
	Computer Skills - Basic Desktop Software	X	x	X		X	X		X	X	X	X			X
	Computer Skills - Systems		X	X		X	X	X	X			X	X	X	
	Computer Skills - Quality Improvement		X	x		X	X		X	X		X			X
	Computer Skills - Research			X		X			X	X	X	X		X	
	Computer Skills - Project Management			X	X					X	X	X		X	
	Computer Skills - Simulation					X	X	X	X	X	X	X	X	X	X

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Information Literacy															
	Informatics Skills - Evaluation		X	X	X	X	X		X	X	X	X	X	X	X
	Informatics Skills - Role		X	X		X	X		X	X	X	X	X		
	Informatics Skills - System Maintenance		X	X		X	X		X	X	X	X	X		X
	Informatics Skills - Analysis			X	X	X	X		X	X	X	X	X	X	X
	Informatics Skills - Data/Data Structure			X		X	X	X	X	X	X	X	X	X	X
	Informatics Skills - Design and Development			X	X	X	X	X	X	X	X	X	X	X	X
	Informatics Skills - Fiscal Management			X	X	X	X		X	X	X	X	X	X	X
	Informatics Skills - Implementation			X		X	X		X	X	X	X	X		X
	Informatics Skills - Management			X	X	X	X	X	X		X		X	X	X
	Informatics Skills - Programming			X		X	X		X		X				
	Informatics Skills - Requirements			X		X	X	X	X	X	X	X	X	X	X
	Informatics Skills - System Selection			X		X	X	X	X	X	X		X	X	X
	Informatics Skills - Testing			X		X	X		X	X	X	X			X
	Informatics Skills - Training			X		X			X	X	X	X			X
	Informatics Knowledge - Impact	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Informatics Knowledge - Privacy/security	X	X	X		X	X	X	X	X	X	X	X	X	X
	Informatics Knowledge - Systems	X	X	X		X	X	X	X	X	X	X	X		X
	Informatics Knowledge - Research		X	X			X	X	X	X	X	X	X		X
	Informatics Knowledge - Regulations			X		X	X	X	X	X	X	X	X	X	X
	Informatics Knowledge - Usability/Human Factors			X	X	X	X		X	X	X	X	X	X	X
	Informatics Knowledge - Education			X	X	X	X		X	X	X	X		X	X
	Informatics Knowledge - Models and Theories			X	X	X	X	X	X	X	X	X	X	X	
	Informatics Knowledge - Nursing Classification, Taxonomies and Nomenclature			X	X	X	X	X	X	X	X	X	X	X	X
	System Lifecycle				X								X	X	
	Organization Change Management		X	X	X	X	X	X	X	X		X	X	X	X
	Systems Theory			X	X		X		X	X	X	X		X	X
	Management Science					X		X	X	X		X	X		X
	Standards for Privacy and Security	X	X	X	X	X	X	X	X	X	X	X	X	X	X

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	Human Computer Interaction			X	X		X		X	X	X	X		X	X
	Computer Assisted Instruction											X			
	Statistical Analysis			X	X	X	X				X			X	X
	Adapting information technology as a primary means of patient safety	X	X	X		X	X	X	X	X	X	X	X	X	X
	Openness to disruptive innovation	X	X	X	X	X	X	X	X	X	X	X			X
Professional Development															
	Integration of a reference terminology for nursing in nursing practice			X	X	X	X	X	X	X	X	X	X	X	X
	Integration of multidisciplinary language infrastructure and standards in practice			X	X	X	X	X	X	X	X	X	X	X	X
	Recognize the role on informatics in nursing	X	X	X	X	X		X	X	X	X	X	X	X	X
	Knowledge representation methodologies for evidenced based practice		X	X	X	X	X	X	X	X	X	X	X	X	X
	Incorporation of technology and software for the development of clinical information systems			X	X		X	X	X	X	X				X
	Reinforce conceptual framework			X	X		X		X		X	X		X	
	Applying newfound skills in modeling and designing systems			X	X		X		X		X			X	
	Combining design processes with engineering				X						X			X	
	Consider object-oriented modeling				X									X	
	Support by providing data for decision making -Demand evidence based databases		X	X		X	X	X	X	X	X	X		X	X
	Use of information technology to support clinical and admin processes	X	X												X
	Promote openness in knowledge to innovate technology in health care		X	X	X	X	X	X	X	X	X	X		X	X
	Adopting computerized patient records	X	X			X						X			X
	Promoting the need for yielding integrated, scalable applications			X	X	X	X		X		X	X			X

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	Use of information technology to support patient safety initiatives	X	X	X		X	X		X	X	X	X	X	X	X	

1
2

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Competencies and Metastructures

The components of metastructures - data, information, knowledge and wisdom - can be compared and contrasted with the elements in the competencies matrix. Using a patient care example, the Beginning Nurse uses skills that rely on the ability of obtaining data. Computer skills, data entry, and the use of the patient's electronic medical record are the major focus of their practice. The Experienced Nurse builds upon this and applies the basic computer skills into information regarding the patient.

The INS has obtained expertise in Nursing as well as higher levels of computer literacy, information literacy and professional development/leadership. This increased level represents knowledge within nursing informatics. For example, the ability to analyze systems and processes is evident. This leads to the use of knowledge for patient care, administration, research or educational activities. Last, the Informatics Innovator has achieved a level of knowledge coupled with experience. Thus, the innovator exemplifies wisdom. Wisdom in informatics might be the creation of unique methods for system design or evaluation, or the political finesse to justify system purchase.

Work in Progress

Work in NI competencies is an area in evolution; there is not one consolidated list of competencies across educational levels or a reference list of competencies for employers. Perhaps it is premature to close the innovation demonstrated to date. Yet the proliferation of lists can be confusing to the uninitiated.

In addition to numerous researchers, academics and employers, many professional organizations are actively working toward identifying competencies for nursing informatics, such as:

- The American Medical Informatics Association (AMIA)'s 10x10 program (Oregon Health & Science University Biomedical Informatics, 2006).
- AMIA Educational Workgroup
- The HIMSS nursing informatics working group
- An NLN Task Group on Informatics Competencies and subsequent initiatives.
- Technology Informatics Guiding Education Reform (TIGER) Summit Report

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NI Competencies Conclusion

The work on informatics competencies has expanded greatly in the last five years. After the initial work of Staggers et al (2001, 2002), numerous authors and agencies have now developed informatics competencies. We offer a new matrix that marries competencies with typical NI functional areas. In the future, the rapid pace of technological change and generation of information and knowledge present challenges for maintaining current and accurate competencies for nursing informatics. It is critical that faculty have an understanding of competencies for nursing informatics so that it becomes an integral part of curriculums and also to stimulate research. While interest in competencies in the educational arena continue to develop, there is a growing interest by employers. More important, within the next few years, the myriad efforts and lists of NI competencies could benefit from consensus and consolidation.

