Informatics Competencies for Nurses at Four Levels of Practice

Nancy Staggers, PhD, RN, FAAN; Carole A. Gassert, PhD, RN, FAAN; and Christine Curran, PhD, RN, CNA

ABSTRACT

Valid and comprehensive nursing informatics (NI) competencies currently are lacking. Meanwhile, nursing leaders are emphasizing the need to include NI in nursing curricula, as well as within the roles of practicing nurses in all settings. This article presents the initial work of a team of NI experts toward development of a valid and reliable set of NI competencies. Previous work primarily has focused on computer-related skills, rather than examining a broad definition of informatics competencies. For this current work, NI competencies encompass all skills, not only computer-related skills, as well as knowledge and attitudes needed by nurses. The first two authors created a database of NI competencies from the existing literature. A larger panel of NI experts then affirmed, modified, added, or deleted competencies from this database. Competencies were placed into four distinct skill levels. Definitions of each skill level and an initial master list of competencies are provided.

Dr. Staggers is Associate Chief Information Officer, Information Technology Services, Salt Lake City, Utah; Dr. Gassert is Informatics Nurse Consultant, Division of Nursing, Bureau of Health Professions, Health Resources and Services Administration, Rockville, Maryland; and Dr. Curran is Assistant Professor and Director, Informatics Program, School of Nursing, Columbia University, New York, New York.

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Address correspondence to Nancy Staggers, PhD, RN, FAAN, Associate Chief Information Officer, Information Technology Services, 421 Wakara Way, Suite 204, Salt Lake City, UT 84108.

Health care leaders emphasize the need to include information technology and informatics concepts in nursing education (American Association of College of Nurses [AACN], 1997, 1998; Gassert, 1998; Pew, 1998). The Pew Health Professions Commission (1998) stated that the effective and appropriate use of communication and information technologies was one of 21 essential competencies needed by all health care professionals. A panel of national nursing informatics (NI) experts outlined strategic directions for nursing in 1996. One of the primary recommendations was to educate and prepare nursing students and practicing nurses in core NI competencies (Gassert, 1998). The American Association of Colleges of Nursing (AACN) (1997) affirmed that within the next decade all higher education in nursing must address priorities to include the management of data and technology. Recently, the 1999 American Medical Informatics Association's (AMIA) spring congress focused on education in health informatics and emphasized the need for consensus on health informatics competencies.

However, the integration of NI into nursing education in the United States has progressed slowly. Johnson (1995) found that computer literacy was the only emphasis area not addressed by the majority of accredited baccalaureate nursing programs. Two current studies indicate that NI integration into curricula has not improved. Carty and Rosenfeld (1998) conducted an empirical study and discovered that less than one third of nursing programs in the United States even addressed NI in their curricula. Austin (1999) reported that only three of 60 nursing computer literacy skills were being integrated into teaching practice by nursing faculty at a moderate or extensive level.

A few organizations have published guidelines about NI, information management, and information technology (IT). The AACN (1998) provided seven broad guidelines related to information and health care technologies. The American Nurses Association (ANA) defined the

scope of practice for NI (1994) and standards for the specialty (1995), but has not yet published comprehensive material about NI competencies for all nurses. The National League for Nursing (NLN) published nurses' informatics competencies recommended by a workgroup of nurses from the International Medical Informatics Association (IMIA) in 1988 to 1989 (Grobe, 1989; Peterson & Gerdin-Jelger, 1988). However, the competencies now need to be updated. In addition, the IMIA drafted broad guidelines in 1999 for health informatics competencies and informatics education. These guidelines have since been approved by the IMIA board.

Besides these general guidelines, numerous authors have published articles describing the specifics of needed nursing IT or NI skills (Armstrong, 1986; Bachman & Panzarine, 1998; Bryson, 1991; Carter & Axford, 1993; Lewis & Watson, 1997; Riley, 1996; Saba & Riley, 1997; Travis & Flatley-Brennan, 1998; Walker & Walker, 1994). However, authors do not agree about specific requirements for informatics nor the methods to integrate informatics into nursing curricula. Clearly, a current, comprehensive list of competencies to guide integration of NI into curricula is lacking.

Comprehensive informatics competencies would be valuable to the nursing profession for several reasons. The work on informatics competencies provides a foundation for determining educational needs for all nurses, while in formal programs and after completion. Also, competencies are useful for describing nurses' preparation in roles within practice, education, administration, and research (Grobe, 1989). Last, informatics competencies will be useful for developing nursing and health curricula and job descriptions, and managing the expectations of potential employers and health care consumers (Staggers & Gassert, 2000).

The purpose of this article is to describe the authors' research-based approach for determining comprehensive NI competencies for RNs. Four levels of practice—beginning nurse, experienced nurse, informatics specialist, and informatics innovator—are proposed. After describing the existing literature on NI competencies, the methods for deriving and developing NI competencies will be outlined. Last, an initial master list of competencies is offered.

LITERATURE REVIEW

Despite the slow progress of informatics integration into nursing, informatics competencies have been discussed in the literature since the early 1980s. However, the literature review in this article is limited to the past 15 years. Competencies before that time are less likely to include fundamental concepts such as personal computing skills, nursing informatics specialist activities, and clinical information systems uses.

The more frequently cited publications about NI competencies were completed more than 12 years ago by nursing members of the IMIA (Grobe, 1989; Peterson & Gerdin-Jelger, 1988). The task force defined three levels

of competencies (i.e., user, developer, expert) and developed informatics competencies according to these levels. Unfortunately, this foundational work was not research based, it was never validated beyond the work group members, and the competencies are now dated because they do not include contemporary advances in the field.

