

Report to  
the Secretary  
of the  
Department of  
Health &  
Human  
Services:

**A  
National  
Informatics  
Agenda  
for  
Nursing  
Education  
and  
Practice**

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Bureau of Health Professions • Division of Nursing

**National Advisory Council on  
Nurse Education and Practice**

U. S. Department of Health & Human Services • Health Resources and Services Administration

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## EXECUTIVE SUMMARY

The National Advisory Council on Nurse Education and Practice (NACNEP) is responsible for advising the Secretary on ways to enhance the health of the public through development of the registered nurse workforce. NACNEP recognized a need to more adequately prepare the registered nurse workforce to manage information using technology.

Federal initiatives focused on building the Nation's technology infrastructure will help to create an environment that allows nurses to use technology routinely in delivering care. For example, the National Information Infrastructure (NII) initiative focuses on enhancing the basic infrastructure for telecommunications and computer technology in all sectors of the U.S. economy. The NII will add value to health care if people use information technologies to access and manage information. Realizing benefits from the NII is dependent on the quality of information; the availability of easy-to-use software applications; the development of network standards and transmission codes; and the availability of people to organize information, develop applications, maintain the network, and educate individuals to use the systems.

An information infrastructure is very important to health care. Information has become a capital good, with a value similar to labor, materials, and financial resources. Effective information management separates the economic survivors from the non-survivors in today's health care environment.

Nursing informatics (NI) is a specialty whose activities center around information management and processing for the nursing profession. The Division of Nursing (DN) further defines nursing informatics as combining nursing science, information management science, and computer science to manage and process nursing data, information, and knowledge to deliver quality care to the public, particularly disadvantaged and underserved populations.

Although many industries such as banking and travel readily adopted information technology, health care providers, including nurses, are slower to use computers for information processing. The literature was examined to determine the state-of-the-art in NI. Available data indicate the following situation. The nursing culture needs to promote acceptance and use of information technologies as basic tools for information management and exchange. Computers are available in schools of

nursing; however, infrastructure support in terms of personnel, planning, and budgeting is often lacking in schools of nursing. Computer technology that is available is not fully utilized. Information technology must facilitate, not hinder information exchange. Practicing nurses are not necessarily computer competent. More nursing informatics educational programs are needed.

The DN and NACNEP recognized a need to identify initiatives that would more adequately prepare the Nation's nursing workforce to use technology to manage information for education and practice and to help patients gain access to health care information. As a result, NACNEP commissioned a panel of experts to advise them in setting the Nation's future direction for using informatics in nursing education and practice.

Nineteen panel members, known as the National Nursing Informatics Work Group (NNIWG), were selected from nursing informatics experts across the country. The members are recognized for their outstanding contributions to nursing informatics in a variety of work settings, including practice, industry, education, and government. These individuals have expertise in decision support, distance education, informatics education and competencies, information systems, languages and taxonomies, and telecommunications.

At the beginning of the 2day meeting, NNIWG members were informed of the mission, authorization, and strategic directions of the DN and the national priorities of the Health Resources and Services Administration (HRSA). Five NNIWG members presented position papers, challenging their colleagues to consider the current status, future directions, and major barriers to reaching full use of cutting edge information technologies, telecommunications, distance learning, data sets, and information systems. Data from the literature on faculty's informatics needs, students' computer competencies, and availability of computers were presented to review further the status of NI.

A nominal group technique was used to identify and prioritize informatics needs. NNIWG members were assigned to one of two subgroups. Subgroup members in turn each stated one nursing informatics need that was recorded without discussion. Rounds continued until members had no further ideas to list or time had expired. Ideas were then expanded, combined, rephrased, or eliminated with consent of the originator of that idea. Using a weighting method, needs were prioritized.

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Five assumptions were foundational to identifying informatics needs and developing policy goals for NI education and practice:

- 1) Learners are students, faculty, and clinicians.
- 2) Nursing informatics must be considered within an interdisciplinary context of partnerships and collaboration.
- 3) Efforts should target disadvantaged and underserved populations.
- 4) Initiatives should be responsive to other government funding priorities.
- 5) Collaboration among Federal agencies and between Federal and private entities is necessary.

Eight categories of NI needs were identified:

- 1) Education and curriculum
  - a) Identify and incorporate informatics skills and competencies for all levels of education (basic, graduate, post-graduate, continuing education, and informatics specialization).
  - b) Teach information seeking and evaluation behaviors that consider age, learning styles, and motivation.
  - c) Integrate nursing science with NI education and practice to encourage innovations in nursing practice.
- 2) Demonstration projects for telenursing, patient education in the community, patient-specific clinical decision support systems, virtual courses, and consumer education about the nurse as a broker of information.
- 3) Development of models of nurse-patient encounters using technology including shared decision-making, consumer health information acquisition, multiproviders, and optimal ways to interact with systems.
- 4) Preparation of faculty in informatics including Internet skills, effective distance education schemes, and benchmarking strategies for technology education.
- 5) Collaboration on informatics initiatives with partnerships
  - a) Collaborate at Federal, academic, industry, and community levels.
  - b) Form partnerships among these groups.
  - c) Develop technology supported models of community development to identify new roles and to maximize use of technologies.
- 6) Integration of nursing informatics into practice
  - a) Include informatics in nurse-managed clinics.
  - b) Link nurse-managed clinics and practices.

- c) Identify barriers to using technology.
- 7) Additional informatics programs
  - a) Develop innovative programs that share expertise and resources.
  - b) Link regions to deliver informatics education.
- 8) Interdisciplinary focus in informatics
  - a) Determine if informatics can be used as a model for interdisciplinary education.
  - b) Develop interdisciplinary partnerships within universities and colleges to support informatics research and development.

Based on prioritized informatics needs, assumptions, and the expertise of *NNIWG* members, NACNEP recommends the following National Informatics Agenda for Nursing Education and Practice:

***1) Educate nursing students and practicing nurses in core informatics content.***

Federal resources should promote the inclusion of core informatics skills and knowledge leading to competency in nursing undergraduate, graduate, and continuing education programs.

***2) Prepare nurses with specialized skills in informatics.***

Federal funds should support innovative nursing and health informatics programs that teach specialized informatics skills needed to develop information technology that supports the national health goals of providing accessible, high quality, and cost-effective care.

***3) Enhance nursing practice and education through informatics projects.***

The Federal government should fund innovative, collaborative telecommunication projects that would enhance the quality of clinical practice for populations at risk and contribute to the education of health care providers.

***4) Prepare nursing faculty in informatics.***

Federal resources should support increased nursing faculty preparation in informatics through the use of collaborative programs and technology.

***5) Increase collaborative efforts in nursing informatics.***

Federal resources should support efforts to facilitate the advancement of informatics in nursing through collaboration among public and private organizations.

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## SECTION I: NURSING INFORMATICS

### Building the Infrastructure

The National Advisory Council on Nurse Education and Practice (NACNEP) was established by Title VIII of the Public Health Service Act to advise the Secretary of Health and Human Services on the programs of the Nurse Training Act. As part of its review of the Nurse Training Act, NACNEP turned its attention to the shaping of the registered nurse (RN) workforce to meet the public's health care needs. NACNEP's purposes under its charter were broadened in 1994 to explicitly meet this responsibility for advising the Secretary on ways to enhance the health of the public through the development of the RN workforce.

The Division of Nursing (DN) and NACNEP recognized a need to identify initiatives that will more adequately prepare the Nation's nursing workforce to use technology to manage information for education and practice and to help patients gain access to health care information. As a result, NACNEP commissioned a panel of informatics experts, the National Nursing Informatics Work Group (NNIWG), to recommend future direction for nursing informatics (NI) education and practice for the nation.

Federal initiatives focused on building the Nation's technology infrastructure will help to create an environment that allows nurses to use technology routinely in delivering care. For example, the National Information Infrastructure (NII) initiative focuses on enhancing the basic infrastructure for telecommunications and computer technology in all sectors of the US economy, including health care.<sup>7</sup> Such an infrastructure will provide a seamless web of communications networks, computers, databases, and consumer electronics that allows users to access a tremendous amount of information. The NII has the potential to revolutionize information management within health care, thereby cutting unnecessary medical costs and improving health care access and quality.<sup>2</sup>

The NII will only add value to health care if people can use and benefit from it. Ability of the MI to realize these goals is dependent on the quality of its components. An obvious component is the hardware available to access information. Other components, equally as important to a successful information network but often overlooked, are (a) the information itself, its medium, accuracy, timeliness, and reliability; (b) easy-to-use software applications to access, organize, and manipulate information; (c) network standards and transmission codes that allow different sites to exchange information, while protecting individuals' privacy and

security; and (d) people to organize information, develop applications, maintain the network, and train individuals to use the systems.

The information infrastructure is very important to health care. Tapscott and Caston<sup>3</sup> remind us that information has become a capital good, with a value similar to labor, materials, and financial resources. Swart<sup>4</sup> emphasizes further the value of information by indicating that data has become the basis of power in organizations. Effective information management separates the economic survivors from the non-survivors in today's health care environment. In spite of the importance of processing information, health care trails other industries in spending for information technology. Less than 2 percent of the health care industry's annual budget is spent on information system purchase and implementation, while industries such as banking spend 12 percent of their operating budget on information processing technologies.<sup>5</sup> For too long health care has been concerned with the cost and justification of purchasing information technology, rather than adopting a philosophy that accepts this technology as a critical part of doing business. Zielstorff<sup>6</sup> recently noted a decreasing focus on the cost of systems and an increasing concern with the technology's ability to capture data, produce needed information, and transmit that information to other partners in existing health information networks. This shifting view should help health care move more rapidly to adopt needed information technology.

