Nursing Informatics

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KEYWORDS
• Informatics • Accessibility • Information system • Computer system • Nursing science
• Cognitive science

KEY POINTS
• Nursing informatics is both a system and a science.
• Shift in health care system from experiential to longitudinal focus.
• Application opportunities for informatics in perioperative practice, administration, education, and research.
• Issues of accessibility represent both challenges and opportunities.

Nursing informatics (NI) is both a system and a science. A system brings order or method and is a coordinated arrangement of working elements or organisms.\(^1,2\) Science is a systematic acquisition of knowledge, especially knowledge that can be precisely measured. If we think of body systems such as cardiovascular, respiratory, skin, and so forth, none of these can operate independent of the other, and often controlling or supporting changes in related systems. NI functions in the same way. A system may also use science to acquire knowledge for precise measurement just as the body uses incremental changes in blood flow, which will change the extremity vascular system outcome. NI uses both a system process and scientific data.

SELECTED NURSING INFORMATICS DEFINITIONS

In 1994, the American Nurses Association (ANA) began developing a statement to describe the scope of practice for NI: "The development and evaluation of applications, tools, processes, and structures which assist nurses with the management of data in taking care of patients or supporting the practice of nursing."\(^3,4\) This foundational work supported the need and importance of NI related to the practice of nursing. Then in 1996, Turley\(^5\) framed NI, identifying the sciences reflected in NI. The overlapping concepts of the Venn diagram (Fig. 1) demonstrate the center where NI is represented.

In 1998, the Nursing Informatics Special Interest Group of International Medical Informatics Association\(^6\) also developed a definition: "The integration of nursing, its
information, and information management with information processing and communication technology, to support the health of people worldwide. Then in 2001 (Box 1), ANA developed a more detailed definition focusing on the three science legs of NI; nursing science, computer science, and information science. NI is the facilitator of the integration of data that supports our patients related to nursing decision-making. We do that in everyday work; therefore, the definition of NI is being built on what we do in nursing practice. The structures, the processes, and the added information technology make up the foundational pieces that support what NI is to nursing practice.

In 2008, ANA enhanced iterations of the NI definition.

“Nursing informatics (NI) is the specialty that integrates nursing science, computer science, and information science to manage and communicate data, information, knowledge, and wisdom in nursing practice. Nursing informatics facilitates the integration of data, information and knowledge to support patients, nurses and other providers in their decision-making in all roles and settings.

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We collect data or facts that may be reported without interpretation such as blood pressure, pulse rate, temperatures, and so forth, but if nothing is done with the data or there is no interpretation of what they mean, then data become of little value. Computer science deals with the organization of the data by collecting, storing, processing, retrieving, and displaying information as well as communicating the information. This process is done with hardware, software, various platforms, portals for data collection and retrieval, and components necessary for the computer science portion of NI.

Information science is the processing systems associated with placing data into relative and meaningful statements. The data cannot stand by itself, it must have the information processed and then analyzed within the information system science. From there the knowledge through cognitive science allows involvement demonstrating developing interrelationships among informational statements to create a meaningful whole yielding cognition and knowledge or perception. Informatics combines computer and informational science in order to manage and process data, information, and knowledge that then lead to actions by the perioperative nurse.

THEORIES SUPPORTING NURSING INFORMATICS

Burns and Grove describe theory as consisting “of an integrated set of defined concepts, existence statements, and relational statements that present a view of phenomenon and can be used to describe, explain, predict, or control that phenomenon.” There are theories that inform and help frame NI such as general systems theory and cybernetics, cognitive theory, and change theory.

Systems or general systems theory has been discussed earlier in this article and has to do with interacting parts within some form of a boundary. Boundaries are present all the time and are dealt with routinely. The body itself is a boundary for housing our body parts and organs. Each of the parts of a human, bounded by the skin and utilizing the skeletal frame, all come together to make a whole. Cybernetics (controlled system) theory is “based on communication (transfer of information) between system and environment and within the system, and control (feedback) of the system’s function in regard to environment.” That process might be similar to that of a thermostat in our home where there is an opportunity to set high and low parameters for the system to adjust automatically to keep it in the preset range. Perioperative nurses use cardiac monitors that allow high/low parameters to be established to cause alarms to signal a problem is at hand for the nurse to take action.