Authors do not agree about the general composition of NI competencies. Some emphasized computer literacy skills (Lewis & Watson, 1997; Walker & Walker, 1994, 1995), while others concentrated on information resources (Verhey, 1999), a combination of NI knowledge and technology skills (Armstrong, 1986; Bryson, 1991), or patient-centered information (Travis & Flatley-Brennan, 1998).

Several authors outlined methods for integrating informatics or computer literacy into nursing curricula (Riley, 1996; Vanderbeek & Beery, 1998). Descriptive articles such as these are especially useful to the two thirds of nursing programs without informatics, but because there is not yet agreement about informatics competencies for undergraduates, nursing programs are defining NI curricula uniquely. San Francisco State University concentrated on the retrieval, evaluation, and use of current information resources, such as CINAHL journal articles (Verhey, 1999). Georgetown University integrated general computer literacy, such as word processing, databases, spreadsheets, Internet use, and bibliographic retrieval, throughout the baccalaureate level (Riley, 1996). At the graduate level, students learned other concepts, such as nursing vocabularies. Case Western Reserve University focused on clinical nursing information needs for acute and critical care nursing at the baccalaureate level (Travis & Flatley-Brennan, 1998). Travis and Flatley-Brennan (1998) used the concepts of information, technology, and clinical care processes to develop a patient-centered approach to informatics integration.

Empirical Studies of NI Competencies

A number of studies examined aspects of NI competencies for nurses in academic programs. Armstrong (1986) used a two-round Delphi technique and a panel of 55 to 56 educators to determine present and future needs for computer competence in nursing practice and teaching. Present needs were developed using literature from 1975 to 1985. Future requirements were determined by polling computer technology representatives and nurse researchers. The resulting lists included psychomotor, cognitive, and affective competencies in the areas of:

- Knowledge of computer technology.
- The nurse's role and issues with computers.
- Development of computerized documentation.

As part of his doctoral work, completed in 1989, Bryson (1991) investigated nurse educators' perceptions about the amount and kinds of computer training that should be included in baccalaureate programs. An expert panel of NI educators and health software developers created a questionnaire consisting of instructional objectives. A random sample of 110 nurse educators then agreed or dis-

agreed with the items. The results were organized by seven computer literacy domains, which were defined by a computer consortium and included knowledge, attitudes, and computer skills about:

- Basic computer hardware and software.
- How a computer operates.
- Understanding the concepts of programming (but not actually programming courses).

Gassert and MacDowell (1995) conducted a study to determine whether faculty needed to continue teaching basic computer skills to undergraduate and graduate students. They developed an instrument using students' self-report of computing skills (e.g., word processing, database design), skills throughout the systems life cycle (e.g., systems analysis), and other skills (e.g., typing). The authors found a low level of computer literacy and continued to teach these skills (Gassert & MacDowell, 1995).

Austin (1999) evaluated nurse educators' perceptions of competence in 60 computer literacy skills and the integration of these skills into baccalaureate programs. The authors used Bryson's (1991) competencies but updated the list with three items for computer-mediated communication and multimedia presentations. The sample of 184 nurse educators stated that 21 of the 60 skills were being performed at least "well" by 50% of respondents. However, only 3 of the 60 skills were being integrated into teaching by 50% of the sample.

Verhey (1999) evaluated an undergraduate program that integrated information literacy into the curriculum. Students reported positive results for skills in bibliographic retrieval (e.g., use of CINAHL, use of a local library, comfort level with using journal literature), but they did not perceive they had better knowledge of information resources. Faculty assessments of students' capabilities for evaluating information remained the same from 1992 to 1996.

Graveley, Lust, and Fullerton (1999) evaluated a self-report of undergraduate nurses' computer literacy before and after computer skills training. The authors developed an instrument to assess computer literacy based on the work of Gassert and McDowell (1995) and Staggers (1994). Using paired *t* tests, Graveley et al. (1999) reported significant differences in students' overall use of the computer, word processing, the Internet, spreadsheets, and PowerPoint.

Bachman and Panzarine (1998) assessed the impact of an Internet course on 20 RN-to-MSN students. Of interest is that the authors developed an instrument with 13 computer uses such as word processing, searching the Internet for health information, transferring files, and e-mail. The authors found that students taking an Internet course reported increased computer use, knowledge, and skills. However, this innovative course's evaluation is limited by its nonexperimental design and the students' knowledge that this new course was being evaluated extensively.

Outside formal nursing programs, Carter and Axford (1993) studied the computer learning needs of bedside nurses. Nursing informatics experts in Australia developed 71 knowledge and skill items they thought nurses needed. The authors then surveyed 96 clinical nurses (computer experts and novices) who agreed that only one area was essential—practical knowledge and skills for computer operations.

Last, Staggers (1994) developed an instrument to measure nurses' computer experience. The 43-item tool assessed:

- Computer knowledge and uses.
- Hospital information knowledge and uses.
- NI specialist role activities.
- Informatics or computer courses taken.

Psychometric parameters for the instrument are reported elsewhere (Staggers, 1994). The instrument has been requested widely within the nursing field, as well as outside the discipline.

Seven of the nine empirical studies addressed faculty's or students' needs in formal nursing programs, five at the baccalaureate level and two at the undergraduate and graduate level. Carter and Axford's (1993) study is the only investigation of bedside clinical nurses, although it was conducted in Australia. Clearly, practicing nurses in the United States are an understudied group. In all studies, computer literacy concerns were the most frequently studied topic. Empirical studies about nurses' informatics knowledge and skills have yet to be reported.