It is an exciting time for NI. With its focus on the development and use of information and technology, NI is in an excellent position to help nursing become at least an equal partner with other health care providers in using the NII. Many informatics specialists believe that if nursing does not more readily adopt and use technologies in education and practice to meet the information needs of patients and nurses, other health care providers and business entrepreneurs will use those same technologies to replace nurses.

The DN and NACNEP recognize the important role of informatics in preparing the Nation's nursing workforce to abandon manual information processing for newer and more productive technologies. The DN defines NI as combining nursing science, information management science, and computer science to manage and process nursing data, information, and knowledge to deliver quality care to the public, particularly to disadvantaged and underserved populations. The activities of NI center around information management and processing. Information management involves the collection, organization, aggregation, storage, retrieval, and display of data in a way that supports nursing practice and

education. At the individual patient care level, data are processed into information and knowledge by nurses as they make decisions regarding the delivery of care to their patients. As data are further organized and aggregated, they can be retrieved in a purposeful way and used to evaluate the outcomes or responses of patient populations to various treatment modalities. Aggregated at a higher level across patient populations, data (as information) are used to establish policy for the public's health.

Information technologies are essential tools to facilitate the management of information used by all health care providers, including nurses. Information technologies include computers and software packages such as word processing, database management, spreadsheets, graphics presentation, as well as the Internet and World Wide Web systems. Mastery of these basic tools is commonly called computer literacy and is an expected outcome for all nursing students to achieve in their basic educational program.<sup>7</sup>

More advanced information technologies that can be used by nurses in practice and education include decision support systems, expert systems, clinical information systems, data repositories, distance education systems, and telehealth systems. Informatics processes vital to information management include using system design, selection, implementation, and evaluation principles; and developing and coding representative languages for communicating health information to patients, their families, other providers, and policy makers.

### **Nursing Informatics as a Specialty**

Informatics is not a new concept—it has been around for as long as people have recorded their thoughts, ideas, and observations for others to see. Information has always been the product of informatics. To be useful to health care, information must be collected, stored, retrieved, and displayed so that it is accurate, timely, understandable, easily accessible, and usable for practitioners, students, or policy makers to reach appropriate decisions. Recognition of the need for information in today's health care environment and for improved but less expensive technology has resulted in tremendous growth in the use of information technologies such as information systems, databases, desktop computers, personal digital assistants, laptops, modems, and the Internet. These tools have increased the focus on informatics.

Since the 1970s when hospital-wide information systems were first installed, nurses have worked in hospitals, for vendors, or as consultants to design, develop, and install

information systems and technologies. It was not until 1992 that NI was recognized as a specialty by the American Nurses Association (ANA).<sup>8</sup> To qualify as a specialty, NI exhibited the same attributes that are required of all specialties: practice differentiated by definition, domain, scope of practice, and standards; educational programs for preparing nurses to practice in the specialty; a mechanism for credentialing nurses in the specialty; organizational representation of the specialty; and a research program.<sup>9-10</sup>

Nursing is the largest group of health care providers with more than 2 million practicing RNs.<sup>11</sup> They have many needs related to NI. Standardized vocabularies are needed to describe: patients from nursing's perspective, interventions delivered by nurses and other providers, and outcomes of care received. Information technologies are needed to link those entities in a way that practice can be evaluated in terms of access, cost, and effectiveness. These areas of concern are the essence of NI practice. Nursing informatics is described as the essential infrastructure for quality assessment and improvement in nursing.<sup>12</sup> The importance of NI in the development of information technologies is again emphasized by Zielstorff, Hudgings, and Grobe<sup>13</sup> as they discuss essential characteristics of information systems needed for professional nursing practice.

### **Definition**

The definition of NI is dynamic, changing to reflect the maturation of the specialty. NI was first defined as the discipline of applying computer science to nursing processes.<sup>14</sup> A year later it was characterized as a focus that uses information technology to accomplish nursing's functions or tasks.<sup>15</sup> Although widely used, these two definitions limited NI to mean the use of computer technologies.

In 1988 Grobe expanded the description of NI to include application of information science principles and theory in studying, analyzing, and managing information.<sup>16</sup> A widely disseminated definition of NI appears in a classic and pivotal article by Graves and Corcoran<sup>17</sup> that describes the study of NI. The authors define NI as combining nursing, information, and computer sciences to manage and process nursing data to use in the delivery of health care. These two definitions acknowledge the inclusion of conceptual frameworks and theories such as information processing theory, decision theory, language development, human-computer interface issues, and application of the system development life cycle in NI practice. If used to guide curricula, the latter definitions assure development of more representative informatics education that teaches informatics concepts, not just computer literacy. Building on the two definitions, the

*Scope of Practice for Nursing Informatics* document also describes NI as a specialty that combines nursing, computer, and information sciences in organizing, processing, and managing data and information to support nursing practice. It adds that NI expands nursing knowledge.<sup>7</sup>

### ***Domains of Interest***

The nursing phenomena of interest are client, health, environment, and nurse. Because it is grounded in nursing, NI shares interest in these four phenomena, but adds to them a focus on all data, information, and knowledge involved in nursing.<sup>7,17</sup> Representation of data in a meaningful way is essential if isolated facts and observations are to be aggregated and used to make decisions regarding the public's health. It is the responsibility of informatics nurses to establish language that represents nursing's practice yet interfaces with languages used by other health providers.

A position statement from ANA<sup>18</sup> visualizes that nursing's language will move along a continuum from a collection of nursing terms to a unified language and finally to a uniform language. The ANA currently recognizes the Nursing Minimum Data Set<sup>19-20</sup> and five languages as representative of nursing: North American Nursing Diagnostic Association<sup>21</sup>, Nursing Intervention Classification (NIC)<sup>22</sup>, Nursing Outcomes Classification<sup>23</sup>, the Omaha System<sup>24</sup>, and the Home Health Classification.<sup>25</sup> The ANA is developing an evaluation system that will allow information system software to be critiqued for its compliance with one of these five nursing languages.<sup>26</sup> Informatics scholars have evaluated the fit of nursing's languages with taxonomies used by other healthcare providers and have determined that more work needs to be done with language development.<sup>27-29</sup>

Nursing informatics scholars continue to develop components of nursing's language that have not been completely addressed. Grobe<sup>30</sup> is developing a Nursing Intervention Lexicon and Taxonomy for chronic illness. Ozbolt, Fruchtnight, and Hayden<sup>31</sup> are using existing data from a consortium of hospitals to develop standard terms and codes for recording nursing care in patient records.

Renner and Swart<sup>32</sup> released a report on the Patient Core Data Set (PCDS) designed for use by multiple disciplines in aggregating patient data across health care settings. The PCDS identifies a core of common data elements and provides uniform definitions and coding that is consistent with both the Health Level 7 (HL7) and American Society for Testing and Materials (ASTM) electronic data interchange standards. Because

standards are built into PCDS, it will be easier to establish a longitudinal health and medical record for patients.

Solving issues of data representation through language is critical to the transfer of data across different systems, different groups of practitioners, and different geographic locations. The Health Insurance Portability and Accountability Act of 1996 legislates the use of national standard data sets for financial and administrative data. McCormick and colleagues<sup>33</sup> indicate this law may influence additional data sets as well. Nursing as a whole must reach consensus about language standards, identify a working set of standards, or develop schemes to link like terms if it is to have a representative language included in national standards. Unless nursing is represented in language standards, many questions about its best practices and patient outcomes will go unanswered. Without data that demonstrate its contribution to patient outcomes, nursing will become even more invisible in health care delivery.

### ***Scope of Practice and Standards***

In 1994, the ANA convened a panel of informatics experts to develop the *Scope of Practice for Nursing Informatics* that outlines in detail what is and is not NI practice.<sup>18</sup> The panel acknowledged that use of applications software is imperative for NI practice, but insufficient to define it. Within nursing, NI focuses on the methods and technologies of information handling needed for practice. In the document nursing practice refers to patient care, research, education, administration and informatics. Information handling includes organizing, processing, and managing data and information. Nursing informatics practice spans both direct and indirect clinical practice, depending upon whether individual or aggregate level data are being processed into information and used for decision-making.

The scope of practice makes it clear that informatics nurses must interface with other informatics disciplines to implement effective information solutions. It seems logical to describe NI as one of several discipline-specific informatics practices that fall under a more general rubric of health informatics. Medical and dental informatics are other examples of discipline-specific informatics practices. Included in the activities of health informatics are:

1. Identifying information to be collected and processed.
2. Creating databases for storing data.
3. Developing user-friendly screens to enter data and retrieve information.

4. Educating users to work effectively with information technology.
5. Preparing users to maximize use of available information systems.
6. Installing and maintaining health care information systems.
7. Developing distance education and telehealth systems for information exchange.

Although very similar to health informatics, NI activities are performed from a nursing perspective. Brennan<sup>34</sup> points out that each health profession (a) provides perspective, (b) illuminates values and beliefs, (c) denotes a practice base, (d) produces unique knowledge, (e) distinguishes groups of practitioners, (f) focuses attention on certain phenomena, (g) provides needed language, and (h) provides context to words. Using clinical experience and knowledge, informatics nurses are prepared to add the dimension of nursing to the health informatics viewpoint. This assures that information systems represent and facilitate nursing practice. Information is organized, collected, stored, displayed, and retrieved so that it supports nursing practice and education. As an example, informatics nurses work to include nursing language vocabularies in information systems so nursing practice can be adequately documented and evaluated. The role of nurses who can combine expertise in informatics with experience in education or practice will expand as information and technologies become integral parts of the health care infrastructure.