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The Integration of Nursing Informatics

As the use of technology increases in nursing, the boundaries between the roles of nurses and INs are blurred. It becomes important to identify the functions that make the practice of nursing informatics unique from other nursing specialties as well as identify those items that would be common along a continuum for nurses in all levels and specialties. Across all nursing roles, there is an integration of technology within the practice of nursing. Information is central to healthcare delivery, and all nurses must be skilled in managing and communicating information. However, nurses outside NI are primarily concerned with the content of that information while NI is concerned with the creation, structure and delivery of that information. Information needs are facilitated from the simple use of technology at the bedside to provide direct care, to providing

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access to healthcare information at the healthcare consumer's point of need, through managing the data from this information to develop new nursing knowledge. This range in the use of information and technology can be visualized on a continuum as seen in Figure 5.

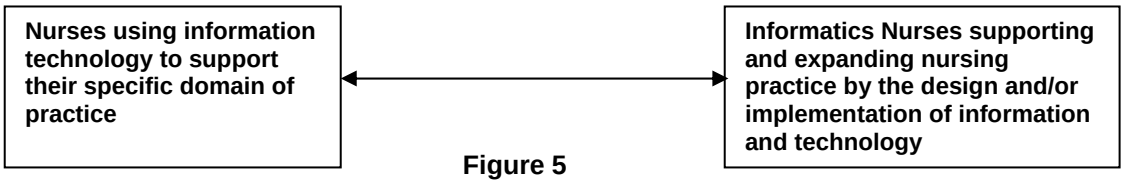

Figure 5

A Continuum of Information and Technology Integration into Nursing Practice

NI is also integrated into other healthcare informatics specialties. The INS or IN is often responsible for implementing or coordinating projects involving multiple disciplines. The INS or IN is expected to interact with professionals involved in all phases of the information systems lifecycle and with professionals at all aspects of system utilization. NI can be conceptualized either as an integral part of healthcare informatics or as an overlapping specialty within healthcare informatics. In many cases core concepts that are common to many informatics disciplines are identified and underpin each specialty. There are also individualized concepts and methods that are unique to each discipline. Two concept diagrams presented by Englebardt and Nelson (2002) demonstrate the different approaches to the role of NI in relation to other healthcare informatics specialties. (see Figure 6 and Figure 7)

Figure 6
Health Care Informatics Specialist: Umbrella Model

Figure 7
Health Care Informatics Specialist: Overlapping Model

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NI is also integrated into all aspects of the healthcare continuum. This integration allows for access of healthcare information at the point of need, such as at the bedside in acute healthcare settings, ambulatory care settings, at home or even when traveling locally or globally.

The Boundaries of Nursing Informatics

This section summarizes the differences between NI and other specialties in nursing, and reviews the differences between NI and other informatics specialties. To reiterate, NI is a specialty that integrates nursing science, computer science, and information science to manage and communicate data, information, knowledge and wisdom in nursing practice. Although critical thinking is a requirement of nursing practice, NI facilitates this critical thinking through the integration of data, information, knowledge and wisdom 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 and information technology. The difference between NI and other nursing specialties is the emphasis on informatics concepts, tools, and methods to facilitate nursing practice. NI focuses on the integration of informatics tools and methods, such as information structure, information technology, and information management and communication. Although some outside the specialty might consider NI synonymous with information technology, focusing on technology alone does not define NI; it is merely supportive of the work of NI. Facilitating the synthesis of data and information into knowledge and wisdom is central to NI; information technology assists in this process. INSs have moved toward the behaviors that Hanna, Ball and Edwards described in 1994 and have adopted an anticipatory proactive stance and are continuously striving to exploit technology in the design, structure, and presentation of information, as well the impact this has on healthcare delivery in general, and the nursing process specifically. Table 3 distinguishes the foci of nursing from NI.

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Table 3. Nursing and Nursing Informatics Foci.

Nursing Focus	Nursing Informatics Focus
Nurses, patients, health, environment	Information user, information recipient, information exchange
Content of information	Design, structure and representation of data as information
Using information applications and technology	Develop, implement and evaluate applications and technology, insuring the quality, effectiveness, efficiency and usability of applications and technology.

NI is also differentiated from other informatics specialties. The roles of healthcare providers overlap, but each has a distinct emphasis making them different. Each informatics specialty is aligned uniquely with their primary role, requiring that nursing informaticists build on their base nursing knowledge with unique informatics skills. Nursing informatics exists as a recognized component of both the broad field of health care informatics and as a subspecialty within nursing (Brennen, 2003). This results in a unique body of knowledge and demonstrates the need for advanced preparation unique to nursing. NI incorporates informatics concepts used by others, but applies them to a foundation of nursing. What differentiates an INS and IN from others in this area is the knowledge of nursing content and process. The synthesis of informatics and nursing results in a whole that is greater than the parts. An understanding of how informatics can support patient care within the context of the nursing process is a foundation for NI. There are core components of informatics knowledge and skills that underpin all informatics specialties such as the use of technology, computer literacy and data management structures. There are also components unique to each discipline such as their taxonomy.

Tenets of Nursing Informatics

- Nursing informatics has a unique body of knowledge, formal preparation within the specialty, and identifiable techniques and methods.
- Nursing informatics supports the clinical and non-clinical efforts of nurses, and other providers to improve the quality of care and the welfare of health care consumer.

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Information or informatics methods alone do not improve patient care; rather, this information is used by clinicians and managers to effect improvements in care, information management and patient outcomes.

- Nursing informatics collaborates with and is closely linked to other health-related informatics specialties.
- Although concerned with information technology, nursing informatics focuses on efficient and effective delivery of complete and accurate information in order to achieve quality outcomes.
- Human factors, human–computer interaction, ergonomics, and usability concepts are interwoven throughout the practice of NI.
- Nursing informatics promotes established, emerging, and innovative information technologies.
- Nursing informatics' key concerns include ensuring the confidentiality and security of health care data and information and advocating privacy.

Tenets References

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Ethics in Nursing Informatics

Nursing has a long history of applying ethical principles to nursing practice, with a primary concern for the patient and a commitment to the professional code of ethics for nurses. Thus, the Code of Ethics for Nurses (ANA, 2001) serves as a guidepost for the IN facing ethical issues, dilemmas and decisions. The ANAs policy on privacy and confidentiality addresses the impact of HIPAA legislation and the ethics of protecting information in a changing health care environment. Additionally, with the increase in Electronic Health Records (EHR) across multiple systems, decisions related to the use of information in the EHR must strike a balance between

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"ethically justified ends and otherwise appropriate means" (IMIA, 2006, p.1). The primacy of concern for patients and the commitment to the Code of Ethics for Nurses form a foundation for considering ethical issues in nursing, including nursing informatics. However, the practice of nursing informatics, a highly specialized and non-traditional nursing practice, begs consideration of specialty-specific ethical guidelines.