Comprehensive sets of skills and competencies were developed and validated by Armstrong (1986), Bryson (1991), and Staggers (1994). Armstrong (1986) and Bryson (1991) included elements for skills, knowledge, and attitudes, a method consistent with competency definitions (Butler, 1978; May, Edell, Butell, Doughty, & Langford, 1999; Staggers & Gassert, 2000). However, their measures need to be updated. Staggers' (1994) instrument, revised in 1998, defined the depth and breadth of nurses' computer experience to include skills and knowledge needed by informaticists but does not include the attitudinal measures more reflective of competency assessments.

Across publications, authors seldom discussed the knowledge all nurses should have about informatics, such as privacy and confidentiality issues. Perhaps because several authors concentrated on competencies for nurses at the baccalaureate level, the special knowledge and skills nurse informaticists require (e.g., techniques in systems analysis, system selection, evaluation of system impacts) are only acknowledged by two NI authors (Gassert & McDowell, 1995; Staggers, 1994). Informatics knowledge and skills for doctorally prepared informaticists were notably absent. More important, no publications addressed comprehensive competencies for the range of nurses from baccalaureate to doctoral levels or from novice to expert.

Of the multitude of publications about NI competencies in curricula, few reported research-based competency development. In fact, the publications reviewed in this article built less on each other than was anticipated. With

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TABLE 1
Definitions of Four Levels of Practicing Nurses

Beginning Nurse

- Has fundamental information management and computer technology skills.
- Uses existing information systems and available information to manage practice.

Experienced Nurse

- Has proficiency in a domain of interest (e.g., public health, education, administration).
- Highly skilled in using information management and computer technology skills to support their major area of practice.
- Sees relationships among data elements and makes judgments based on trends and patterns within these data.
- Uses current information systems but collaborates with the informatics nurse specialist to suggest improvement to systems.

Informatics Nurse Specialist

- An RN with advanced preparation possessing additional knowledge and skills specific to information management and computer technology.
- Focuses on information needs for the practice of nursing, which includes education, administration, research, and clinical practice.
- Practice is built on the integration and application of information science, computer science, and nursing science.
- Uses the tools of critical thinking, process skills, data management skills (including identifying, acquiring, preserving, retrieving, aggregating, analyzing, and transmitting data), systems development life cycle, and computer skills.

Informatics Innovator

- Educationally prepared to conduct informatics research and generate informatics theory.
- Has a vision of what is possible and a keen sense of timing to make things happen.
- Leads the advancement of informatics practice and research.
- Functions with an ongoing, healthy skepticism of existing data management practices and is creative in developing solutions.
- Possesses a sophisticated level of understanding and skills in information management and computer technology.
- Understands the interdependence of systems, disciplines, and outcomes, and can finesse situations to maximize outcomes.

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the exception of Austin (1999) and Graveley et al. (1999), authors typically described unique programs and NI competencies. For example, the research-based work of Armstrong (1986) and Bryson (1991) has been available for many years, but the adoption of their work into curricula is not evident in the literature. Therefore, competencies from the literature seemed to guide curricular development and researchers less than expected.

The current study builds on the previous work of other authors by inductively deriving competencies from the existing literature and then developing competencies where gaps were discovered. Because available literature from 1986 to 1998 was used to extract competencies, the result of this work was a comprehensive description of NI competencies. Competencies go beyond computer literacy skills to the sets of skills, knowledge, attitudes, and perceptions nurses need. Additionally, NI competencies are determined for nurses at different levels of educational preparation and experience.

DETERMINING NURSING INFORMATICS COMPETENCIES

Nursing Informatics Competency Definition

Among the studies reviewed, different terms were used to express informatics requirements (e.g., computer skills, computer literacy, computer competence, informatics, information literacy, information technology needs). Concentrating only on technology or computer literacy was deemed too narrow a focus for determining informat-

ics requirements. Therefore, for this study, the definition of competencies was the integration of knowledge, skills, and attitudes in the performance of various nursing informatics activities within prescribed levels of nursing practice (Staggers & Gassert, 2000).

Study Methods and Results

To begin the process of determining competencies, initial NI competencies were abstracted from 35 articles published from 1986 to 1998 and from 14 job descriptions from practicing nurse informaticists in the Washington, DC, area. The resulting database included 1,159 items. These initial competencies were reviewed by the first two authors of this article (N.S., C.A.G.) and NI experts, and were classified into inductively derived categories for consolidation. For example, one competency was "employ an authoring language to develop computer-assisted instruction." This item was labeled computer-assisted instruction (CAI).

After all items were categorized similarly, the categories then were used to sort initial competencies in a database and to eliminate redundant items. During this process, three broad categories emerged—computer skills, informatics knowledge, and informatics skills. These broader categories were conceptually divided into 22, 10, and 25 subcategories, respectively, as suggested by the competency statements. The schema facilitated consolidation of obviously duplicative competency statements. The resulting list included 313 unique items after consolidation.

In November 1998, 26 members of the AMIA Nursing Informatics Working Group were invited to help validate the 313 unique items as important to NI practice. Participants were asked to indicate with a "yes" or "no" whether items reflected NI practice. Many found the decision difficult, particularly without a context. Therefore, results of the survey were unusable.

Subsequently, an expert panel with national representation was convened in December 1998 to develop and refine these NI competencies. Members included doctorally prepared NI representatives from academia and service sectors:
- New York University (Barbara Carty, EdD, RN).
- Division of Nursing, Department of Health and Human Services (Carole Gassert, PhD, RN).
- Penn State Geisinger Health System (Christine Curran, MSN, RN, CNA, doctoral candidate at the University of Maryland).
- Slippery Rock University (Ramona Nelson, PhD, RN).
- University of Utah (Rita Snyder-Halpern, PhD, RN, and Nancy Staggers, PhD, RN).