Information and communications are areas that relate to how the computer groups data, information, and knowledge input into the system. There is a connection to these elements of storage relative to cognitive theory as it incorporates information input, processing, and output relative to short- and long-term learning, memory, and skills. Change theory also comes into direct play as health care facilities increase their use of electronic health records (EHR). Lewin’s force field theory is a sequence of unfreezing from the current situation, moving toward the new reality, and finally refreezing so the new change is a part of practice and no longer seen as new. For example, the perioperative setting where the perioperative patient record is being migrated from an all-paper system to an electronic format can represent a fairly static or frozen state of being for nurses steeped in the paper tradition. The change occurs,
and after a time the new EHR is established into the setting, and the nurse has learned and solidified (refrozen) the method into his/her practice.

HEALTH CARE SYSTEM SHIFT

Health care has been transitioning for several years now, from a traditional system or somewhat of a stand-alone system into a more information-driven system. Constantly we are asked for data to support opinions or ideas. Information is the foundation on which we make our decisions. Therefore, information is critical to the outcome, and the method used involves both the computer systems and information systems. The information management of those systems becomes imperative. Nurses think about patients from a whole-being mindset from birth to death, or a longitudinal process. However, in hospitals in the past we tended to think of one patient experience, that moment in time; we chart everything related to that situation, and then we may never see the patient again. In a longitudinal process, we are looking for how this experience relates to the whole patient over his/her whole life. These mindsets represent the variations from our past to a much more current theme and approach to health care from traditional to information-driven systems.

NURSING ROLE

In 2009, 60% of all nurses worked within the hospital setting. Perioperative registered nurses (RNs) work in interdependent practice environments relying heavily on information access, data transfer, innovative patient interaction, and communication systems for accountable and measurable care outcomes. Perioperative nurses work with their health professional colleagues in informatics, information systems, and computer technology to create systems that are capable of storing, collecting, and analyzing the data into meaningful elements for the nurses’ use. The analysis reports from the collected data are then evaluated for opportunities to improve on the practice processes and systems, allowing the nurse to better meet patient needs.

NURSING DATA ELEMENTS AND SETS

Terms are defined so that single-structured data elements are used within the charting process. This strategy allows for the care that is provided patients to be documented and provides a quality way for the care to be effectively evaluated. Box 2 represents a sample list of languages that are currently in use by nurses, such as Nursing Intervention Classification (NIC), Nursing Outcomes Classification (NOC), and

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Box 2
Selected nursing and health care data elements and sets

<table>
<thead>
<tr>
<th>Standard Terminology Acceptable in Electronic Health Record</th>
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<tbody>
<tr>
<td>Perioperative Nursing Data Set (PNDS) Patient Care Data Set (PCDS)</td>
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<tr>
<td>Home Health Care Classification (HHCC) Omaha System</td>
</tr>
<tr>
<td>North American Nursing Diagnostic Association (NANDA) Nursing Intervention Classification (NIC)</td>
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<tr>
<td>Nursing Outcomes Classification (NOC)</td>
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<td>Nursing Management Minimum Data Set (NMMDS)</td>
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<tr>
<td>Systematized Nomenclature of Medicine - Reference Terminology (SNOMED RT)</td>
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North American Nursing Diagnostic Association (NANDA). Perhaps less familiar are the specialty organizations’ data elements and nomenclature development involved in the process over time, such as that of the Perioperative Nursing Data Set (PNDS).