To become a specialty, a field of practice must develop standards. In 1995, the ANA convened a second expert panel to develop the *Standards of Practice for Nursing Informatics* document.<sup>35</sup> It describes the responsibilities of RNs who practice NI at the generalist level (called informatics nurses) and was used as a foundation for developing the certification examination. Practice responsibilities focus on assessment, diagnosis, outcome identification, planning, implementation, and evaluation of information systems and technologies. Professional performance standards for informatics nurses include statements about the following: maintaining quality of informatics practice, appraising performance, keeping knowledge current, developing professional colleagues, using ethical principles, collaborating with other nurses and other disciplines, participating in research, and utilizing appropriate resources. A third group of standards describes specific domain responsibilities for NI. They include applying the information systems' life cycle, using informatics knowledge and principles from supporting disciplines, gaining proficiency in using information technologies, communicating with other disciplines, and supporting databases that represent nursing language.

The standards for informatics nurses described above focus primarily on information systems and technologies rather than on data structures or interactions between humans and machines. A more advanced level of informatics practice is needed to deal with complex issues of human-computer interface, data representation, linguistic analysis, information processing, use of information, decision support systems, and system design. Development of standards for more advanced informatics practice is a future project.

### ***Educational Preparation in Nursing Informatics***

Early preparation in NI was available only through work-related experiences and a limited number of continuing education conferences and programs. Later a handful of faculty provided informatics education to graduate students through independent study focused on informatics concepts. More recently five informatics education models, ranging from continuing education to specialization, have been identified. Additional detail about the educational models is found in Section III. The appropriate model for an educational institution is dependent on the levels of informatics competency desired as an outcome for students.

In 1988, the International Medical Informatics Association's (IMIA) Nursing Informatics Work Group met in Sweden to identify informatics competence required for nurses at three different levels of expertise.<sup>36</sup> Information about expected competencies for each of the levels has served as a framework for informatics programs, including specialized informatics education at the University of Maryland at Baltimore.<sup>37</sup>

According to the IMIA work group, level one competencies prepare nurses to be users of information technology. Nurses are expected to know, understand, use, and interact with computer applications and information systems. Level one nurses are also prepared to collect relevant data for patient care, access information needed to provide nursing services, and implement policies that assure the privacy, confidentiality and security of data. This preparation is expected to occur in baccalaureate nursing programs. The scope of practice document<sup>7</sup> suggests almost identical competencies for all RNs completing their basic nursing programs.

Level two nurses are described by the IMIA work group as information system and technology modifiers. At this level nurses are prepared to analyze, manage, critique, develop, modify, and evaluate the technology by applying theoretical knowledge from nursing, information science, computer science, and business. To achieve the desired competencies of level two, nurses

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need at least specialized informatics courses and perhaps graduate specialty programs of study in NI.

Level three nurses are labeled information technology innovators. Nurses who perform at this level design and develop research-based information technology; analyze, define and develop the structure of nursing's language; and define the decision-making processes used for clinical nursing (individual level) and administrative policy (aggregate level) decision-making. According to the IMIA work group, nurses must be prepared at the doctoral level to become informatics innovators.

### ***Certification***

Although many different organizations certify nurses<sup>38</sup>, informatics certification is granted only through the American Nurses Credentialing Center (ANCC), a subsidiary of ANA. Current certification recognizes informatics generalists and calls them informatics nurses. This is a basic level of certification in informatics. Nurses who hold a baccalaureate or higher degree in nursing may apply for the certification test after they have practiced as a registered nurse for a minimum of 2 years and have practiced in informatics nursing for 2,000 hours within the past 5 years. If the applicant has 12 semester hours of academic credit in informatics in a graduate program, the number of practice hours is reduced to 1,000.<sup>39</sup> The examination is administered by computerized testing and is given continuously.

The certification test was developed from informatics standards written by the ANA's Task Force to Develop Measurement Criteria for Standards for Nursing Informatics. The content outline is as follows: systems analysis and design, system implementation and support, system testing and evaluation, human factors, computer technology, information/database management, professional practice trends and issues, and basic theories impacting NI. In 1997 more than 120 nurses are certified as informatics nurses.

### ***Organizational Support***

To qualify as a specialty, a practice area must be represented by at least one organized body. Three national organizations, the ANA, National League for Nursing (NLN), and American Medical Informatics Association (AMIA), and one international organization, IMIA, have councils, work groups, or special interest groups that represent NI. In addition, there are several regional or local special interest groups in NI. (See Appendix A)

### ***Research Program***

The final attribute required of specialties is a defined research program. The National Center for Nursing Research (NCNR), now the National Institute for Nursing Research (NINR), released a 1992-1996 national nursing research agenda for NI.<sup>40</sup> The report was developed by a panel of experts in NI. Their recommended priorities are as follows:

1. Using data, information, and knowledge to deliver and manage patient care.
2. Defining and describing data and information for patient care.
3. Acquiring and delivering knowledge from and for patient care.
4. Investigating new technologies to create tools for patient care.
5. Applying patient care ergonomics to the patient-nurse-machine interaction.
6. Integrating systems for better patient care.
7. Evaluating the effects of nursing information systems.

The report noted that most of the recommendations will be impacted by the development of nursing language.

Although the research agenda was defined, moneys for conducting NI research are difficult to obtain. Informatics researchers successful in obtaining funding generally have linked projects to clinical priorities. Some informatics researchers have questioned whether grant reviewers fully appreciate the role of informatics as an infrastructure for addressing language and technology issues. Informatics researchers also question whether some of the delay in innovative and new technologies reaching health care is tied to the skepticism of the reviewers.

## SECTION II: NURSING INFORMATICS IN EDUCATION AND PRACTICE

To define the state of NI in education and practice, an extensive review was conducted of literature published from 1990 to early 1997. The review focused on determining 1) the information and technology skills of nursing students, nursing faculty, and practicing nurses; 2) the informatics education needs of students, faculty and practicing nurses; 3) the use of computers by students, faculty, and practicing nurses; and 4) the availability of computers and applications in education and practice. Literature was reviewed from many media, including written and electronic publications.

A preliminary step was to informally poll experts in NI to determine if there were sentinel documents or fugitive literature that should be reviewed. None were discovered. An electronic literature search for NI was undertaken on CINAHL, then repeated through Medline Express, as a cross-check. Attempts to increase the specificity and limit the search were unsuccessful.

Surveys of schools of nursing and other relevant articles were found through Internet lists and on Web pages. Those articles were obtained, and their bibliographies were checked to locate any additional relevant articles. Nurse educators who were known to have conducted surveys were interviewed by telephone to obtain their

findings. Finally, non-informatics specialty nursing journals, such as nursing administration or public health nursing, that have published articles on NI were scrutinized for relevant articles not located through other search mechanisms.

Fewer than 300 articles published since 1990 were located through the electronic searches. Published research on the general topic of NI was more scarce. This result is not surprising since most NI literature is retrieved under specific topics of interest such as decision support, telecommunications, telemedicine or telehealth, and nursing language. Abstracts of articles indicated that only 38 reported research findings. Two informal, unpublished surveys were also located. The 40 studies examined computer literacy, use, competencies, attitudes, or preferences of practicing nurses, nursing students, and faculty.

Generally, samples were small, convenience samples of individuals within the institution being surveyed, such as nursing students enrolled in a specific course at one point in time. Such articles seldom reported results of repeating the survey at a later time in the academic year or with a different sample. There seemed to be no attempt to replicate studies or to use instruments with established records of reliability or validity. In most cases, the instrument was developed for each study setting,

### Division of Nursing Informatics Funding

The DN has recognized the importance of NI for a number of years, funding projects early in the development of the specialty. A summary of funded projects and initiatives is presented in Table 1.

1972	DN funded Community Nursing Services of Philadelphia to develop a computerized record system for planning, administrating, and evaluating nursing services.
1973	DN and NLN sponsored a 3-day national conference to exchange and evaluate knowledge of computerized information systems for nursing and health care management.
1974	DN and NLN sponsored four regional conferences (Omaha, Boston, San Francisco, and Atlanta) to stimulate development of management information systems.
1975	DN funded Visiting Nurse Association (VNA) of Omaha to develop a patient problem classification scheme; this is one of five nursing vocabularies recognized by the ANA.
1977	DN funded VNA of Omaha to develop outcomes and an outcome classification scheme to be adapted for computerized information systems for public health nursing. <sup>24,41-42</sup>
1984	DN funded St. Louis University to expand a nursing management graduate program that included computer technology as an integral part of the program. <sup>43</sup>

1987	DN funded American Journal of Nursing (AJN) Company to develop, implement, and evaluate the effectiveness of interactive videodiscs (IVDs) on clinical decision making skills. Three IVDs were developed: <u>Nursing Care of the Elderly Patient with Chronic Obstructive Pulmonary Disease</u> , <u>Nursing Care of Elderly Patients with Acute Cardiac Disorders</u> , and <u>Ethical Dilemmas and Legal Issues in Care of the Elderly</u> . <sup>44-48</sup>
1988	DN funded University of Maryland at Baltimore to start the Nation's first graduate program in NI; it was positioned within the nursing administration track. <sup>49</sup>
1990	DN funded University of Utah to start the second graduate program in NI; it was positioned within the clinical nursing track. <sup>50</sup>
1991	DN funded University of Maryland at Baltimore to start a doctoral specialty in NI. <sup>51</sup>
1991	DN funded Rutgers University to revise the graduate community health nursing program to include NI. <sup>52</sup>
1992	Legislation eliminated the support of graduate programs in nursing administration thus eliminating support for NI programs. DN support for such programs was terminated.
1994	DN awarded a special projects grant to the AJN Company to develop a national information service to provide continuing education through an electronic network to nurses in medically underserved communities. <sup>53</sup>
1994 1995	DN supported 25 distance education grants: 9 Nursing Special Projects; 6 Advanced Nurse Education; 10 Nurse Practitioner and Nurse-Midwifery.
1996	DN awarded cooperative agreements to three regional nursing compacts to provide introductory NI continuing education for faculty at sites across the Nation.
1996	DN entered collaboration with the National Library of Medicine (NLM) to support NI fellows in developing expertise that can be applied to nursing education and practice.
1997	DN convened NNIWG to advise NACNEP on establishing a National Informatics Agenda for Nursing Education and Practice.