Dr. Staggers and Dr. Gassert led the development effort and coordinated it with the AMIA Nursing Informatics Working Group.

The expert panel initially began validating the 313 competencies. However, the members discovered that they were unable to progress without defining a nursing context for the competencies. Therefore, the group defined four levels of nurses—beginning nurse, experienced nurse, informatics specialist, and informatics innovator. See Table 1 for the definitions created for these nurse levels.

To begin to achieve consensus about competencies by nurse level, each panel member separately rated all competencies. An 80% level was established as the threshold for agreement about an item. Items outside that range were discussed and either clarified and leveled, or eliminated. Only a few competencies were eliminated because they clearly were outdated (e.g., skills in using a fax machine). Several others that were eliminated did not address competencies specific to informatics but were generic to nursing (e.g., practices according to the Code for Nurses).

After leveling, the panel noted that the informatics innovator category was underdeveloped. Competencies were created to describe the informatics innovator. A matrix then was developed to identify categories of statements across the levels of nurses.

Using consensus among expert panel members, subcategories were collapsed as appropriate (Table 2). Not surprisingly, more informatics knowledge and skills are required for the informatics specialist than for other levels of nurses. With the matrix completed, the panel reworded competencies across levels to reflect the increases in complexity from beginner to innovator. Bloom's taxonomy (cited in Waltz, Strickland, & Lenz, 1984) was used to determine appropriate verbs for each level. The list of the 304 competencies agreed on by the

TABLE 2
Categories of Informatics Competencies

Categories	Level 1: Beginning Nurse	Level 2: Experienced Nurse	Level 3: Informatics Specialist	Level 4: Informatics Innovator
COMPUTER SKILLS				
Administration	✓	✓	—	—
Communication	✓	—	—	—
Data access	✓	✓	—	—
Decision support	✓	—	—	—
Documentation	✓	—	—	—
Education	✓	✓*	—	—
Monitoring	✓	✓	—	—
Basic desktop software	✓	✓	✓	—
Systems	✓	✓	✓	—
Quality improvement	—	✓	✓	✓
Research	—	✓	—	—
CASE† tools	—	—	✓	—
Project management	—	—	✓	—
Simulation	—	—	✓	✓
INFORMATICS KNOWLEDGE				
Data	✓	✓	✓	—
Impact	✓	✓	✓	✓
Privacy/security	✓	✓	—	—
Systems	✓	✓	✓	—
Education	—	✓	✓	✓
Research	—	✓	—	—
Usability/ergonomics	—	—	✓	—
Regulations	—	—	✓	—
INFORMATICS SKILLS				
Evaluation	—	✓	✓	✓
Role	—	✓	✓	—
Analysis	—	—	✓	✓
Data structures	—	—	—	✓
Design/development	—	—	✓	✓
Fiscal management	—	—	✓	—
Implementation	—	—	✓	—
Management	—	—	✓	✓
Privacy/security	—	—	✓	—
Programming	—	—	✓	—
Requirements	—	—	✓	—
Systems maintenance	—	✓	✓	—
System selection	—	—	✓	—
Testing	—	—	✓	—
Research (funding)	—	—	—	✓
Training	—	—	✓	—
Education	—	—	—	✓

* Computer-assisted instruction.
† Computer-assisted software engineering tools.

expert panel is listed in the Appendix beginning on page 309.

CONCLUSION

This work builds on efforts of NI researchers and presents a comprehensive list of informatics skills and knowledge for nurses at four levels of practice. The next step in validating these NI competencies will be to conduct a study using a Delphi technique with a large sample of experienced NI nurses. Funding for the effort was obtained from the University of Utah College of Nursing. The project was completed in the fall of 2001.

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APPENDIX
Expert Panel Nursing Informatics Competencies

Level 1: Beginning Nurse

COMPUTER SKILLS: ADMINISTRATION
1. Uses administrative applications for practice management (e.g., searches for patient, retrieves demographics, billing data).
2. Uses applications for structured data entry (e.g., patient acuity, classification applications)

COMPUTER SKILLS: COMMUNICATION
3. Uses telecommunication devices (e.g., modems, other devices) to communicate with other systems (e.g., access data, upload, download).
4. Uses e-mail (e.g., create, send, respond, use attachments).
5. Locates and evaluates patient support groups or chat rooms on the Internet.
6. Uses the Internet to locate and download items of interest (e.g., patient or nursing resources).

COMPUTER SKILLS: DATA ACCESS
7. Uses sources of data that relate to practice and care.
8. Accesses, enters, and retrieves data used locally for patient care (e.g., uses Hospital Information System and Clinical Information System for plans of care, assessments, interventions, notes, discharge planning).
9. Uses a database management program to develop a simple database and/or table.
10. Uses database applications to enter and retrieve information.
11. Conducts on-line literature searches.

COMPUTER SKILLS: DECISION SUPPORT
12. Uses decision support systems, expert systems, and aids for clinical decision making or differential diagnosis.

COMPUTER SKILLS: DOCUMENTATION
13. Uses an application to document patient care.
14. Uses an application to plan care for patients to include discharge planning.
15. Uses an application to enter patient data (e.g., vital signs).

COMPUTER SKILLS: EDUCATION
16. Uses computer-assisted instruction (CAI).
17. Uses information management technologies for patient education (e.g., identifies areas for instruction, conducts education, evaluates outcomes, resources).

COMPUTER SKILLS: MONITORING
18. Uses computerized patient monitoring systems.

COMPUTER SKILLS: BASIC DESKTOP SOFTWARE
19. Uses presentation graphics (e.g., PowerPoint) to create slides, displays.
20. Uses multimedia presentations.
21. Uses word processing.
22. Demonstrates keyboarding (i.e., typing) skills.
23. Uses spreadsheets.