Ethical questions or issues often arise when common corporate business practices run counter to the ethical mandates of health care professionals. The INS brings an integrated, systems perspective to discussions of ethical issues, such as:

- Is a code of ethics integrated into the expanding distributed environment of electronic health information and health care service delivery?
- Is the individual responding to a health care related e-mail or web site inquiry appropriately licensed and qualified?
- In health care related electronic communication, are appropriate safeguards in place to protect the sender's identity and privacy, the content and integrity of messages, and the respondent's identity?

The International Medical Informatics Association (IMIA) has developed a detailed code of ethics for health information professionals. IMIAs code of ethics is meant to guide decision-making for "gathering, processing, storing, communicating, using, manipulating and accessing health information" (IMIA, 2006, p. 2). As such, it offers specialty-specific ethical guidance applicable to nursing informatics. The IMIA code describes general principles of informatics ethics. Two are of special interest to nursing informatics: information privacy and disposition, and legitimate infringement. The information privacy and disposition principle states that all persons have a fundamental right to privacy, and hence control over the collection, storage, access, use, communication, manipulation and disposition of data about themselves (IMIA, p3). However, this principle must be balanced with the principle of legitimate infringement, which states that this fundamental right is tempered by the legitimate, appropriate and relevant data needs of a free, responsible and democratic society, and by the equal and competing rights of other persons (IMIA, 2006, p. 4).

Further, INSs should understand and apply the basic principles of autonomy, beneficence, non-malfeasance and justice as they relate to the practice of informatics (ANA, 2001). The INS encounters questions of biomedical ethics throughout systems development, implementation,

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and administration. For example, informatics professionals including nurse specialists must determine whether patients have the ability to see all of their lab results online, perhaps before a clinician has seen them. This decision may not be so much a technical question as an ethical question, concerning the principle of patient autonomy. Security standards respond to the principles of autonomy and non-malfeasance. In the United States, decisions concerning the appropriate access and use of data may be guided by both HIPAA rules and the ethical principle of justice.

The general principles described by IMIA and the ANA Code of Ethics provide a solid foundation for INSs as they apply ethical principles in their practice. The INS has a responsibility to advocate for data confidentiality, integrity and security, quality management of information, and legitimate data use. These needs must be balanced with users' timely access to accurate data for decision-making in all settings. The role of ethics in Informatics practice is increasing and INSs are in a unique position to make or aid decision-making for informatics policy and operations. INSs can harmonize organizational risk with users' needs for timely data access. INS, in particular, can serve as the voice of wisdom in all settings – as translators and advocates for users who also understand the relevant ethical, political, and technological considerations.

New computing approaches such as knowledge discovery, clinical data repositories (CDR) and data warehouses have already created new opportunities for the INS application of ethical principles. Vast data stores of personal data currently exist in the electronic realm. Contemporary organizations are grappling with complex issues, for example regulation of data access such that only appropriate data is accessed by appropriate users. As technologies evolve and data stores increase, the ethics of data use and protection will become increasingly intricate, requiring continual evaluation and monitoring. Pertinent considerations for all health informatics professionals include the following ethical responsibilities:

- To ensure personal competence, integrity, diligence and responsibility for all actions performed (IMIA, 2006).
- To ensure that an electronic records, or the data contained in it, are used only for the stated purposes for which the data was collected or for the purposes that are otherwise ethically defensible (IMIA, 2006, p 6)
- To ensure that appropriate structures are in place to evaluate the technical legal and ethical acceptability of the data collection, storage, retrieval, processing,

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accessing, communication and utilization of data in the settings in which they carry out their work (IMIA, 2006, p 7).

- To ensure that health care professionals are informed about the status of the information services upon which users rely and health professional must immediately advise users of any problems or difficulties that might be associated or could reasonably be expected to arise in connection with these informatics services (IMIA 2006, p 6). For example, processes such as phone trees for notification of system difficulties need to be addressed in both the planning and implementation of those services.

In conclusion, the INS has the opportunity and responsibility to address ethical concerns related to design, implementation and utilization of health care information systems. The INS is challenged to balance the improvement of health care with individual privacy, security and safety concerns. Balancing the autonomy of patients and their health information along with the just use of health information to benefit others requires thoughtful consideration across multiple levels. Given the complexity and challenge of making ethical decisions related to health care information systems, the INS must contribute to and act in accordance with a broad-based understanding of the applicable ethical principles.

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The Future of Nursing Informatics

This document outlines the state of nursing informatics for 2006 extending into the first quarter of 2007. The rate of change in our discipline is rapid and the state of NI will change even shortly after this document is in print. Current trends will likely influence the direction of this change in nursing informatics. We discuss three trends here: the positions and competencies for nurses and informatics, technological aspects of the field, and changes in healthcare delivery and regulatory requirements.

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Trends in Positions and Competencies for Nurses and Informatics

The boundaries are blurring for INSs, other nurses and associated health informatics disciplines. As information and technology are more highly integrated into the workplace, nurses in all settings will gain informatics knowledge and skills. The number and complexity of informatics competencies for nurses will continue to escalate. Some informatics competencies ascribed to informatics specialists will likely transition to mainstream nurses, and the level of competencies required for INSs will continue to expand. Thus, the baseline set of NI competencies required of nurses at all levels will rise in the future.

In the last few years, new areas of nursing have been incorporated into nursing informatics. For example, nurses who heavily use information and technology, such as telehealth nurses, may be considered one type of IN. As others in nursing design, implement and evaluate informatics solutions, the scope of nursing informatics may continue to expand.

The globalization of informatics and nursing informatics is apparent. Nursing informatics is becoming a world community with less distinction and more commonalities among INSs everywhere.

Last, the role boundaries between other health informatics colleagues and NI are less conspicuous than in the past. One of the centerpieces of NI practice is its interdisciplinary nature. INSs often lead interdisciplinary projects and craft informatics solutions for use by many disciplines. INSs and general INs work within and across disciplines for usable informatics solutions. INSs have assumed executive positions in the health informatics arena. Other health informatics colleagues also function in much of the same positions, blurring boundaries while sharing some common ground. NI and other informatics sub-specialty areas share a common set of functions, skills and knowledge. This trend will likely continue as professional informatics organizations define a shared, core set of knowledge and skills required by all informatics specialties. Probably the clearest trend is evolving change in the functional areas for INSs, a state of continual change away from a more generic set of skills for any one discipline and toward a shared set of competencies based upon functional areas required to enact a particular position (i.e., clinical analyst, informatics executive, futurist, KDD researcher or database developer)

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Trends in Technology

Information technology is becoming commonplace in our lives as well as in health care. For the first time in history, a generation exists never having known a world without the internet, cell phones, online social networks, blogs, and other technology-influenced media. These techno-influenced individuals will be entering the health care field as knowledge workers as well as consumers of health care delivery. Implications for NI are:

- Creating new models for work and education for superbly techno-savvy users, who have less resistance to technology. In fact, they will demand it.
- Adapting to users with less skill in face-to-face communications,
- Having consumers with even greater expectations for accelerated information and technology implementations.