### Informatics Education Models

In 1996, Lange conducted an informal survey to compile a list of schools offering education in NI.<sup>54</sup> The researcher talked with informatics colleagues, broadcast messages on a NI listserv, posted an announcement on the Web page of AMIA Nursing Informatics Work Group, and contacted faculty at schools of nursing either known or rumored to have informatics programs. Lange divided responses into three categories or models of NI education. Two additional categories were added to accommodate integrated models and continuing education models described in the literature. The listings are included to provide examples of NI education models, not to provide an exhaustive list of programs.

### *Category I Models: Graduate Programs with a Specialty Nursing Informatics Focus*

Two master's programs fit within this category; the University of Maryland and University of Utah programs. Implemented in 1988, Maryland's program prepares graduates to analyze information requirements for nursing, design system alternatives, manage information technology, identify and implement user training strategies, and evaluate effectiveness of clinical and management information systems in patient care? Courses are required in management, finance, and theories of organizations. The program uses an interdisciplinary approach to informatics, requiring NI students to take at least nine credits of information systems management courses with information majors. Suggested courses include systems analysis and design, databases, decision support systems, data security, project management, and networks. Informatics principles are then applied in nine credits of NI. Included in the NI courses are: 1) a field experience in

which students work with clients to identify system requirements or plan system implementation, and 2) a practicum experience in which students are assigned to work with NI specialists in health care agencies (acute care, long-term, or home health), consulting firms, vendor corporations, or administrative offices setting informatics policies (e.g., ANA or Department of Defense).

Utah's program opened in 1990 and prepares graduates to practice and conduct research in nursing and health care informatics. The program was placed within the Parent, Child, and Adult Nursing Division. Students need 26 quarter credits of specialty coursework in structured programming, analysis and design of clinical nursing and health care systems, database theory and design, design of decision support systems, and implementation of systems. Field experience is included in each informatics course, and a practicum is included.<sup>50</sup>

Together these two NI programs have prepared successfully over 100 informatics nurse specialists for the marketplace. To be successful, master's programs in NI should meet the following guidelines:

1. Build on nursing science coursework
2. Use interdisciplinary coursework to build informatics and technology competencies
3. Have available state-of-the-art technology
4. Provide adequate faculty and technology support, and
5. Have available a variety of settings for practicum experiences.

The supply of graduates produced by these two programs, however, is inadequate to meet the demand for specialists in NI. Because of the need for informatics nurses, graduates of the two programs have multiple opportunities for employment.

### ***Category 2 Models: Graduate and Undergraduate Programs and Courses in Nursing Informatics: Concentrations and Minors***

Lange found six programs that offer a concentration or minor in informatics.<sup>54</sup> Case Western Reserve University implemented a program that offers four NI courses (totaling seven credits) to prepare undergraduate baccalaureate students to be sophisticated users of information and information technology. The courses are spread out over 3 years and focus on the content, flow, and processing of patient information; information and the clinical care process; use of information technologies; and hands-on experience in NI.<sup>55</sup>

Since January 1997, Duke University School of Nursing has offered a NI option within the nursing

administration program. Graduate students take between 8 and 14 credit hours of informatics courses. The program includes a post-master's certificate option for nurses who have earned an MSN. The unique feature of Duke's program is that courses are designed for distance learners who are able to commute to Duke on a limited basis and take the rest of the classes through a virtual classroom experience.<sup>54</sup>

Saint Louis University, University of Iowa, and University of Arizona offer programs that allow graduate students to select an informatics option within their nursing administration programs. The Iowa program allows students to take elective courses from the departments of management and organizations, management sciences, hospital and health administration, computer science, and library and information science. Lawless<sup>56</sup> describes Northeastern University's program that includes three NI courses required as part of the nursing administration program.

### ***Category 3 Models: Individual Courses in Nursing Informatics Within Graduate/Undergraduate Programs***

While much attention has been focused on potential uses of information technology, schools of nursing have been slow to include informatics in their curricula. Carty and Rosenfeld<sup>57</sup> found that less than half of 190 accredited schools of nursing reported the availability of informatics education either through integrated or freestanding courses offered as part of the curriculum.

Lange compiled information about several graduate programs that offer courses in informatics.<sup>54</sup> The list has been expanded to include information about graduate and undergraduate NI courses found in the literature. To help students understand the nature of courses offered, developers need to differentiate between offerings that focus only on computer literacy and those that teach additional informatics concepts. Currently the NI title is used for both types of courses. Examples of entries follow.

School: Lewis University, College of Nursing  
Course Title: Graduate Program in Nursing Applications in Multimedia.

Description: The course introduces the use of computerized multimedia presentations for advanced practice nurses.

Intended Audience: Graduate students

School: Loyola University at Chicago  
Course Title: Introduction to Information Systems for Health Care Management.

Description: The course presents an overview of

information systems and related concepts in a hands-on format. Emphasis is on evaluation, analysis, and use of clinical, administrative, financial, home health, and integrated information systems. The roles of the computer-based patient record, standardized nursing languages, and electronic networks in health care are also discussed.

Intended Audience: RN to MS students

School: Oregon Health Sciences University  
Course Title: Information Management and Technologies.

Description: The course is offered within the community nursing master's program and provides an introduction to NI.

Intended Audience: Master's students

School: University of North Carolina - Chapel Hill  
Course Title: Health Care Informatics.

Description: The course focuses on developing an understanding of concepts relevant to health care informatics and the use of computerized information systems in health care organizations.

Intended Audience: Graduate students

School: Georgia College and State University  
Course Title: Health Science Informatics.

Description: The course is an overview of health science informatics and the skills needed to access information. The focus is the use of computer and technology based health applications.

Intended Audience: Undergraduate and graduate students

School: Wichita State University, College of Health Professions, School of Nursing

Course Title: Health Care Information Systems.

Description: The Internet-based course examines information systems as they relate to health care; analyzes information systems in clinical management, administration, education and research; and emphasizes issues surrounding information systems.

Intended audience: Graduate students

School: Hunter College, Hunter-Bellevue School of Nursing

Course Title: Nursing Informatics.

Description: The course emphasizes the integration and use of computer/information technology. Class experiences include mastering of basic computer competencies, evaluating trends in electronic information processing, and establishing connections through electronic networks.<sup>58</sup>

Intended audience: Graduate students

#### ***Category 4 Models: Nursing Informatics Integrated into the Curriculum***

Some schools have elected to integrate computer competency and informatics concepts into the curriculum rather than offering separate courses.

School: Saint Louis University

Graduate students in administration use information technologies as they develop their skills in forecasting and budgeting (spreadsheets), managing projects (project management software), presenting (presentation graphics), manipulating databases, and negotiating (idea generation software).<sup>43</sup>

School: Rutgers University, College of Nursing

Revised its graduate community health nursing curriculum to include NI. A 2-day orientation workshop prepares incoming students to use computer technology. Informatics concepts and experiences are incorporated into subsequent courses.<sup>52</sup>

School: Miami University, Department of Nursing  
Integrated information technology into the undergraduate curriculum. The focus is on preparing students to use technology devices.<sup>59</sup>

#### ***Category 5 Models: Continuing Education and Professional Development in Nursing Informatics***

The mainstay of education for nurses in informatics has been continuing education through workshops, conferences, institutes, fellowships, and literature self-study. Programs in this category range from traditional 2- or 3-day conferences to intensive fellowships lasting up to 3 years. All are focused on NI.

##### Workshops or Conferences:

For 15 years Rutgers University, College of Nursing, has offered an international NI conference. The conference is held in the spring and has focused primarily on educational application of NI.

For many years New York University Medical Center held a spring NI conference under the direction of Patsy Marr. In 1996 NYU's nursing education department partnered with the Medical Center to present the conference.

Numerous informatics programs are available through informatics professional organizations. Each year AMIA holds spring and fall congresses that focus on informatics issues. Every three years IMIA presents MedInfo, an international conference that rotates to different countries. In 1998 MedInfo will be held in South Korea. IMIA's NI Special Interest Group

sponsors an international conference every third year. The 1997 meeting was held in Sweden; the 2000 meeting will be in New Zealand. One of the largest conferences in terms of attendance is presented each year in February by the Healthcare Information Management Systems Society (HIMSS). It rotates to different parts of the United States each year.