COMPUTER SKILLS: SYSTEMS
24. Uses networks to navigate systems (e.g., file servers, World Wide Web).
25. Operates peripheral devices (e.g., bedside terminals, hand-helds).
26. Uses operating systems (e.g., copy, delete, change directories).
27. Uses existing external peripheral devices (e.g., CD-ROMs, zip drives).
28. Uses computer technology safely.
29. Is able to navigate Windows (e.g., manipulate files using file manager, determine active printer, access installed applications, create and delete directories).
30. Identifies the appropriate technology to capture the required patient data (e.g., fetal monitoring device).
31. Demonstrates basic technology skills (e.g., turn computer off and on, load paper, change toner, remove paper jams, print documents).

INFORMATICS KNOWLEDGE: DATA
32. Recognizes the use and/or importance of nursing data for improving practice.

INFORMATICS KNOWLEDGE: IMPACT
33. Recognizes that a computer program has limitations due to its design and capacity of the computer.
34. Recognizes that it takes time, persistent effort, and skill for computers to become an effective tool.
35. Recognizes that health computing will become more common.
36. Recognizes that the computer is only a tool to provide better nursing care and that there are human functions that cannot be performed by computer.
37. Recognizes that one does not have to be a computer programmer to make effective use of the computer in nursing.

APPENDIX (CONTINUED)
Expert Panel Nursing Informatics Competencies

Level 1: Beginning Nurse (Continued)

INFORMATICS KNOWLEDGE: IMPACT (Continued)
38. Describes the computerized or manual paper system that is present.
39. Explains the use of networks for electronic communication (e.g., Internet).
40. Identifies the basic components of the current computer system (e.g., features of a personal computer, workstation).

INFORMATICS KNOWLEDGE: PRIVACY/SECURITY
41. Seeks available resources to help formulate ethical decisions in computing.
42. Describes patients' rights as they pertain to computerized information management.

INFORMATICS KNOWLEDGE: SYSTEMS
43. Recognizes the value of clinicians' involvement in the design, selection, implementation, and evaluation of applications and systems in health care.

Level 2: Experienced Nurse

COMPUTER SKILLS: ADMINISTRATION
44. Uses administrative applications for forecasting.
45. Uses administrative applications for budget.
46. Uses applications to manage aggregated data.
47. Uses administrative applications for staff scheduling.
48. Uses administrative applications for maintaining employee records.
49. Uses applications for diagnostic coding.

COMPUTER SKILLS: EDUCATION
50. Uses applications to develop testing materials.
51. Uses applications for curriculum planning.
52. Uses authoring tools to develop CAI for students, nurses, and/or patients.
53. Evaluates CAI as a teaching tool.

COMPUTER SKILLS: DATA ACCESS
54. Accesses shared data sets.
55. Extracts data from clinical data sets.
56. Extracts selected literature resources and integrates them to a personally usable file.

COMPUTER SKILLS: MONITORING
57. Applies monitoring system appropriately according to the data needed.

COMPUTER SKILLS: QUALITY IMPROVEMENT
58. Uses data and statistical analyses to evaluate practice and perform quality improvement.

COMPUTER SKILLS: RESEARCH
59. Uses computer applications for statistical analysis and nursing research.

COMPUTER SKILLS: BASIC DESKTOP SOFTWARE
60. Uses desktop publishing.

INFORMATICS KNOWLEDGE: DATA
61. Supports efforts toward development and use of a unified nursing language.
62. Promotes the integrity of nursing information and access necessary for patient care within an integrated computer-based patient record.
63. Provides for efficient data collection.

INFORMATICS KNOWLEDGE: RESEARCH
64. Describes general applications available for research.

INFORMATICS KNOWLEDGE: IMPACT
65. Defines the impact of computerized information management on the role of the nurse.

INFORMATICS KNOWLEDGE: PRIVACY/SECURITY
66. Discusses the principles of data integrity, professional ethics and legal requirements.
67. Describes ways to protect data.

INFORMATICS KNOWLEDGE: SYSTEMS
68. Describes general applications to support administration (e.g., staffing, budget).
69. Describes general applications and systems to support clinical care.

APPENDIX (CONTINUED)
Expert Panel Nursing Informatics Competencies

Level 2: Experienced Nurse (Continued)

INFORMATICS KNOWLEDGE: SYSTEMS (Continued)
70. Describes general applications to support nursing education.
71. Discusses CAI as a teaching and learning tool.

INFORMATICS SKILLS: EVALUATION
72. Assesses the accuracy of health information on the Internet.
73. Assists patients to use databases to make informed decisions.

INFORMATICS SKILLS: ROLE
74. Participates in influencing the attitudes of other nurses toward computer use for nursing practice.
75. As a clinician (nurse), participates in the selection process, design, implementation, and evaluation of systems.
76. Acts as an advocate of system users including patients or clients.
77. Markets self, system, or application to others.

INFORMATICS SKILLS: SYSTEMS MAINTENANCE
78. Performs basic trouble-shooting in applications.

Level 3: Informatics Specialist

COMPUTER SKILLS: BASIC DESKTOP SOFTWARE
79. Develops or modifies spreadsheets used for complex problems.
80. Discusses the mathematical models underlying the fiscal management system or spreadsheet.
81. Writes macros and shortcuts for spreadsheets.

COMPUTER SKILLS: CASE TOOLS
82. Applies computer-assisted software engineering (CASE) tools.

COMPUTER SKILLS: PROJECT MANAGEMENT
83. Manages projects with project management software.

COMPUTER SKILLS: QUALITY IMPROVEMENT
84. Determines indicators used to monitor quality and effectiveness of nursing informatics practice.
85. Collects data to monitor quality and effectiveness of nursing informatics practice.
86. Determines aspects of nursing informatics practice important for quality monitoring.