Several advances in technology will likely impact nursing informatics in the future. A number of these are outlined in the following sections.

Nanotechnology

Nanotechnology is expected to more heavily impact health care in the next 2-5 years. Some of the pending technologies that will impact the INS, clinicians and patients may include:

- New methods for medication administration
  - Sensing patient's internal drug levels by having miniature medical diagnostic tools circulating within patients' bloodstreams.
- New monitoring devices for the home:
  - A talking pill bottle that enables patients to push a button to hear prescription information
  - Bathroom counters that announce whether it's safe to mix two medications
  - A shower with built-in scales to calculate body mass index (Hong Kong Polytechnic University)
  - Measuring devices in the bathroom to track urine frequency and output and upload these data to a system or care manager
  - Non-invasive Blood Glucose Monitors to eliminate sticks, sensors to compute blood sugar levels using a multi-wavelength reflective dispersion photometer (Hong Kong Polytechnic University)

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New Technology Tools for Managing Public Health Concerns and Information about Populations

The threat of terrorism, bioterrorism, and the need for improved disease management across traditional boundaries will drive the demand for new tools and solutions that the INS will be responsible for designing and implementing. A partnership with public health professionals and the emergence of public health informatics is a response to the need for population management tools and early disease detection.

Devices and Hardware

The increased miniaturization of devices will change where and how IT solutions will be deployed and adopted. No perfect hardware solution exists in the market today to address all diverse nursing workflows and mobile caregiver demands. An emphasis on ergonomics and human-computer interaction will lead to new solutions to support diverse workflow requirements.

New integrated technologies will increase common access to health information, e.g., cell phones, smart phones, PDA's, and multi-functional devices. These solutions are becoming ubiquitous in daily lives. They will change how clinicians and patients expectations and interactions with various technology solutions. In particular, providers will continue to be challenged to be as knowledgeable about new disease treatments and research findings as patients with accessible devices are.

Wearable Computing

Wearable computing is a revolutionary paradigm which will shatter myths of what computers are and how they should be used. A computer will be worn, much as eyeglasses or clothing are worn, and interactions with the user are based on the context of the situation. With heads-up displays, embedded sensors in fabrics, unobtrusive input devices, personal wireless local area networks, and a host of other context sensing and communication tools, wearable computers can act as an intelligent assistant and/or a data collection and analysis device.

Smart fabrics with embedded sensors have been on the commercial market since 2000 and are being used in shirts, gloves and other clothing. These wearable computer and remote monitoring systems are intertwined with the user's activity so that the technology becomes transparent. Sensors and devices can gather data during the patient's daily routine, providing

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researchers and/or healthcare providers/significant others a periodic or continuous data feed of the subject's health at work, school, exercise, sleep, rather than the current "snapshot" generated during a typical hospital or clinic visits. A partial list of applications for wearable computing includes (Wearable Computing, 2007a):

- Sudden Infant Death Syndrome monitoring for infants
- Ambulatory cardiac and respiratory monitoring
- Ambulatory monitoring of neuromuscular disease
- Monitoring of Ventilation During Exercise
- Monitoring Rescue Workers Vital Signs
- Activity Level of Post-Stroke Patients
- Patterns of Breathing in Asthma
- Assessment of Stress in Individuals
- Arrhythmia and Cardiac Control
- Daily Activity Monitors
- Monitoring heat stress and dehydration

Wearable computing is applicable to workers as well as consumers or patients. Examples here may include:

- Proximity badges and RFID (radio frequency Identification) allow tracking of providers for workflow or allowing logon to systems
- Wearable glasses allow a heads-up display of vital signs or images while also focusing on the patient. (Wearable computing, 2007b)
- Bar code scanners that fit on a finger or wrist- activated input devices

Future developments for input methods may also be applicable in the healthcare market. For example, an "interface-free," touch-driven computer screen, manipulated intuitively with the fingertips, responds to varying levels of pressure. Another example is virtual keyboards using Bluetooth technology. A keyboard can be displayed and used on any surface (Keyboard, 2007).

Robotics

The use of robotics will expand more broadly into patient care areas. Robots have been used for many years to deliver supplies to patient care areas. Robotics are used for remote surgeries

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and “virtual reality” surgical procedures. At Johns Hopkins, robots are being used to provide language translation to patients (Greenback, 2007). Hand-assist devices have helped patients regain strength after a stroke (Device, 2007). Robots are providing a remote presence for physicians to be able to virtually examine patients by manipulating remote cameras (Remote Presence, 2007). In the future, robots may also be used in direct patient care, for instance, to help lift morbidly obese patients.

Knowledge Representation

As more and more electronic data becomes available for and about patients over their life time, clinicians will need advanced tools to help them locate, synthesize and even cope with this vast volume of data. New research areas will expand regarding advances in displaying vast amounts of data to clinicians to optimize patient care, patient and clinician efficiencies while avoiding medical errors. NI may need more nurses trained in knowledge representation, semantic representation and other knowledge areas. This also has implications for knowledge discovery in databases, data quality and a continued emphasis on data standards and data quality

Nurses make numerous, complex, and diverse decisions in their daily practice. Decision making for nursing practice must consider relevant evidence-based and patient-specific information. As nurse decision-making grows increasingly complex, the need for computerized clinical decision support will increase. In the absence of adequately explicit evidence-based guidelines for nursing decisions, novel technologies will be necessary to synthesize evidence from the literature and/ or induce models from clinical data. Knowledge discovery in databases could play an important role in the induction of clinical knowledge models.

Genomics

The advances in the human genome and understanding of individual DNA will have a dramatic impact on what we know about patients. These data, especially once they are integrated into an EHR or Personal Health Record (PHR), will lead to advances in customized patient care, and customized medications targeted to individuals’ responses to medications. Care processes and medications can be very specifically customized to patients based on their unique DNA profile and how they have responded to specific medications and other interventions in the past. This

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will dramatically change how patients are managed for specific diseases and conditions, extending into the prevention of some diseases.

The inherent complexity of customized patient care will demand computerized clinical decision support. Predictive disease models based upon patients' specific DNA profiles will emerge as clinicians better understand DNA mapping. These advances have implications for a new model of care and for INSs' participation in the development of genomic-IT solutions. More than ever, patients will need to be partners in this development. Genomics will lead to many specialized advances in care delivery and be linked to exact, individualized data within Personal Health Record (PHR) Subsequently, advanced disease management with the goal aimed at disease prevention will be possible. This change has many implications for ethics as well as informatics. In fact, genomics competencies and curricular guidelines are available at http://nursingworld.org/ethics/genetics.