A few nursing organizations have added informatics continuing education to their programs. The NLN's Council on Nursing Informatics holds a conference each year. The ANA included informatics in general education sessions for the first time at the 1996 biennial meeting.

Even though an increasing number of conferences and workshops in informatics are available to help nurses learn about NI and technology issues, nurses continually express the need for more accessible educational programs to help them perform better within the field of informatics.

#### Institutes and Fellowships:

Institutes and fellowships are designed to provide an intensive learning experience for participants. A summer institute in NI has been held every July since 1991 at the University of Maryland at Baltimore, School of Nursing.<sup>60</sup> The institute has attracted international nurses and other health care providers who practice in informatics. Using a faculty of informatics experts, participants have received information about basic processes such as system selection and implementation, informatics issues, and future trends in informatics. Hands-on opportunity to interface with information technologies has been provided. To maximize opportunity for networking with faculty, host site staff, and other participants, the enrollment has been limited to 100. The institute is completely subscribed each year, indicating the interest in continuing education of this kind.

Another model of an informatics institute is the HBO Scholars Program held from 1989-1995. A healthcare information systems vendor, HBO and Company, partnered with the University of Colorado and the State University of New York at Buffalo to provide a unique opportunity for nurse educators to learn about informatics.<sup>61</sup> Through a competitive process, a small number of scholars were brought to HBO's corporate headquarters each spring for an intensive 1-week immersion in informatics. A faculty of NI experts helped the HBO scholars learn informatics concepts they could share with the nursing community of students, faculty, practitioners, and administrators. This cadre of scholars

(about 75 nurse educators) has impacted NI tremendously through its subsequent research and education efforts.

Since 1993, the Massachusetts General Hospital, and now its parent Partners Healthcare Corporation, has sponsored a NI fellow. The competitive 1-year fellowship is open to nurses who have completed a graduate informatics program of study. The intent is to provide a rich informatics environment where fellows can begin informatics practice with guidance available as needed. The fellowship has been very successful in launching NI specialists on their career trajectories.

Informatics fellowships are also available to nurses through the NLM Medical Informatics Fellowship Program. Post-master's and post-doctoral informatics fellowship programs accept both nurse and physician applicants.

#### **Student Preparation in Nursing Informatics**

More than 10 years ago, Ronald and Skiba wrote *Guidelines for Basic Computer Education in Nursing*.<sup>62</sup> The publication offered very helpful information about the purchase of computers and adding computer education to nursing curricula. Even though information was available, many nursing educators pay little, if any, attention to students' computer skills and their ability to use information technologies in practice. More recently, Division of Nursing staff explored the literature to confirm the availability of computers to students.

Rossel<sup>63</sup> conducted a national survey of baccalaureate nursing computer labs in 1994, focusing on the administration, funding, and use of those labs. The sample of 297 baccalaureate schools (62 percent responded) was included in the State-Approved Schools of Nursing listing from NLN. Respondents were divided into four regions, Northeast (60 percent), northern Midwest (64 percent), southern Midwest (58 percent), and Western plus Alaska and Hawaii (62 percent). Rossel found that **almost all schools** have access to computers, printers, and library searches. The researcher concluded that connecting to a network for Internet and Web access is more likely in large schools, public schools, and the Western region. In this study, grant funds provided half of the computer hardware and one-third of all the software available in the schools.

In 1997, Carty and Rosenfeld<sup>57</sup> reported on the extent of NI in nursing curricula and how students are being prepared in the area of informatics. The sample consisted of 190 of the 347 (55 percent) NLN approved diploma, associate, and baccalaureate schools of nursing. Many of Rossel's findings were confirmed by Carty and

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Rosenfeld. In assessing the availability of computer technology, the researchers found that computers are available to students in more than 97 percent of schools responding. Further technology analysis shows nearly 68 percent of the schools have Internet access, 56 percent of schools have Web access, 51 percent have a local area network, and 20 percent have distance learning access.

Examining the technology infrastructure of schools of nursing in terms of allocation of technology personnel and financial resources, as well as the existence of a network manager and a technology planning committee produced quite different results. Half of the schools allocated no moneys for the technology infrastructure. Those that did have allocated resources depended mainly on grants and institutions for funding. Fifty percent of schools with technology budgets allocated \$7,000 or less per year. The most common amount allocated was \$1,000. The limited funding for information technology raises the question if nursing students receive adequate support to use the technology effectively. With such small budgets, upgrading hardware and software to accommodate changes in technology is a problem in schools of nursing.

Carty and Rosenfeld were also interested in the availability of NI education in the surveyed schools. In their sample only 38 percent of nursing schools have included NI in the curriculum. Fifty-one (28 percent) programs indicated they had integrated NI into the curriculum. Another 19 schools (10 percent) said they have specific NI courses. The researchers concluded that NI needs to be recognized as essential to the curriculum.

Johnson<sup>64</sup> examined curricular trends in nursing programs to determine the presence or absence of current health care emphases, and of essential nursing knowledge and skills in nursing curricula. The sample for the study was 113 NLN accredited generic baccalaureate programs (61 percent responded). Current health care emphases were: computerization, critical care, geriatric health care, economics, health maintenance, home health care, legal issues, long-term health care, and rehabilitative health care. Respondents represented 22-24 percent of baccalaureate programs accredited by the NLN between 1986 and 1990 in each of four regions. Johnson looked at computer literacy, a skill required before more sophisticated activities of NI can be performed and found that computer literacy was the only health care emphasis the majority of respondents did not address through a required course. Thirty-nine percent of schools in the study addressed computer literacy by a specific course or program objectives, and 27 percent integrated computer literacy in one or more courses. About 27 percent also reported

that computer literacy was addressed in an elective course outside of the nursing school or through an entrance requirement. Johnson states that since computer literacy is not required, it is not yet considered an important element for nursing curricula.

Faculty do not always use the term computer literacy to mean the same set of skills. Bryson<sup>65</sup> investigated the perceptions of nursing educators concerning the amount and kinds of computer education that would make students computer literate. A panel of two computer educators, one software developer, and nine nursing educators used the seven domains of computer literacy defined by the Minnesota Educational Computer Consortium to identify instructional objectives that delineate computer literacy for students completing 2- or 4-year nursing programs. To validate the objectives, a questionnaire was administered to 87 faculty from 2-year programs and 93 faculty from 4-year programs. From the NLN list of state-approved nursing programs published in 1987, faculty were randomly chosen to participate in the survey. Of the 74 objectives presented, 57 received scores of 3.5 or greater on a 5-point Likert scale and were retained to identify computer literacy. As a result of Bryson's study, a computer literate nurse is defined as one who has knowledge about computers, is able to learn by using computers, and is able to use the computer as an effective tool in nursing. Bryson observed that only 20 percent of the nursing schools represented by study subjects require a computer course.

Educators have speculated that with the increased use of technology throughout primary and secondary education, nursing schools would not have to be concerned about the computer skills of incoming students. Data are needed to either confirm or refute that thinking. Birx, Castleberry, and Perry<sup>66</sup> report a study that included self-reported measures of computer skills. Laptop computers were issued to 20 senior nursing students for transmitting weekly assignments to faculty. To evaluate their own computer skills, the students also completed three check lists. Students who used the laptops showed significant improvement in computer skills related to e-mail, word processing, and computerized library database searching skills. The level of computer literacy of these students at the start of the study is not indicated, only that their self-reported skills improved by using the laptop computers.

Jacobs and dela Cruz<sup>67</sup> determined the informatics curriculum needs of graduate nursing students. The study actually looked at the computer literacy of 67 students in one school of nursing (74 percent responded). Eighty-two percent of the students had word processing experience, but half of these were at the beginning level. Other skills were as follows: 24 percent

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had used spreadsheets, 21 percent had used learning modules, 3 percent had used computers for decision analysis, 33 percent had performed statistical analysis, and 30 percent had done a literature search using a database. Most of the students had access to a computer either at home, at work, or at school.

Two unpublished studies give additional information about computer literacy, but reach different conclusions. Saba<sup>68</sup> has administered an 8-item computer literacy survey to incoming undergraduate and graduate nursing students for the past 10 years. Computer literacy is defined by this researcher as the ability to use a keyboard to prepare a paper, conduct a literature search, send e-mail, access the Internet, and operate computer-assisted instruction (CAI) programs. Scoring for the survey is unclear. Saba reports the computer literacy rate increased from 20 percent in 1986 to 99.9 percent in 1996. In the second unpublished study, results were not as encouraging. Gassert and McDowel<sup>69</sup> administered a survey instrument consisting of 15 items with a 4-point Likert scale to determine students' perception of their ability to use computers and software. Factor analysis of the survey items identified three factors: connectivity, applications, and hardware. A total of 394 students, most of them juniors, completed the survey in 1994 and 1995. The modal age of students was 20 years. Sixty percent of the students owned a computer, and 60 percent had some computer instruction. Surprisingly, when looking at connectivity, over half of the students had never used e-mail or the Internet and over 80 percent had never accessed the Web. Scores were also low for the applications factor. More than 50 percent of students had no experience with databases, spreadsheets, presentation graphics, bibliographic databases, or statistical software. Students scored higher on the hardware factor. Mean scores for keyboard skills and word processing indicated students had moderate skills in this area. These data indicate that students know how to word process, but cannot use other applications to access, process, and transmit data using the NII. The researchers concluded that faculty needed to continue teaching computer literacy to nursing students.