The PNDS is a nomenclature germane to the practice of perioperative nursing. Creating a nomenclature is a lengthy process, and specialty organizations such as the Association of periOperative Registered Nurses (AORN, Inc.) do not want to reinvent the wheel, but rather to build on what is already established and at the same time explore what is germane to the specialty. That language then needs to be a part of the total system so all perioperative nurses are using the same definitions in the same way for the same function, item, or activity. It is therefore critical for these types of elements to be developed to provide the basis for effectiveness related to evaluation of outcomes. For example, using consistent language for procedure start time and exit time provides a method to compare data results across hospital systems for quality improvement.

**NURSING APPLICATIONS**

**Practice**

Nursing information systems can be applied to nursing practice in ways such as work lists, client documentation, monitoring devices, care plan and critical pathways, automatic billing with nursing documentation, reminders during documentation to aid charting, and quick accessibility regarding patient data from previous encounters. This is not an exclusive list, it is simply offered as an example of the ways nursing practice implements the use of information systems. Consider this perioperative scenario: a patient arrives in the patient holding area prior to surgery short of breath and complaining of chest pain. Describe how informatics can help the perioperative RN and other health care providers more efficiently and effectively care for this patient. Whether taking a very broad approach in the conceptual thinking or very specific, the issue is to think through what is being used from an information systems standpoint. Consider things such as the old patient records, including medical history, and medications that are available at the touch of a fingertip today. High quality care is readily available through telemedicine, electronically submitted electrocardiograms, chest radiographs, and on-call specialists that might be off-site. Perhaps the latest research on the patient’s drugs and presenting symptoms are available via the Internet. Expert systems and care maps guide the treatment plan. These are methods for using various information systems in perioperative practice.

**Administration**

Information systems are constantly being used in nursing administration. I know of few managers who do not rely heavily on staffing scheduling systems. E-mail is a feature almost all of us use to aid communications via our phone system and laptops. The cost and trending analysis for budgeting purposes is imperative to have solid data to make decisions, and data are what drives the whole process. If improvements are to be made to quality services provided, then looking for the desired outcomes data to support our opinions is imperative. Administrators’ use of data helps reinforce the opinions on what is happening around them to determine the path and direction of change they are choosing for system improvements.

**Education**

Nursing education is using information systems routinely, from face-to-face simulation to online simulation opportunities. The Internet is the lifeline to other countries and identifying the best possible ways and means to access data not available in the
past to accomplish the desired outcomes. Computerized record-keeping, computer-assisted instruction, distance learning via teleconferencing, Internet resources, and Web-based education, along with presentation software all support the continued advancement of nursing education.

Experiential learning concepts are about concrete experience, observation, and reflection, in which generalizations are formulated about situations and patients that have lasting implications for nursing practice. In addition, any new situation encountered influences this generalization. Reflection then is a conceptual tool for understanding variation, differences, and ambiguity, and then putting them all into a framework that makes them understandable. Reflection **IN** action is, for example, the reflection occurring when providing care to a patient. A reflection **IN** action might be when a student nurse is giving an injection for the first time. How does it make students feel; are they nervous or calm, is it working for them to be able to give the injection, or is panic taking over? A new employee in the perioperative setting in a new situation is performing a new activity; what is his/her first reaction in that moment of time? It is his/her own self-reflection of the experience as it is occurring that is a reflection **IN** action of that particular moment in time?

Reflection **ON** action is taking place after the learning or event has occurred. For example, during the post conference of a group of students or new nurses the instructor asks them to interpret their practice for that day related to information systems. What did they use, how did they use it, and why did they use information systems to accomplish their responsibilities and tasks? Their responses would be a reflection **ON** action.