New Educational Technologies

Evolving teaching technologies are changing the education stratagems used in the classroom, the lab and the clinical setting. For example, patient care simulators allow students to run programmed care scenarios in a safe environment and provide innovative options for teaching critical thinking skills. Group learning tools such as clickers, used in interactive teaching, can change how students engage with class content as well as how they learn to function as members of a team (Michaelsen, Fink, Knight, 2007). Distance education technologies such as web-based course management systems and the related student support services are challenging basic education concepts such as what academic resources must be included in a library collection or how a university defines a credit hour of education. Administrative information systems are now automating basic university functions such as admissions, registration, student record management, grant management and financial aid for example (Nelson, et. al., 2006). This automation is forcing institutions to review and in many cases to redesign their educational policies and procedures. These technologies require a paradigmatic shift in knowledge delivery, impacting students, instructors and course content.

Within these modern educational settings, faculty, with little more than office applications for support, continue to manage large amounts of educational data about individual students, curricula and accreditation. Comprehensive, enterprise-wide educational information systems

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that integrate administrative and academic functions are just beginning to provide educators with applications to manage all aspects of the educator role. As nursing informatics faculty become actively involved in the design, monitoring and evaluation of these comprehensive systems, they will create the health care educational institutions of the future.

Traditional tuition models are a barrier to the globalization of education, but they are being slowly eroded. New educational models are already being created as universities educate beyond their walls or create virtual educational experiences, e.g., partnering with other institutions to deliver classes for students across a region. Perhaps in the future, universities will partner with business entities and vendors to create innovative models of education.

Curriculum design will change. Information is now generated and made available so quickly that baseline knowledge for students will evolve away from specific content to methods of finding accurate, current information and knowledge. In the future, students may not be evaluated on specific knowledge for one area or course, but instead be evaluated on their growth over time. The INS will be core in pushing this marriage of informatics and new educational models because of the focus on managing information.

New Tools for Patients and Continued Access to Health Information

Patients will continue to become stronger partners with providers, with increased accountability for their own care. This type of model will require solutions and patient education by clinical nurses and INSs to devise the best methods of care as well as solutions to monitor and maintain patients' health.

Expanded Use of IT in Nursing

The earlier discussions imply that technology use will increase everywhere in our work and home settings, even constantly traveling with us as wearable devices. Two implications are outlined here. One is a current concern about students relying on available, structured information, computerized alerts and reminders in systems such as EHRs and DSSs. Some educators and administrators now are concerned that students' critical thinking skills may diminish. This concern may mean that INS and educators of the future will determine and test new, effective academic and practice models. Perhaps academic applications will be designed differently than practice applications to encourage questioning and active cognitive

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engagement. Or system designers may need to rethink systems to promote a different cognitive engagement by practitioners. Or educators might teach a new level of human information processing to maximize human capabilities, one beyond students needing to memorize structures for a physical examination and similar static information stored in an EHR. In this model, information technology serves as support and not a replacement for human thinking and judgment.

Second, as applications are increasingly integrated into healthcare, the impact of downtime becomes more severe and quick recovery methods imperative. Especially with orders management in place, institutions must ensure continual uptimes. Stratagems and technologies are available to support continual uptime and the INS is typically involved in defining, designing and installing them. Pervasive computing creates a new standard for information access – even when there is no power supply, e.g., a laptop was developed using a hand crank to generate power (MIT, 2007). Thus, INSs must be strong advocates for systems to be continuously available. Likewise, they can be intimately involved in disaster recovery, including being an advocate for funding allocations for recovery methods.

In 2005, the Hurricane Katrina incident emphasized the importance of having redundant systems and effective disaster recovery procedures. Requirements for current and future systems will include:

- 24X7 operation and performance with redundancies throughout the system, failovers and tested high reliability
- Tools to assist with monitoring and managing the IT environment. Tools set up to monitor system use and catch technology issues before system failure occurs, more preventative than reacting to an issue later.
- Scalable IT solutions as more clinical applications come on-line
- Solutions that IT departments can manage without in-depth technology expertise

Implications for INSs

There are a number of implications for INSs. INSs will need to have a systematic method for becoming aware of emerging technologies and their projected impact(s) to healthcare and informatics. INSs can be essential leaders and partners for the safe and smart incorporation of new technology and techniques into health informatics solutions. The content or information on

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devices is still the most critical component of the technology and INSs can serve as content designers in this capacity. Areas such as genomics may have ethical considerations that INSs may need to voice and champion. The continued sub-specialization within NI will continue to expand and INSs may find themselves specializing in the safe use of particular technologies.

All of these areas have implications for curricular design and education in the future. The expansion of technology emphasizes the need for continuous availability of systems. On the other hand, the digital divide is still apparent, with some having little access to information technology. INSs can be leaders in eliminating the digital divide. In all examples, INSs can advocate and apply methods for users to learn and use new technologies effectively and safely.

Trends in Health Delivery and Regulatory Initiatives

Current driving forces have greatly increased the pace of information technology and EHR installations in the US. These forces include a national emphasis on patient safety, including technology installation as a focal point for reducing for errors in healthcare. A second driving force is that both health organizations such as AHRQ and IHI as well as non-health organizations such as Leapfrog are impatient with slow progress to the point that they are providing incentives for health institutions to implement informatics solutions. Other forces will likely escalate the pace of adoption. Organizations are using value versus return on investment models to justify health IT and pay for performance models will likely accelerate EHR installations. Data are becoming more visible to consumers and hospital boards. Organizations will continue to expand the transparency of data and, more importantly, the quality of care being delivered.

Regulatory requirements and standards will shape the future. INSs will be at the table defining these and future standards, designing, building, implementing, using and certifying products that comply with the standards. A number of projects are underway with a sample including:

- CCHIT- Certification Commission for Healthcare Information Technology. " CCHIT is a recognized certification body for electronic health records and their networks, and an independent, voluntary, private-sector initiative. Their mission is "to accelerate the adoption of health information technology by creating an efficient, credible and sustainable product certification program" (CCHIT, 2007).

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- HL7 is defining interoperability standards for systems.
- The IEEEP2407 working group is focusing on developing standards for Personalized Health Informatics.
- The Joint Commission continues to expand regulatory compliance for patient safety, e.g., National Patient Safety Goals, medication reconciliation and other requirements with implications for the INS.
- Health Information Technology Standards Panel (HITSP) are harmonizing industry-wide health IT standards
-
- Nationwide Health Information Network (NHIN) is creating prototype architectures for widespread health information exchange

The FDA (Food and Drug Administration) has several initiatives underway:

- Bar Code Label Requirements for Human Drug Products and Biological Products (FDA, 2007)
- Draft guidelines for the safe and effective use of radio frequency devices
- Nanotechnology development (FDA Nanotechnology, 2007) and an potential expansion of products covered, e.g., advanced decision support tools and similar informatics applications.

New Care Delivery models

Care is no longer a local phenomenon. Patients in rural ICUs can be monitored remotely by intensivists and ICU nurses. Pharmacists are providing remote pharmacological assistance to rural areas. Radiologists can read images in realtime from anywhere in the world. Physicians are assisted by robots while examining patients in distant locations.