In summary, many nursing students have access to computers, but have limited or no ability to use them except for word processing. The level of computer literacy is dependent on how it is defined. To identify computer education needs, more schools of nursing must evaluate the computer literacy of incoming students by means of valid and reliable instruments.

### **Faculty Preparation in Nursing Informatics**

There is a need to know if faculty are prepared adequately to use information technology so they can

teach students to use computers. In 1994 the Southern Council on Collegiate Education for Nursing (SCCEN) surveyed institutions in the southern States to determine how nurse educators were using educational technologies.<sup>70</sup> Surveys were sent to 440 institutions and 174 responded (40 percent). Sixty-six percent of responding schools had access to the Internet, but interestingly, 33 percent of those said that less than five faculty members had access. Information access through bibliographic databases showed more favorable results. On-line library catalogs were accessible to 77 percent of schools, and 48 percent said off-campus users could access the electronic catalog. The survey also asked about the availability of continuing education to help faculty incorporate information technology into the curriculum. Sixty-five percent of responding schools offer orientation to technology, but most often by individual troubleshooting rather than through organized training or workshops.

In the SCCEN survey, many respondents indicated their interest in distance learning activities: 81 percent of schools receive or are planning to receive educational programs; 70 percent deliver or plan to deliver educational programs to off-campus sites; and 36 percent produce educational programs to be delivered by this technology. Of the responding schools, 85 percent plan to offer distance education by technology in the future; but only 47 percent of the schools stated interest in working through a consortium to share educational offerings.

In 1996, another interesting survey identified the NI educational needs of faculty and practicing informatics nurses, and the computer applications they used." A total of 497 nurses who were on a computer conference list responded to the survey (33 percent). More than half of the respondents were prepared at the master's level. The sample was composed of 172 informatics nurses, 140 nurse educators, and 131 nurse managers. Fifty-four responses could not be used. Access to computers was no problem for this sample; more than 80 percent had computer access at home and more than 90 percent had access at work. Software usage for the sample was as follows: word processing, 73 percent; e-mail 50 percent; database, spreadsheet and hospital information systems, 40 percent; presentation graphics, 38 percent; and Internet, 29 percent.

Arnold asked participants if they were interested in obtaining formal NI education. More than 80 percent of informatics nurses were interested in certification, and 70 percent were interested in an informatics degree. Nurse managers were also quite interested in informatics education. About 80 percent were interested in certificate education, and more than 60 percent expressed interest in

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an informatics degree. In this survey nurse educators were less interested in informatics education. Sixty percent of nurse educators wanted a certificate in informatics, and only 40 percent expressed interest in an informatics degree. Acquiring nurse faculty prepared in informatics has been difficult, so a lower interest in obtaining informatics knowledge is of concern.

Arnold examined the desired knowledge related to informatics content areas and again found differences among the three groups of respondents. Informatics nurses chose decision support, advanced informatics knowledge, and integration of NI as their first three priorities. Nurse managers wanted knowledge of graphical presentations, clinical data analysis, and electronic communication. Nurse educators also chose graphical presentation as a first priority, but selected computer assisted instruction critique, and decision support as their next two preferences. The researcher concluded that informatics nurses had more differences than similarities with the other two groups in terms of desired knowledge of informatics content. Findings of the study support the need for specialized courses, certificate programs, and degree programs in NI.

### **Practicing Clinicians' Preparation in Nursing Informatics**

The number of nurses prepared to work in the specialty of informatics is unknown. Nurses hired to fill informatics positions in health care agencies use many different titles and are placed within administration, nursing, or information system departments. Berends<sup>72</sup> found that 39 informatics nurses reported 34 different job titles. The informatics jobs could be classified into eight categories. Carty<sup>73</sup> likewise found that the titles of 89 informatics nurses fell within 10 different informatics job categories. A majority of respondents in Carty's sample worked in hospitals (63 percent). Another 10 percent worked in community agencies, home health agencies, or schools of nursing. Although not included as respondents in Carty's study, informatics nurses employed by software vendors and consulting firms work in a variety of positions and are often assigned different titles for jobs having similar responsibilities. The variety of settings, job titles, and categories speaks to the diversity of informatics nurses' roles, but makes it very difficult to determine the number of nurses actually employed in the field.

What is known is that most informatics nurses have prepared themselves to work in the field through job experiences, continuing education, and self-study.<sup>74</sup> In a 1993 study of role activities of informatics nurses, Berends found that 53 percent of 43 informatics nurses had master's degrees, but only 2 percent of these were in

NI.<sup>72</sup> Twenty-one percent had master's degrees from specialties other than nursing. In 1994, Carty reported similar data for a sample of 97 nursing information specialists from 37 states and Canada who also demonstrated diverse entry routes into NI.<sup>73</sup> Although 63 percent of Carty's sample had master's degrees, only 6 percent held a master's degree in NI and 19 percent had master's degrees from specialties other than nursing, including management, business, and computer science. Carty concluded that the diversity in educational specialization for informatics nurses emphasizes the scarcity of formal graduate courses in NI. Carty lists the University of Maryland and the University of Utah as the only two graduate programs awarding master's degrees in NI. Both of these programs received initial funding from the Division of Nursing (see Table 1).

Only a few studies reported on the informatics preparation of practicing nurse clinicians. Stagers<sup>75</sup> included a measure of computer experience (computer use and knowledge) in a larger study of the effect of screen density on detecting critical on-line information. The study sample of 110 clinical nurses from 145 randomly selected nurses (76 percent response rate) in a large eastern academic health center completed the Stagers Nursing Computer Experience Questionnaire (NCEQ).<sup>76</sup> The NCEQ is comprised of 4 subscales: overall computer use, overall computer knowledge, role participation, and role knowledge; it has a possible score of 292. The mean score for the NCEQ for this sample was 29.27. The mean subscale score for computer use was 14.56 (of a possible 128) and the mean subscale score for computer knowledge was 12.79 (of a possible 124). A hospital-wide information system was not in place in the study setting. The study findings have tremendous implications for educating clinical nurses to use information systems.

In an earlier study, Burkes<sup>77</sup> examined the satisfaction, motivation, and beliefs of 52 ICU staff nurses related to computer use in an environment that had computerized nursing programs in place since 1982. Computer experience was measured as one of the nursing characteristics and was recorded as length of time using computers. Forty-two percent of the sample had used computers more than 2 years, 32 percent had used computers 1 to 2 years, and 25 percent had used computers less than 1 year. At the same time 85 percent of the ICU nurses had worked as a nurse for 4 or more years. The data indicate that the ICU nurses had worked much of their careers without using computers. This is not surprising, given the fairly recent interest in installing information systems in acute care environments. In Burkes' study, computer knowledge scores were almost equally distributed in five categories from very low to very high. Interestingly, length of

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computer experience and nursing experience related negatively to nurses' computer-use satisfaction. More computer experience was expected to correlate positively with satisfaction. Burkes states the finding may indicate the nurses were able to critically evaluate existing computer programs and were dissatisfied with their inadequacies. This view is supported by findings that increased computer knowledge correlated positively with beliefs. The researcher postulates that knowing more about computers motivates nurses to use computerized nursing programs. Findings from this study also imply a need to educate nurses about computers prior to system implementation.

Computer use was included as a variable by Patterson and colleagues<sup>78</sup> when they investigated the information exchange required for continuity of care across patient units. The researchers assessed the information exchange problems and preferences of staff RNs, as well as their database needs, when faced with 3,750 patient transfers a month between 21 different nursing units. A sample of 197 staff nurses in all 21 clinical units participated in the survey (response rate 45 percent). Methods for receiving information about incoming patients were studied. Results show the telephone was used by 82 percent of nurses, the medical record was used by 81 percent, an interunit transfer form was used by 64 percent of nurses, and the medical center computer was used by 55 percent of the nurses. Nearly half of the nurses preferred the telephone for receiving information, while only 10 percent preferred the computer. When asked whether computer use would improve conveyance and timeliness of clinical information exchanges, 56 percent of the nurses thought it would improve care continuity. Thirty-five percent also said that if data entry were simple, they would use the computer to report patient transfers in the future. Since it was not the focus of the study, the ability of clinical nurses to use computers was not addressed.

## Summary

In summary, several implications can be drawn from the studies reviewed. First, the nursing culture needs to be changed to promote acceptance and use of computer technologie as basic tools for information management and exchange by nurses. Second, technology is available in the schools of nursing that have been studied; however, infrastructure support in terms of personnel, planning, and budgeting is often not present. Technology that is available in many schools is not fully utilized. Third, information technology needs to facilitate, not hinder information exchange; therefore, informatics nurses who understand nursing, information, and information technology need to be included in the design and development of systems that work for nurses as well as other care providers. Fourth, more NI educational programs are needed. There are needs for computer education courses, informatics courses, and specialty informatics programs to prepare nurses as specialists in informatics. Fifth, practicing nurses are not necessarily computer competent. They need increased educational opportunities through continuing education programs so they are ready to interface with information technology in their work environments.

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## SECTION III: NATIONAL NURSING INFORMATICS WORK GROUP

### Description of Members

In January 1997, NNIWG was convened to make recommendations to NACNEP in setting the Nation's informatics agenda for nursing education and practice. NNIWG identified and prioritized informatics needs and initiatives that will prepare the nursing workforce to use information technology and apply informatics concepts to manage patient care information.