Reflection **FOR** action is where the individual is reflecting on what opportunities exist for change and improvement in the future. **How will I incorporate those changes for improvement into my future practice?** Based on what was learned from the experience, what action will be taken for improvement? Those three elements: reflection **IN**, **ON**, and **FOR** action, are the makeup of an experiential learning activity.15

There are five Es of electronic education, and those are experiential learning, engagement, empowerment, electronics, and evaluation. **Engagement** is the understanding of the process of learning, which means there is engagement by the student, and it is crucial for learning to happen. The learner must be able to influence what is being learned. There must be active and engaged learning taking place for knowledge to be gained. **Empowerment** means distribution of responsibility among all participants including students, teachers, and the educational activity. The faculty/staff development instructor needs to be the **guide on the side** versus the person who is performing all of the content delivery and serving as a **sage on stage**. The learner needs to be able to share that responsibility with the teacher for the process of learning to take place. **Electronic**, use of information technology in educational activities such as the use of Second Life or ConnectPro, provide Internet-based simulation and communication opportunity. **Evaluation** and the reflection on processes and outcomes are critical components of electronic education. Similar and related to what is happening in an “in the seat” environment, it is imperative that the evaluation occur in the electronic environment as well.

Reflection on process evaluation related to education fits in both the hospital and the academic settings. Individuals who are being asked to share their thoughts on evaluation of the process are students in academic settings and patients within the hospital setting. What is the satisfaction level and were the outcomes expected actually achieved by the participant in this case? Process evaluation also includes the faculty/nurse and the facility such as the hospital, clinic, or classroom. How did the
process meet or not meet the needs of the specific individual? The reflection on outcomes has to do with whether the action taken accomplished the original target or established benchmark. Measurements of cost means did the cost outweigh the benefits, and if that is the case, then how to go about adjusting the process to help change the outcome result. Monitoring the number of participants enrolled or participating in the continuing education event addresses one area related to determining a return on investment for conducting the classes.

This reflective evaluation process occurs in the perioperative setting, for example, the numbers of first case start times over the previous year may be an example of meeting a targeted outcome. Were data provided to surgeons that had an impact on their behavior for arriving in the operating room on time, resulting in an increase in on-time case starts? Infection rates, mortality, and morbidity are other indicators that are used to establish reflection on outcomes. The desired outcomes or benchmark are determined first, the activities are completed, and the evaluation occurs in relation to the preset targets.

**Research**

Nursing research is another application for information systems. An interesting side note, CINAHL (Cumulative Index to Nursing and Allied Literature) in 1940 started out as a series of index cards, and not until 1984 did it move into an online database. The means for searching the literature was finding the index card, then finding the hard copy article in the library stacks in order to be able to find relevant materials. That process has gone from the index cards that would lead the perioperative nurse to the journal stacks to now having the full-text journal articles accessible to nurses via the Internet. The transition has been phenomenal. The adoption of standardized languages related to nursing terms has been able to help drill down into the searching process in order to find significant articles that meet the needs of the topic being researched. The ability to find trends and aggregated data also allows us to look at large populations of groups using a variety of different databases such as computerized literature searching using CINAHL, CHIN (Community Health Information Networks) or MEDLINE/PubMed (“MEDLINE® contains journal citations and abstracts for biomedical literature from around the world. PubMed® provides free access to MEDLINE and links to full text articles when possible”17). The Internet has become a way of obtaining, collecting, and conducting research. It provides the means to ask the questions about perioperative practice such as how to change the practice or if the current practice is the best practice possible for the patients.

**ROADBLOCKS AND CHALLENGES VERSUS OPPORTUNITIES AND TRENDS**

There are multiple roadblocks and challenges faced when new opportunities and trends begin to demonstrate themselves relative to NI. However, with information systems, one of the things to consider is how to change these challenges and roadblocks into opportunities for new and innovative ideas. Access is a part of this issue such as *freedom of use* versus *security of information*. We must work with the Health Insurance and Portability Act guidelines and for universities the Family Education Rights and Privacy Act guidelines. The main question is who has the right to use the items or information and who does not. Giving access to the individuals who need it without breaching the confidentiality of patients and restricting others from accessing who should not have the information is a key debatable item. One current negative trend is the issue of lack of privacy or feeling like *big brother* is watching and accessing one’s personal information without the person’s knowledge or consent. In our environment of
threats to our society and our personal information and identity managing, these types of issues are affecting our practice and our society.