COMPUTER SKILLS: SIMULATION
87. Applies simulation models.

COMPUTER SKILLS: SYSTEMS
88. Has the ability to integrate different applications or programs.
89. Uses utility programs for data recovery and system performance indices.

INFORMATICS KNOWLEDGE: DATA
90. Demonstrates fluency in informatics and nursing terminologies.
91. Supports integration of a unified nursing language with the standardized language developed in collaboration with other health care disciplines.
92. Recognizes the capacity for data aggregation and integration.

INFORMATICS KNOWLEDGE: EDUCATION
93. Implements and evaluates application/system training programs for users and clients.
94. Plans and develops application/system training programs for users and clients.
95. Constructs guidelines for the purchase of software and hardware.
96. Participates with practicing nurses, nurse administrators, and nurse researchers to define and develop new computer competencies.
97. Teaches users and clients about effective and ethical uses of applications and systems.
98. Serves as an informational resource person for applications/system.

INFORMATICS KNOWLEDGE: IMPACT
99. Determines the impact of computerized information management on managers and executive roles.
100. Interprets current legislation, research, and economics affecting computerized information management in health care.
101. Assesses current capabilities and limitations of technology (e.g., data transfer rates, chip capacity).
102. Determines projected impacts to users and organizations when changing to computerized information management.
103. Determines the reasons for slow response time (e.g., heavy demands on computer system at time of shift change).
104. Discusses new careers available to informaticists.
105. Determines the social, legal, and ethical impacts of changing to computerized information management.

APPENDIX (CONTINUED)
Expert Panel Nursing Informatics Competencies

Level 3: Informatics Specialist (Continued)

INFORMATICS KNOWLEDGE: IMPACT (Continued)
106. Discusses the interdependencies computerized information management creates (e.g., changes when doctor enters own orders).
107. Determines the limitations and reliability of computerized patient monitoring systems.
108. Applies strategies for change management to produce satisfied and productive users.
109. Determines the impact of information management technologies on therapeutic outcomes and quality of care.
110. Discusses the computer's effect on cost of health care.
111. Interprets the benefits and risks of computerized information management.
112. Interprets research findings about the impact of computerized information management on clinical practice, educational, administration, and research.
113. Analyzes the impacts of information management technologies on time allocation and tasks of care.
114. Interprets the impact of computerized information management on nursing education.

INFORMATICS KNOWLEDGE: PRIVACY/SECURITY
115. Interprets copyright issues in computing.
116. Discusses features, capabilities, and scope of user passwords.
117. Devises strategies to protect the confidentiality of computerized information.
118. Differentiates issues surrounding confidentiality in computerized information management.

INFORMATICS KNOWLEDGE: REGULATIONS
119. Incorporates relevant law and regulations into informatics practice.

INFORMATICS KNOWLEDGE: SYSTEMS
120. Explains various input and output devices.
121. Applies theories that influence computerization in health care.
122. Discusses computer fundamentals (e.g., hardware, software, networks, data communications).
123. Projects health care computing trends in nursing.
124. Evaluates applications/systems available in health care.
125. Differentiates significant highlights in the evolution of computer technology.
126. Interprets capabilities and limitations of hardware, interfaces and their relationship to the outcomes of health computing.
127. Demonstrates extensive knowledge of the applications/systems currently in use.
128. Discusses concepts and uses of robotics.
129. Constructs resources to support users.
130. Discusses general knowledge of computer theory and terminology.
131. Recognizes viruses and other system risks.
132. Discusses broad knowledge of other available hardware and software.
133. Devises strategies to involve clinicians in the design, selection, implementation, and evaluation of applications and systems in health care.
134. Discusses current applications available to support clinical care.
135. Recognizes computerized diagnosis equipment (e.g., computed tomography scan, magnetic resonance imaging, digital imaging).
136. Discusses concepts of telemedicine and Internet and their relationship to nursing.
137. Discusses bedside terminals and associated issues. such as use in sterile environments.
138. Conducts site visits of health information systems in actual use.
139. Recommends who generates, owns, and uses nursing and other data.
140. Interprets the current and projected future state of physiological monitoring.

INFORMATICS KNOWLEDGE: USABILITY
141. Analyzes the health and safety aspects of a workstation and its location.
142. Applies human factors and ergonomics to the design of the computer screen, location and design of devices, and design of software.

INFORMATICS SKILLS: ANALYSIS
143. Analyzes and refines work plans and site methodologies.
144. Constructs data elements appropriate to a given practice context.
145. Applies principles and techniques of systems analysis.
146. Discusses functional areas and how they interact with the area of interest.
147. Analyzes current computerized information and recommends enhancements.
148. Analyzes business practices to determine need for reengineering.
149. Applies principles of computing (e.g., reading an algorithm).
150. Analyzes user areas to determine procedural errors versus hardware and software problems.
151. Interprets information flow within the organization.
152. Modifies existing applications, devices to meet changing requirements.

APPENDIX (CONTINUED)
Expert Panel Nursing Informatics Competencies

Level 3: Informatics Specialist (Continued)

INFORMATICS SKILLS: ANALYSIS (Continued)
153. Conducts feasibility assessments throughout the information systems life cycle.
154. Prepares process flow charts to describe current and proposed information flows for all aspects of clinical systems.
155. Analyzes organizations to determine policies affecting information flow.
156. Determines problems and impediments in installing computerized information management.