The 19 members comprising NNIWG (see Appendix B) are recognized for their outstanding contributions to NI in a variety of work settings. Six members work in patient care settings, two in commercial business, three in government service, and nine in nursing education. In addition, one is a nurse practitioner and one is not a nurse, thus broadening the panel's health care and informatics perspectives. Members are recognized for their expertise in one or more of six key areas of informatics practice and education. The distribution of expertise of the panel is as follows:

1. Decision support	3 members
2. Distance education	3 members
3. Informatics education/competencies	3 members
4. Information systems	6 members
5. Language and taxonomies	5 members
6. Telecommunications	4 members

### Context for Identifying Informatics Needs and Initiatives

To provide adequate governmental context for setting the NI agenda, the NNIWG members were briefed on the mission, authorization, and strategic directions of the DN and the national priorities of the Health Resources and Services Administration (HRSA). The DN's critical foci are: (a) enhancing nursing's contribution to primary health care and public health; (b) developing and promoting innovative practice models for improved and expanded nursing services; (c) enhancing racial and ethnic diversity and cultural competency in the nursing workforce; (d) promoting improved and expanded linkages between education and practice; (e) improving and expanding nursing services to high-risk and underserved populations; (f) enhancing nursing's contributions to achieving the Healthy People 2000 objectives and health systems change; and (g) capacity-building for meeting the nursing service needs of the nation.

HRSA has identified eight priorities that will help put primary health care providers and services in places they are needed most. The four priorities most pertinent for

informatics are: (a) forming academic and community partnerships to move clinical education into neighborhood sites and to empower communities to meet their unique health care needs; (b) using advanced information technology systems, such as telemedicine, to solve service delivery problems; (c) building state and community relationships to better serve populations; and (d) safeguarding adolescent health by providing primary care to children and teenagers.

Five NNIWG panel members presented position papers that challenged their colleagues to consider the current status, future directions, major issues, and the barriers to reaching full use of specific informatics languages and technologies. Topics presented were cutting edge information technologies, telecommunications, distance learning, data sets, and information systems. Data from the literature on faculty's informatics needs, students' computer competencies, and availability of computers in public health settings were presented to review further the status of NI. The final phase of sharing information with NNIWG members was to present an update on informatics projects funded by the DN.

### Method for Identifying Informatics Needs and Initiatives

Nominal group technique, a group process method, was used to assist members in identifying and prioritizing informatics needs. First, NNIWG members were randomly assigned to one of two subgroups. Subgroup facilitators helped participants complete their assigned tasks within the designated time period. Second, subgroup members in turn each stated one NI need that was recorded without discussion. Rounds continued until members had no further ideas to list or time had expired. Third, ideas were explored through discussion in the subgroups; and items were expanded, combined, rephrased, or eliminated with consent of the originator of that idea. Fourth, subgroup members prioritized the needs by placing one of five colored dots that represented a weighted value from 5 (first priority) to 1 (fifth priority) beside each chosen item. This process allowed overall scores to be determined for each item on the list, thus prioritizing the items.

### Nursing Informatics Needs

In identifying NI needs, NNIWG members agreed on five assumptions foundational to all further discussion of informatics:

- 1) Learners are students, faculty, and clinicians.
- 2) Nursing informatics must be considered within an interdisciplinary context of partnerships and collaboration.
- 3) Efforts should target disadvantaged and

underserved populations.

- 4) Initiatives should be responsive to other government funding priorities.
- 5) Collaboration among Federal agencies and between Federal and private entities is necessary.

Based on identified assumptions, informatics expertise, and information presented, the subgroups named a total of 81 informatics needs for nursing education and practice. Group One initially listed 48 informatics needs. After discussion its list was reduced to 21 items. In prioritizing the items, only 8 of the 21 needs received a score. Group Two initially identified 33 informatics needs. Following discussion its list was reduced to 15 items. As Group Two members prioritized their needs, 13 of the 15 items received votes.

Eight focal areas of NI needs emerged from the two lists.

- 1) Education and curriculum
  - a) Identify and incorporate informatics skills and competencies for all levels of education (basic, graduate, post-graduate, continuing education, and informatics specialization).
  - b) Teach information seeking and evaluation behaviors that consider age, learning styles, and motivation.
  - c) Integrate nursing science with NI education and practice to encourage innovations in nursing practice.
- 2) Demonstration projects for telenursing, patient education in the community, patient-specific clinical decision support systems, virtual courses, and consumer education about the nurse as a broker of information.
- 3) Development of models of nurse-patient encounters using technology including shared decision-making, consumer health information acquisition, multiproviders, and optimal ways to interact with systems.
- 4) Preparation of faculty in informatics including Internet skills, effective distance education schemes, and benchmarking strategies for technology education.
- 5) Collaboration on informatics initiatives with partnerships
  - a) Collaborate at Federal, academic, industry, and community levels.
  - b) Form partnerships among these groups.
  - c) Develop technology supported models of community development to identify new roles and to maximize use of technologies.
- 6) Integration of nursing informatics into practice
  - a) Include informatics in nurse-managed clinics.
  - b) Link nurse-managed clinics and practices.

- c) Identify barriers to using technology.
- 7) Additional informatics programs
  - a) Develop innovative programs that share expertise and resources.
  - b) Link regions to deliver informatics education.
- 8) Interdisciplinary focus in informatics
  - a) Determine if informatics can be used as a model for interdisciplinary education.
  - b) Develop interdisciplinary partnerships within universities and colleges to support informatics research and development.

### **Proposed Nursing Informatics Initiatives**

The second phase of the NNIWG project was to produce informatics initiatives for nursing education and practice from the prioritized needs. Seven NI initiatives and actions were identified by Group One. Members of this group considered the need for an interdisciplinary focus in informatics to be one of the assumptions and did not develop a separate initiative for it. Using broader language, Group Two members wrote four general NI initiatives. Each of these initiatives linked to several of their prioritized needs. In a final session, all 11 initiatives were presented and clarified. Two sets of initiatives were combined, leaving nine initiatives to be prioritized by assigning weighted values to them.

The nine initiatives developed by NNIWG addressed the following topics in descending order of priority:

- 1) Core informatics education
- 2) Advanced informatics preparation
- 3) Demonstration projects
- 4) Enhancement of clinical practice
- 5) Faculty preparation
- 6) Enhancement of community partnerships
- 7) Collaborative initiatives
- 8) Competencies for practicing nurses
- 9) Interdisciplinary academic-industry partnerships

Results of the prioritization were distributed to NNIWG members for feedback and comments. Based on input received, two additional sets of initiatives were combined and items were reworded. A list of five initiatives were submitted by the NNIWG to the NACNEP.

NACNEP reviewed the initiatives in April 1997 and approved them with minor changes. The National Agenda for Informatics in Nursing Education and Practice is presented in Section IV.

## SECTION IV: POLICY, ISSUES, GOALS, AND OPTIONS

The National Advisory Council on Nurse Education and Practice accepts the assumptions and initiatives proposed by NNIWG and recommends five informatics goals for nursing education and practice to the Secretary of Health and Human Services.

### Educate Nursing Students and Practicing Nurses in Core Informatics Content

**Issue:** The first priority in educating the nursing workforce is to include basic informatics skills and content in undergraduate, graduate, and continuing education nursing programs. Basic computing skills include the ability to use word processing, E-mail, spreadsheets, databases, bibliographic retrieval, the Internet, World Wide Web, and presentation graphics software. In addition, all nurses need to be competent in collecting and recording data, analyzing and interpreting information needed for patient care, using clinical information systems, and in implementing policies related to privacy, confidentiality, and security of information? Informatics content such as decision-making, information management, standard nomenclatures for nursing's language, and informatics roles should be integrated in nursing curricula. This knowledge will prepare nurses more adequately to collect and process health care information to make appropriate clinical and administrative decisions. Curricula content must reflect emerging information technologies.

**Policy Goal:** Federal resources should promote the inclusion of core informatics skills and knowledge leading to competency in nursing undergraduate, graduate, and continuing education programs.

#### **Policy Options:**

- 1) Provide funds to develop models to identify core informatics competencies, including those for emerging technologies.
- 2) Provide funds to disseminate information regarding core informatics knowledge and competencies appropriate for different levels of education through model curricula, identification of centers of excellence in informatics, and establishment of a clearinghouse.
- 3) Support strategies to create demand for including core informatics content in nursing education and practice.
- 4) Fund creative continuing education models, including partnerships among academia, corporations, and professional organizations, to provide core informatics content to practicing nurses.

- 5) Support employers in rewarding nurses for attending NI educational programs.

### Prepare Nurses with Specialized Skills in Informatics

**Issue:** The number of post-baccalaureate and post-master's certificate, master's and doctoral educational programs that prepare nurses with specialized informatics skills is limited. Most nurses who practice in NI have prepared themselves to work in the field through job experience, self-study, and continuing education programs. Although they have learned how to perform needed tasks, many lack the knowledge of informatics theory and principles required to develop technology solutions. More programs are needed to meet the demand for nurses with specialized informatics skills. Increasing the cadre of nurses with specialized informatics skills will facilitate the development of information technologies that can help improve patients' access to health care, involve patients in care decisions, and monitor the quality of care delivered, especially to underserved populations.

**Policy Goal:** Federal funds should support innovative nursing and health informatics programs that teach the specialized informatics skills needed to develop information technology supporting the Nation's health goals of providing accessible, high quality, and cost-effective care. Nursing informatics content should address competencies expected for the different levels of education, and across practice settings and disciplines.