Care is no longer limited to traditional health care settings, even when it is delivered locally. Clinicians are now available in retail stores, work settings and other non-traditional places. These new settings will require new designs, deployment and support models that will challenge the NI specialist. INSs involvement in the development of the robust health information infrastructure includes but is not limited to:

- Continued innovation of systems and expansion into less traditional settings such as Long Term Care and rural communities
- Personal Health Records – INSs will assist with development of and encourage individuals to maintain an electronic vaccination history, their past medical history,

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medications, allergies, condition/status, visit history in an easily accessible online format. As well, patients online communications with healthcare providers will continue to increase

- Clinical Data Repositories and Regional Health Information Organizations will support accurate, timely and secure transfer of patient data across care settings within a community (ultimately across hospitals, clinics, pharmacies, laboratories, clinician office, long term care facilities and others)

Consumer Informatics

Patients will become stronger partners with providers, having increased accountability and interest in access to their own EMR data, and for their own care. As consumers become more technically savvy, they will consider their electronic healthcare data as necessary and accessible as their banking information or stock transactions online. Likewise, consumers will being monitoring and managing the health of their younger AND older family members for whom they are responsible.

External Partnerships

Health care will likely see non-traditional organizations entering the healthcare arena. For example, one company with an online application for individual, secure, financials is now investigating expansion into personal health records. Likewise, health care should create new, non-traditional partnerships. For instance, perhaps a partnership with the video-gaming industry would also be fruitful for interactive EHRs and provide ideas for optimal user interfaces.

Implications for INSs

New care models have vast implications for INS. These new delivery models will require INSs to continue to develop informatics solutions for care in multiple, remote locations. INSs should have a key role in informatics solutions that emphasize quality care (McCormick, et al., 2007). We need new models to speed the design to use portions of the systems life cycle. An 18 – 24 month build and implementation cycle is not tenable in an era of rapidly changing technology, care delivery and expanding information access. Because of the increasing the number information technology installations and the need to respond to increasing regulatory requirements, INSs will be at centerstage for all phases of the systems lifecycle. They will be developing and implementing new informatics solutions, ensuring that data quality exists for

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implemented solutions and evaluating the impact of solutions. The new model of consumer informatics will require technical solutions and patient education jointly from clinical nurses and INSs. INSs will need to devise the best methods of care as well as designing solutions to enable patients to monitor and maintain their own health. INSs will play a key role in designing new tools for data capture and analyses to comply with regulatory guidelines.

Futures Conclusion

The positions and competencies of nurses, changes in technology and new trends in health delivery and regulation will impact the future of Nursing Informatics. Important concepts underpinning the above themes include:

- Preparing for and evolving with new information and technology changes,
- Inventing and delivering new educational models to teach both new and existing nursing professionals,
- Designing, developing, implementing and evaluating solutions for new information and technologies across all areas of nursing and health settings
- Incorporating newer technologies and methods to redesign care, research and administrative processes,
- Pioneering, designing and facilitating the changes in care models as they evolve away from episodic care toward more predictive and preventative models.

The global nature of informatics is already apparent. In the future, care models and data will be shared even more widely. New technologies will create wider access to information and the need for a new generation of data and information management skills, analytic tools, new educational models and different cognitive skills. Traditional boundaries of institutions, care delivery and education will continue to erode. New positions and functional areas are emerging. Increased collaboration among NI colleagues and a shared scope and standard of NI practice will be the hallmark of the future.

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INFORMATICS NURSE SPECIALIST STANDARDS OF PRACTICE

Nursing informatics is the specialty that integrates nursing science, computer science, and information science to manage and communicate data, information, and knowledge and wisdom 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.

The goal of NI is to improve the health of populations, communities, families, and individuals by optimizing information management and communication. This includes managing information and technology in care processes and health practices in all settings, in developing, implementing and evaluating solutions, in establishing effective administrative systems, in managing and delivering educational experiences, in supporting life-long learning, and/or in supporting nursing research. Methods of supporting the goal of NI are diverse and may be less direct than listed above – in consulting, working for vendors or entrepreneurial roles.

The standards of practice for the IN specialist (INS) are organized using a general problem-solving framework that closely resembles the familiar nursing process of assessment, diagnosis, identification of outcomes, planning, implementation, and evaluation. The problem-solving framework supports all facets of informatics practice, including those without technology, and all areas of nursing practice. INSs and other informatics specialists use a structured problem-solving method to identify and clarify issues and select, develop, implement, and evaluate informatics solutions. These steps are not mutually exclusive and topics may overlap multiple identified steps.

Informatics solution is a generic term used in this document to describe an application, product, method, tool, workflow change or other recommendation an INS makes after identifying and analyzing a need or an issue. An informatics solution may encompass technology and non-technology products such as developing a database, purchasing a new computer application, creating nursing vocabulary, designing informatics curricula, creating a spreadsheet, tailoring an application to a particular environment, designing a designing a research study to describe required informatics competencies, describing information flow in a process redesign, creating newly re-engineered processes or creating a structure for information presentation.

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Several overarching standards inherent in every aspect of practice begin the discussion of the INS standards of practice.

Overarching Standards of Practice for the Informatics Nurse Specialist (INS)

The INS:

1. Incorporates theories, principles, and concepts from appropriate sciences into informatics practice. Examples of theories could include information, systems, and change theories. Principles and concepts could include project management, implementation methods, workflow analyses, with process redesigns, organizational culture, or database structures.
2. Integrates ergonomics and human–computer interaction (HCI) principles into informatics solution design, development, selection, implementation, and evaluation.
3. Systematically determines the social, legal, regulatory and ethical impact of an informatics solution within nursing and health care.

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Standard I. Identify the Need, Issue or Problem

The INS synthesizes data, information, and knowledge to clarify informatics issues or problems.

Measurement Criteria

The INS:

1. Conducts a needs assessment to refine the issue or problem.
    a. Analyzes current practice, workflow, and the potential impact of an informatics solution on that workflow.
    b. Involves crucial stakeholders in an issue or problem and its informatics solution.
    c. Evaluates obtained information and findings for their pertinence to the informatics issue or problem.
2. Incorporates principles and methods of recognized methodologies, such as structured systems analysis, into problem or issue identification.
3. Uses systematic methods to determine user, technical and necessary delivery system requirements to identify and clarify informatics issues.
4. Considers the capabilities and limitations of legacy systems in integration planning and requirements determination.
5. Interprets current legislation, trends, standards, regulations, new developments in clinical practice and research affecting health information management.
6. Actively participates in strategic planning.
7. Conducts a market analysis for an informatics solution.

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Standard II. Identify Alternatives

The INS analyzes multiple approaches/ solutions to the informatics issue or problem.

Measurement Criteria

The INS:

1. Uses problem-solving tools and processes to identify and evaluate approaches and solutions to informatics issues and/or problems. These activities may include:

    a. Conducting a systems analysis to determine information needs.

    b. Developing functional and technical specifications based upon identified needs.

    c. Developing business process redesign recommendations.

    d. Creating business plans including requirements, alternatives with costs, return on investments and other evaluative measures for the development, selection, and/or implementation of informatics solutions. Analyzing costs and potential return on investment (ROI) as a basis for selecting and implementing informatics solutions.

    e. Judging the fit of the proposed informatics solution with the strategic plan.