INFORMATICS SKILLS: DATA
157. Constructs data structures and maintains data sets.
158. Applies data structure concepts in designing a database system.
159. Determines relationships among tables in databases and performs tasks such as database normalization.
160. Integrates nursing taxonomies, unified nomenclatures, and other data needed by nurses within database design.
161. Develops procedures to establish and maintain the validity and integrity of data and databases.
162. Modifies available software programs to support data aggregation and analyses.
163. Alters a defined data structure to interface with another data structure.
164. Manages central facilities to enable data sharing.

INFORMATICS SKILLS: DESIGN AND DEVELOPMENT
165. Develops screen layouts, report formats, and custom views of clinical data working directly with clinical departments and individual users.
166. Consults in the design or enhancements to integrated patient information, management, educational, or research systems.
167. Modifies the available software programs to support data analysis.
168. Participates in the development of new methods or in making modifications to improve the efficiency and/or effectiveness of data storage and its communication.
169. Coordinates the development of integrated computer-based patient record technologies.
170. Maintains database (e.g., adding, deleting fields, structuring input for others, relational database).
171. Incorporates established data and database management standards into database design.
172. Participates in the development of new tools for management purposes.
173. Develops methods of data communication, hardware and software integration, and data transformation.
174. Develops database structures to support clinical care, education, administration, or research.
175. Applies concepts of nursing theory and research to the design of health information applications and systems.
176. Develops databases to facilitate clinical care, education, administration, or research.
177. Develops new ways to interact with information technology and access data.
178. Assists in the development of computer applications to meet clinical, education, administration, and research requirements.
179. Applies skills in the systems life cycle to support all computer-enabled patient care activities.

INFORMATICS SKILLS: EVALUATION
180. Evaluates network capacity.
181. Evaluates existing technologies for cost effectiveness.
182. Evaluates data storage capacities of the system in use.
183. Assures that information systems used in the organization comply with standards set forth by external licensing, accreditation, and regulatory agencies.
184. Evaluates hardware, software, and vendor support.
185. Participates on interdisciplinary teams that evaluate nursing informatics practice or health informatics services.
186. Analyzes the system in use.

INFORMATICS SKILLS: FISCAL MANAGEMENT
187. Develops strategies to obtain funding for information systems.
188. Uses strategies to optimize application use after implementation (benefits realization).
189. Participates in budget activities for the procurement and maintenance of the system.
190. Determines the costs and benefits of computer technology used in practice, education, administration, and/or research.

INFORMATICS SKILLS: IMPLEMENTATION
191. Leads or participates in user groups during all phases of the systems life cycle.
192. Devises strategies for installing applications/systems.
193. Develops implementation plans and marketing materials.
194. Distinguishes implementation phases (i.e., preimplementation, implementation, postimplementation).
195. Applies installation tools during implementation.
196. Develops information management plans and/or work plans to support the systems life cycle.
197. Applies appropriate implementation strategies.
198. Manages the installation process.

APPENDIX (CONTINUED)
Expert Panel Nursing Informatics Competencies

Level 3: Informatics Specialist (Continued)

INFORMATICS SKILLS: IMPLEMENTATION (Continued)

199. Recognizes opportunities for applying information management technologies to clinical practice, education, administration, and/or research situations.
200. Devises strategies to encourage interdisciplinary use of computerized information management.

INFORMATICS SKILLS: MANAGEMENT

201. Manages terms and conditions of a contract with an information systems vendor.
202. Develops a plan for limited resources (e.g., costs, staffing, equipment).
203. Determines project scope, objectives, and resources for each proposed application, system or enhancement.
204. Develops system testing, implementation, conversion, and backup plans.
205. Develops a strategic or long-range plan for the management of applications and systems.
206. Develops policies, procedures, and guidelines based on research.
207. Develops policies and procedures related to information systems implementation, use, and maintenance.
208. Escalates client issues and problems to the next available level of management when appropriate.
209. Communicates progress of project to appropriate personnel.
210. Applies principles and concepts of project management.
211. Functions as a project manager.

INFORMATICS SKILLS: PRIVACY/SECURITY

212. Develops policies related to privacy, confidentiality, and security of patient and client data.
213. Recommends procedures for achieving data integrity and security.
214. Analyzes the capability of information technology to support programs of data integrity and security.

INFORMATICS SKILLS: PROGRAMMING

215. Identifies the more common programming languages in use today.
216. Writes an original computer program and modifies it.
217. Determines the characteristics of a good computer program.
218. Applies principles of computer programming in order to communicate with software developers.
219. Differentiates between machine and high-level programming languages.

INFORMATICS SKILLS: REQUIREMENTS

220. Determines priorities for new requirements within budget constraints.
221. Modifies information technologies to meet changing data requirements and needs.
222. Determines new requirements according to the needs of the organization.
223. Demonstrates skills in the systems life cycle to support policies, procedures and knowledge bases related to decision making.
224. Includes client needs in requirements development.
225. Develops requirements for an integrated clinical, education, administration and/or research applications.
226. Communicates informatics needs to a systems analyst.
227. Performs needs assessment for future requirements.

INFORMATICS SKILLS: ROLE

228. Influences change to improve the impact of informatics on the system of care.
229. Designs strategies to manage the impact of change to information systems implementation.
230. Consults about informatics with clinical, managerial, educational, and/or research entities.
231. Develops collegial relationships with information system technical support personnel.
232. Serves as a liaison among agency departments and vendors.
233. Collaborates with nursing personnel and interdisciplinary teams to accomplish information management work.
234. Promotes understanding and effective use of information technology.
235. Makes formal presentations of project findings, recommendations, and specifications to user department managers, supervisors, and/or administrators.
236. Recommends changes in health informatics practice based upon evaluation data from nursing informatics (e.g., a validated severity of illness instrument).
237. Recommends policies and procedures to improve the quality of nursing informatics practice.
238. Implements activities to enhance the quality of nursing informatics practice.
239. Develops recommendations to improve nursing informatics practice or outcomes.
240. Acts as a liaison to support communication among providers, patient, and technical communities.
241. Uses software tools as appropriate during the systems life cycle.
242. Provides backup support to installation personnel as required.
243. Uses knowledge of patient care processes and nursing to plan, develop, purchase, implement, maintain, and evaluate applications/systems.