#### **Policy Options:**

- 1) Support specialized areas within informatics programs such as language nomenclatures, consumer health informatics, tools for shared decision-making, distance learning strategies, and human computer interface design.
- 2) Encourage partnering with the health care industry to obtain information technology equipment, software, and technical support.
- 3) Support use of information technologies to develop regional consortia that teach NI specialty skills. Develop within these consortia sites of excellence for teaching specific content.
- 4) Support nurse participation in NLM informatics fellowships.
- 5) Support development of interdisciplinary programs that teach nurses informatics specialty skills.

### Enhance Nursing Practice and Education Through Informatics Projects

**Issue:** Informatics principles and technologies can significantly impact patients and providers in underserved areas. Technologies requiring further

analysis include: (1) telenursing/telehealth, (2) patient-specific clinical decision support systems, (3) electronic global health conferences, (4) virtual courses, (5) health information networks, (6) and devices. Information technologies are used increasingly to deliver care to underserved areas, but knowledge of their impact on care processes involving nurses is obscure. New models should be developed to describe patient-provider communications using electronic media, to determine optimal ways of presenting electronic information to patients, to demonstrate nursing's role in shared decision-making, to develop community centers as hubs for health education, to calculate the cost-effectiveness of various technologies, and to help disadvantaged populations connect to providers electronically.

**Policy Goal:** The Federal government should fund innovative, collaborative telecommunication projects that would enhance the quality of clinical practice for populations at risk and contribute to the education of health care providers.

**Policy Options:**

- 1) Fund the design, implementation, and evaluation of NI innovations that support community partnerships. Innovations include information technologies, devices, models, and processes. Partnerships could embrace communities, industries, schools, human service organizations, and care delivery systems.
- 2) Fund collaborative NI laboratories within an interdisciplinary and regional environment for providing simulated learning experiences to the underserved.
- 3) Support nurse-managed clinics and relevant interest groups to streamline information management across the patient's continuum of care.
- 4) Encourage collaboration among interdisciplinary professional organizations such as AMIA and HIMSS to identify centers of excellence that could be included in site visitation programs.
- 5) Support dissemination of information to consumers to educate them about the role of nurses as partners, facilitators, and information managers in the current health care environment.
- 6) Collaborate with the NLM and other Federal agencies to fund innovative informatics projects.
- 7) Fund national conferences for recipients of informatics grants to share successful projects, identify common problems, and provide mentorship. Within the conferences provide instruction in using technology to support ongoing electronic communication among the recipients, mentors, and DN.

## Prepare Nursing Faculty in Informatics

**Issue:** The number of nursing faculty who are prepared sufficiently to teach core informatics content to students and clinicians is inadequate. Inadequate faculty preparation is slowing the adoption of information technology as a basic nursing tool. Although exposure of the population as a whole to computers has increased dramatically, many nursing faculty continue to use computers only as word processors and fail to realize the potential of this technology to assist clinicians with information management. The changing academic environment and the teaching/learning paradigm shift to faculty facilitating information access requires faculty knowledge of telehealth, distance learning, and other information technologies.

**Policy Goal:** Federal resources should support increased nursing faculty preparation in informatics through the use of collaborative programs and technology.

**Policy Options:**

- 1) Support institutional collaborative strategies between the dean and faculty to share knowledge of core informatics content and development of information technology skills.
- 2) Target funds to explore use of collaborative agreements and other partnership mechanisms to determine best practices for faculty preparation in NI.
- 3) Fund consultations and demonstrations of informatics skills at meetings sponsored by the DN.
- 4) Fund collaborative efforts among schools of nursing to provide adequate computer support to each other.

## Increase Collaborative Efforts in Nursing Informatics

**Issue:** Collaborative efforts among health care providers are needed to provide resources for informatics in nursing education and practice. Although NI research priority areas were identified by NINR, funding in this area has been limited. To increase resources, funding agencies should be educated about the potential of NI to improve the access, cost, and effectiveness of care. Funding also can be increased by integrating NI into existing Federal programs, such as telehealth, managed care, and school health programs. Collaboration can help informatics nurses link with Federal and non-Federal programs that are funding resources. After funding sources are identified, collaborative efforts also are needed to help informatics nurses write successful grants.

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**Policy Goal:** Federal resources should facilitate the advancement of informatics in nursing through collaboration among public and private organizations.

**Policy Options:**

- 1) Support collaboration with governmental and non-governmental entities to identify and communicate research and evaluation needs in nursing and health informatics.
- 2) Support establishing a central information resource, such as a Web page, to link nurses to Federal informatics initiatives.
- 3) Fund collaboration with other Federal agencies to develop mechanisms to direct nurses to electronic inventories of informatics projects, such as the Federal Joint Workgroup on Telemedicine.
- 4) Support communication within the nursing community to disseminate results of NI research and development.
- 5) Fund workshops to assist nurses in writing successful grant applications that link NI, practice needs, and HRSA priorities.

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## **APPENDIX A**

### *Nursing Informatics Organizations*

#### **UNITED STATES NATIONAL ORGANIZATIONS REPRESENTING NURSING INFORMATICS**

##### **American Medical Informatics Association Nursing Informatics Working Group**

Area: United States  
Contact: American Medical Informatics Association  
4915 St. Elmo Avenue  
Suite 401, Bethesda, MD 20814  
301-657-1291  
mail @amia2.amia.org;  
<http://www.gl.umbc.edu/~abbott/nurseinfo.html>  
Carole Gassert, Chair, cgassert@hrsa.dhhs.gov

##### **American Nurses Association Council on Nursing Services and Informatics**

Area: United States  
Contact: American Nurses Association  
600 Maryland Avenue  
Suite 100 West, SW  
Washington, DC 20024-2571  
202-651-7000  
chelmlin@ana.org; <http://www.ana.org>  
Jacqueline Dienemann, Chair,  
jdienema@welchlink.welch.jhu.edu

##### **National League for Nursing Council on Nursing Informatics**

Area: United States  
Contact: National League for Nursing  
350 Hudson Street, New York, NY 10014  
800-669-1656, 212-989-9393  
nlainform@nlm.org; <http://www.nln.org>  
Ramona Nelson, Chair, ren@sruvm.sru.edu

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**REGIONAL AND LOCAL NURSING  
INFORMATICS SPECIAL INTEREST GROUPS  
IN THE UNITED STATES**

**American Nursing Informatics Association (ANIA)**

Area: Southern California  
Contact: Karen Lookabaugh, President,  
lookabaughk@csmc.edu  
Peggy Wetsch, President-Elect  
Roseanne Sullivan, Membership Chair

**Boston Area Nursing Informatics Consortium  
(BANIC)**

Area: Boston, MA and Vicinity  
Contact: Mimi Hassett (Chair), mhassett@world.std.com

**Capital Area Roundtable on Informatios in Nursing  
(CARING)**

Area: Maryland, Virginia, Washington, DC  
Contact: Sue Newbold (Subscriptions), 410-531-9244 (tel  
& fax), snewbold@umabnet.ab.umd.edu  
Kathleen Smith (Newsletter Editor), 703-998-4813,  
ksl963@erols.com  
Kelly Wenner (Treasurer), 301-564-1170,  
kwenner@fcgnet.com

**Computers in Healthcare Interfacing with Nursing  
(CHIN)**

Area: Connecticut  
Contact: Ann Bello (President), nk-bello@commnet.edu

**Delaware Valley Nursing Computer Network  
(DVNCN)**

Area: Delaware, New Jersey, and Pennsylvania  
Contact: Mary Ellen Sweeny (Executive Officer), 302-  
994-2511 x 4194, msweeny580@aol.com  
Anne M. Bird (Correspondence Officer), 609-384-2959  
James Cannon (Membership & Newsletter),  
610-566-8061, cannon2@aol.com

**Healthcare Informatics Forum of Eastern Virginia**

Area: Eastern Virginia and Northeast North Carolina  
Contact: Dana Hlusko, 757-594-3591,  
dhlusko@series2000.com

**Health Informatics of New Jersey (HINJ)**

Area: New Jersey  
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**Houston Area Nursing Informatics Group (HANIG)**

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Maryland Society for Healthcare Information  
Systems Management (MSHISM)  
Area: Maryland and surrounding area  
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**Michigan Nursing Informatics Network (MNIN)**

Area: Michigan, including Saginaw Bay City and  
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**Midwest Alliance for Nursing Informatics (MANI)**

Area: Illinois  
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**Midwest Nursing Research Society (MNRS) Nursing  
Informatics Research Section**

Area: Midwest  
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**Minnesota Nursing Informatics Group (MINING)**

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**Mobile Area Nursing Informatics**

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**New Jersey State Nurses Association Computer  
Forum on Nursing Informatics**

Area: New Jersey  
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**North Carolina State Nurses Association Council on  
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**Northern California Nursing Informatics Association  
(NCNIA)**

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**Nursing Information Systems Council of New England (NISCNE)**

Area: New England

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**Texas Nursing and Healthcare Informatics Association**

Area: DallasFort Worth

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**Tri-State Nursing Computer Network (TNCN)**

Area: Pennsylvania, Ohio, West Virginia

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**Utah Nursing Information Network (UNIN)**

Area: Utah

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Diana Willson, Co-chair

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**Western New York Nursing Informatics Group (WNYNIG)**

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**Wisconsin Computers in Nursing (WICAN)**

Area: Wisconsin

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## APPENDIX B

### *National Nursing Informatics Work Group Members*

#### MEMBERS OF THE NATIONAL NURSING INFORMATICS WORK GROUP

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