2. Uses analytical models to identify and evaluate approaches and solutions to informatics issues and/or problems. These activities may include:

    a. Developing conceptual, external, and internal models for representing information needs.

    b. Designing models of informatics solutions.

    c. Using analytic techniques to synthesize evidence and/or induce clinical knowledge models from data.

3. Prepares documents to describe information needs for the proposed informatics solution. These activities may include:

    a. Developing informal and formal requests for an informatics solution such as a request for information, functional specification or an RFP.

    b. Preparing a response to a request for a proposed informatics solution.

    c. Building information and data models that represent nursing practice.

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Standard III. Choose a Solution

The INS develops an informatics solution to address for a specific need or issue.

Measurement Criteria

The INS:

1. Interprets capabilities and limitations of hardware and software and their relationship to the outcomes of proposed informatics solutions in health care.

2. Incorporates usability testing methods in choosing, developing and evaluating an informatics solution.

3. Analyzes economic, technical, and human resources available to develop (including build if pertinent), select, implement and support the informatics solution.

4. Incorporates established informatics standards into the informatics solution.

5. Recommends investment in the development of an informatics solution based on healthcare delivery market need. Development may include purchasing or building solutions.

5. Selects an informatics solution by applying selection criteria appropriate for the solution, targeted users and expected outcomes.

6. Develops an evaluation plan for the informatics solution including measurable outcomes and/or terminal objectives.

7. Develops an informatics solution such as designing a documentation tool, determining healthcare vocabulary, tailoring an application to a specific environment, or writing a manuscript about an informatics topic.

8. Actively participates in strategic and tactical planning, priority setting, and planning for necessary resources, whether they are human, technical, or vendor contract.

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Standard IV. Implement the Solution

The INS manages the process for implementing the solution to the informatics issue or problem.

Measurement Criteria

The INS:

1. Applies principles and concepts of project management to the implementation of the solution.
2. Demonstrates methods of effective project management when implementing the solution.
3. Demonstrates expertise as a project manager.
4. Designs strategies for effective funding of informatics solutions, which may include:
   a. Developing a budget plan for the procurement of resources and maintenance of an informatics solution.
   b. Determining priorities for requirements within budget constraints.
   c. Employing persuasive communication and political astuteness in funding strategies.
5. Develops policies, procedures, and guidelines based on research and analytical findings, which may include:
   a. Supporting the implementation, use, and on-going maintenance of an informatics solution.
   b. Ensuring the validity and integrity of data.
   c. Promoting health and safety within the particular environment.
   d. Ensuring the use of an effective informatics solution.
   e. Ensuring the ethical use of informatics solution.
   f. Ensuring the confidentiality and security of data and privacy for individuals.
6. Ensures that the informatics solution is in compliance with recognized standards from accrediting and regulatory agencies.
7. Manages strategies for implementing the informatics solution.
8. Applies performance or systems testing methodologies to all phases of implementation of the solution, which may include:
   a. Developing procedures, policies, protocols, and scenarios for acceptance testing, conversions, and interface testing.
   b. Developing a plan for testing implementation conversion and backup procedures.
   c. Developing baseline criteria for system acceptance.
   d. Recommending solutions for problems and impediments identified during performance/system testing.

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9. Manages education activities for the informatics solution, which may include:

    a. Developing an education plan based on measurable, learner-oriented outcomes.
    b. Producing education materials based on educational principles.
    c. Implementing educational activities for learners.
    d. Using innovative educational techniques such as computer-based training or virtual reality as appropriate to learner populations and the specific informatics solution.
    e. Evaluating all aspects of educational activities.

10. Applies knowledge of product design, information technologies, and client services to internal and external marketing activities to facilitate the adoption of the solution.

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Standard V. Evaluate and Adjust Solutions

The INS evaluates all processes and solutions used to address the informatics problem.

Measurement Criteria

The INS:

1. Uses a variety of methods to evaluate the structure, process, and outcome of the informatics solution, which may include:

    a. Assessing the ROI.
    b. Conducting a benefits realization analysis at appropriate intervals during and after solution implementation.
    c. Using summative and formative techniques for a comprehensive evaluation approach.
    d. Using reliable and valid instruments to measure user satisfaction with the implemented informatics solution.
    e. Identifying the extent to which the project budget and schedule are met.

2. Analyzes the impact of the informatics solution on individuals, families, communities, and institutions affected by the solution, which may include:

    a. Adapting market analysis tools and techniques to identify recommended changes to the informatics solution.
    b. Using reliable and valid measures to analyze perceived and actual responses to the informatics solution.
    c. Creating written plans for ongoing analysis of the informatics solution's impact.

3. Disseminates results of evaluation to colleagues, stakeholders and others.

4. Reviews all prior steps in the problem-solving process and makes recommendations, which may include:

    a. Systematically assessing the quality and effectiveness of the problem-solving process and informatics solution.
    b. Using the results of the quality and effectiveness analysis to make or recommend process or structural changes.
    c. Incorporating the results of evaluations into policy, procedure, or protocol documentation.

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d. Changing educational programs based on findings.

5. Uses multiple methods, disseminates information and knowledge synthesized from evaluation activities.

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INFORMATICS NURSE SPECIALIST
STANDARDS OF PROFESSIONAL PERFORMANCE

Standard I. Quality of Nursing Informatics Practice

The INS evaluates the quality and effectiveness of nursing informatics practice.

Measurement Criteria

The INS:

1. Integrates knowledge of current professional practice standards, laws, and regulations into informatics practice.
2. Performs quality improvement activities, which may include:
    a. Identifying aspects of nursing informatics practice important for quality monitoring.
    b. Evaluating indicators used to monitor quality and effectiveness of nursing informatics practice.
    c. Collecting data to monitor quality and effectiveness of nursing informatics practice using structures developed for that purpose.
    d. Analyzing quality data to identify opportunities for improving nursing informatics practice.
    e. Formulating recommendations to improve nursing informatics practice or outcomes.
    f. Implementing activities to enhance the quality of nursing informatics practice.
    g. Developing, implementing, and evaluating policies and procedures to improve the quality of nursing informatics practice.
    h. Synthesizing information about the existing and emerging standards to apply to the nursing informatics practice.
3. Implements the results of quality activities to initiate changes in nursing informatics practice.

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Standard II. Education

The INS maintains knowledge and competency that reflects current nursing informatics (NI) practice.

Measurement Criteria

The INS:

1. Maintains current skills and competencies.
2. Seeks new knowledge and skills appropriate to NI practice through professional development activities.
3. Seeks certification, if applicable.

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Standard III. Performance Appraisal

The INS evaluates one's own nursing informatics practice in relation to professional practice standards and relevant statutes and regulations.