APPENDIX (CONTINUED)
Expert Panel Nursing Informatics Competencies

Level 3: Informatics Specialist (Continued)

INFORMATICS SKILLS: ROLE (Continued)
244. Maintains a system perspective that encompasses the entire organization.
245. Integrates knowledge from one area to another to improve patient care, administration, education, and/or research.
246. Participates in top level decisions and policy design which impact clinical information management.
247. Conducts research to examine impacts of computer technology in nursing.
248. Conducts research to determine application needs in clinical care, education, administration, and research.
249. Conducts research in informatics.
250. Disseminates new knowledge by informing colleagues of new developments and applications in nursing or health care informatics.
251. Contributes to informatics education of students, peers and colleagues.

INFORMATICS SKILLS: SYSTEMS MAINTENANCE
252. Assists in the resolution of basic software problems.
253. Performs complex troubleshooting in applications.
254. Recommends solutions to application-specific problems.
255. Maintains the data dictionary and other technical support elements.

INFORMATICS SKILLS: SYSTEM SELECTION
256. Designs evaluation criteria and strategies for selecting applications and systems.
257. Applies ergonomics principles in the selection and use of information management technologies.
258. Participates with others in selecting applications or systems (e.g., users, vendors, system designers).

INFORMATICS SKILLS: TESTING
259. Develops procedures and scenarios for acceptance testing, conversions, and interface testing.
260. Conducts tests of information management applications/systems.

INFORMATICS SKILLS: TRAINING
261. Produces short-term and long-term training plans.
262. Produces training materials and operating manuals tailored to the organization.
263. Delivers user training programs.
264. Evaluates user training programs.

Level 4: Informatics Innovator

COMPUTER SKILLS: SIMULATION
265. Develops models for simulation purposes.

INFORMATICS KNOWLEDGE: EDUCATION
266. Teaches informatics competencies required for specific role functions for the practicing nurse and the nurse administrator.
267. Evaluates informatics competencies required for specific role functions for the practicing nurse, the nurse administrator, and others.

INFORMATICS KNOWLEDGE: IMPACT
268. Evaluates the changing role of educator when computerized information management is introduced.

INFORMATICS SKILLS: ANALYSIS
269. Designs innovative analytic techniques.

INFORMATICS SKILLS: DESIGN AND DEVELOPMENT
270. Designs unique technology or system alternatives for clinical care, education, administration, and/or research.
271. Develops the conceptual model for a database.

INFORMATICS SKILLS: EVALUATION
272. Evaluates applications supporting clinical care (including decision support), education, administration, and/or research.
273. Evaluates the performance and impact of information management technologies on organizational efficiency.
274. Evaluates factors related to safety, effectiveness, cost, and social impact when developing and implementing information management technologies.
275. Based on information management technologies evaluation data, recommends and/or modifies clinical practice enhancements.
276. Evaluates the performance and impact of information management technologies on clinical practice, education, administration, and/or research.
277. Develops a framework(s) for evaluating applications and system performance in clinical care, education, administration, and/or research.

INFORMATICS SKILLS: FISCAL MANAGEMENT
278. Develops strategies to obtain research funding.

APPENDIX (CONTINUED)
Expert Panel Nursing Informatics Competencies

Level 4: Informatics Innovator (Continued)

INFORMATICS SKILLS: MANAGEMENT
279. Designs innovative methods for project management.

RESEARCH
280. Develops innovative and analytic techniques for scientific inquiry in nursing informatics.
281. Develops new methods of organizing data to enhance research capacities.
282. Develops research designs to examine impacts of computer technology in nursing.
283. Conducts basic science research to support the theoretical development of the informatics specialty (e.g., decision making, human-computer interaction, taxonomy development).
284. Designs evaluation techniques to assess the quality of data and information in information systems (e.g., the validity of Internet-based patient educational content).
285. Applies advanced methodological and statistical techniques to the design and evaluation of computerized clinical information systems.
286. Publishes findings from informatics-focused research to support the development of the specialty's theoretical knowledge base.
287. Sustains an informatics-focused program of research.
288. Applies multivariate statistical concepts to the evaluation of complex data sets to forecast quality management trends.
289. Develops psychometrically sound instruments for use in informatics-focused research.
290. Develops new framework(s) for use in informatics.

PRACTICE
291. Applies advanced analysis and design concepts to the system life cycle process.
292. Integrates domain knowledge within computerized decision support systems.
293. Analyzes complex issues (e.g., confidentiality, privacy, data security).
294. Recommends policies based on analytical findings.
295. Designs and/or evaluates enterprise-wide strategies for managing the impact of information systems implementation.
296. Designs the structure for complex data sets.
297. Develops new methods of organizing data to enhance research capabilities.
298. Develops innovative methods of data communication, hardware and software integration, and data transformation.
299. Designs unique system alternatives for clinical care, education, administration or research.
300. Exerts leadership of interdisciplinary teams to provide strategic Information System direction.
301. Influences top-level decisions and policy design which impact clinical information management.

EDUCATION
302. Applies sophisticated educational design and research evaluation concepts to the use of innovative computer-based education techniques (e.g., distance education).
303. Develops theoretically-based curricular models for nursing informatics.
304. Evaluates the effectiveness of curricular models in nursing informatics.