Measurement Criteria

The INS:

1. Engages in and conducts performance appraisal on a regular basis, identifying areas of strengths as well as areas where professional development is needed.
2. Seeks constructive feedback regarding one's own practice.
3. Takes action to achieve goals identified during performance appraisal.
4. Seeks peer review as appropriate.

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Standard IV. Collegiality

The INS contributes to the professional development of peers, informatics colleagues, and others.

Measurement Criteria

The INS:

1. Shares knowledge and skills with peers and colleagues.
2. Contributes to informatics education of students, peers, and colleagues.
3. Provides constructive feedback regarding others' practice.
4. Promotes understanding and effective use of information management and information technology.
5. Promotes understanding of NI by translating NI concepts and practice to others.
6. Participates on multi-professional teams that evaluate health informatics practice.
7. Recommends changes in health care informatics using results from the evaluation of the quality and effectiveness of NI practice.

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Standard V. Collaboration

The INS collaborates with others in the conduct of nursing informatics (NI) practice.

Measurement Criteria

The INS:

1. Collaborates with patients and clients, families, informatics professionals, and others in informatics activities.
2. Collaborates with faculty in developing, maintaining, and evaluating educational and professional development informatics programs.
3. Collaborates with others in building the NI knowledge base. This may include activities such as publishing, policy development, and/or conducting research.

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Standard VI. Ethics

The INS bases decisions and actions on ethical principles.

Measurement Criteria

The INS:

1. Practices according to the current Code of Ethics for Nurses (ANA, 2001).
2. Develops methods to maintain confidentiality, and security of information, data, and knowledge.
3. Advocates for appropriate use of data, information, and knowledge.
4. Practices in a nonjudgmental and nondiscriminatory manner that is sensitive to human diversity.
5. Practices in a manner that preserves and protects human autonomy, dignity, and rights.
6. Seeks available resources as needed when formulating ethical decisions.

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Standard VII. Research

The INS contributes to the body of informatics knowledge.

Measurement Criteria

The INS:

1. Integrates best available evidence into nursing informatics practice.
2. Conducts systematic inquiry of informatics problems and issues.
3. Disseminates information and knowledge related to systematic inquiry.
4. Develops informatics policies, procedures, and guidelines based on systematic inquiry.
5. Formulates an informatics research program when pertinent to the job role and/or function area.

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Standards VIII. Resource Utilization

The INS considers factors related to safety, effectiveness, cost, and impact in conducting informatics practice.

Measurement Criteria

The INS:

1. Evaluates factors related to safety, effectiveness, costs, and impact when developing and implementing information management solutions.
2. Applies strategies to obtain appropriate resources for informatics initiatives.
3. Assigns tasks or delegates responsibilities appropriately based on the nursing informatics activity being conducted.
4. Promotes adoption of activities that assist others in becoming informed about costs, risks, and benefits of information management and information technology solutions.

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Standard IX. Communication

The INS employs effective communications.

Measurement Criteria

The INS:

1. Is fluent in informatics terminology and standardized languages.
2. Articulates informatics requirements to other disciplines.
3. Interprets communication to and from others, such as informatics professionals, clinicians, patients, executives, and vendors.
4. Communicates complex concepts concisely.
5. Demonstrates persuasive abilities in communication.
6. Applies established guidelines to written communication.

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Standard X. Patient Advocacy

The INS advocates for the protections and rights of patients related to the use of and their access to their healthcare data and information.

Measurement Criteria

The INS:

1. Supports patient access to their own personal health information within a reasonable timeframe.

2. Promotes patient awareness of how their personal health information may be used and who has access to it.

3. Supports the individual's ability to supplement, request correction of, and share their personal health information.

4. Evaluates factors related to privacy, security and confidentiality in the use and handling of individually identifiable health information.

5. Promotes awareness and education of the healthcare consumer with regard to the appropriate data collection, information sharing, and information access issues.

6. Supports patient involvement in their own care, facilitated by access to personal healthcare data.

7. Works with community members as needed for their active engagement in the development, oversight, and management of organizations developed for or in the business of health information exchange.

8. Educates clinicians, patients and communities about the rights and responsibilities involved in the collection, use and exchange of healthcare data.

9. Demonstrates the utility of health information access and appropriate aggregation of health information.

10. Uses the communication tools enabled through technology adoption to increase dialogue with patients and authorized caregivers,

11. Uses the communication tools enabled through technology adoption to extend communications to previously underserved patients.

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GLOSSARY

Beginning nurse—A nurse preparing for initial entry into nursing practice or who has just begun a nursing career.

Data—Discrete entities that are described objectively without interpretation.

Experienced nurse—A nurse with proficiency in one or more domains of interest.

Informatics Nurse Specialist – a RN with formal, graduate education in the field of informatics or a related field. A specialist in the field of informatics in nursing.

Informatics Nurse – a RN with an interest or experience working in an informatics field. A generalist in the field of informatics in nursing.

Informatics solution—A generic term used to describe the product an IN specialist recommends after identifying and analyzing an issue. Informatics solutions may encompass technology and non-technology products such as information systems, new applications, nursing vocabulary, or informatics curricula.

Information—Data that are interpreted, organized, or structured.

Knowledge—Information that is synthesized so that relationships are identified and formalized.

Nursing informatics (NI)—A specialty that integrates nursing science, computer science, and information science to manage and communicate data, information, knowledge and wisdom 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.

Wisdom – the appropriate use of knowledge to solve human problems. It is knowing when and how to apply knowledge.

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Appendix A. Listing of the top 50 NI job titles according to count, representing 1835 out of 6338 individuals in the Newbold database as of January, 2006.

Job Title	#
Clinical Analyst	123
Graduate Student	104
Consultant	100
Director of Nursing	88
RN	80
Assistant Professor	78
Clinical Systems Analyst	72
Associate Professor	64
President	59
Project Manager	55
Staff Nurse	52
Senior Consultant	48
Student	47
Systems Analyst	44
Graduate Student - NI	43
Manager	40
Clinical Informatics Specialist	39
Informatics Nurse	37
Professor	36
Director	35
Clinical Informatics Coordinator	31
Clinical Systems Coordinator	30
Nurse Manager	28
Nursing Informatics Coordinator	26
Nursing Informatics Specialist	25
Senior Systems Analyst	25
Faculty	24
Clinical Consultant	24
Clinical Informatics Analyst	23
Director, Clinical Informatics	22
Vice President	22
Nurse Consultant	20
Clinical Coordinator	20
Nurse Educator	19
Staff RN	19
Senior Manager	19
Principal	18
Senior Clinical Analyst	17
Clinical Information Specialist	17
Chief Nursing Officer	16
Application Analyst	16
Executive Director	16
Clinical Informatics	15
Chief Information Officer	15
Product Manager	15
Instructor	15
Doctoral Student	14
Clinical Systems Manager	14
Clinical Informaticist	13
Clinical Application Specialist	13

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