Something never experienced ultimately becomes an opportunity, even though initially it may be approached with a degree of trepidation. For example, a person exiting an elevator in the hospital observes a robot, Pyxis, moving down the hall unassisted. The Pyxis stopped if it encountered people or made adjustments if the hallway shifted, and it moved on down the hall until it came to the nurses’ station where it stopped and waited for a nurse to receive the unit. A fascinating process to observe for the first time as well as to see potential reduction in transport and pharmacy delivery labor costs. A balancing of how does the system work, does the technology meet the need, is it secure, and is it a change that is beneficial to everyone involved are questions that must be addressed when implementing innovative technology. Determining whether it is the right thing to do for the right reasons and for the people involved are essential questions to determine and evaluate the outcome of the new technology.

**Define Information Accessibility**

Information accessibility means information is available regardless of the platform or the user agent. As the population moves away from the personal computer to other user agents such as the smart phone, iPad, and personal digital assistant for communications, information accessibility should increase. Electronic books represent another form of user agent that assists individuals in accessing information. Strict adherence to design guidelines is required by the developers, such as using consistent language when writing the programs and following established standards.

Rendition means the presentation method on the screen, such as does the information show up as a cascading format, does it open into a new window, and how does it appear on the screen for the user. Disability is again a key component, and there are five elements that must be addressed in order to meet all American with Disability Act (ADA) issues. Those aspects are visual, hearing, mobility, cognitive or knowledge, and seizure.18

Information accessibility relates specifically to the user and then moves into the platform and user agent. The computer technology and information systems developments advance society to make information accessible for everyday use.

**Accessibility Change Issues**

Have you ever used a wheelchair ramp to go into a building because it was simply easier than going up the stairs, particularly if you are carrying a large load or pulling luggage? Have you used an elevator instead of stairs or listened to audio tapes instead of reading the book? These innovations developed for physical, appliance, or accessibility issues are based on disabilities and may ultimately be used by people other than those with the originating issue that it was created. Accessibility is often more than the originating disability phenomenon and generates discussions such as those regarding access to buildings. In 1973, the Rehabilitation Act18,19 was implemented, and at that time injured veterans were returning from the Vietnam War. We were in a process where we needed to do things differently than in the past. The process used in the past no longer met the physical needs, and something had to be done.

Appliances are items used to support people but may/may not be used from a physical standpoint. That appliance might be something like a screen reader for the blind. Audio tapes of both music and books are another form of appliance used to support individuals with sight impairment. However, consider how often they are used on a daily bases by drivers particularly on long trips, offsetting the radio or in areas where the radio is not accessible. This practice keeps the driver and his/her hands on
the steering wheel, allows a little entertainment, and at that same time the driver can focus on the road. The disability of limited sight or no vision may have generated the need in the first place; however, appliances of this nature often become used by the general population as well.

In the early 1990s, information access was becoming less of an issue on an internal basis because of the widespread use of computers. Those systems have been changing, and now the Internet is used for a more diverse and wider based option than in those years. It is important to understand that these innovations were coming out of a need to help people access buildings, utilize appliances that provided mobility, and access to information. The innovations were driven initially by disability but are now used routinely by the greater population.

**Importance of Accessibility**

Information accessibility success is important to higher education, administrators, patients, and clinical practice. Think about the shift of education materials from paper-based to Web-based. Fewer organizations are copying materials for hard-copy delivery; it is being done via electronic distribution. The use of nonpersonal computer user agents such as smart phones and iPads is increasing. In order to stay apprised of the changing information flow, one must have access.

The last area is the law that mandates accessibility. However, the law is not the best reason to make changes; it is better to do it simply because it is the right thing to do. If we think about who benefits from making information accessible, the law was originally intended for individuals with some form of impairment, but it provides us opportunities for separate content from a different rendition, which may make it easier for anyone to understand the information differently and with more clarity. The process provides a predictable set of rules for adaptive technology access, meaning that the access must meet all of the ADA criteria. In 1990, ramps were mandated in new construction. Compliance occurred because of the law and it was the right thing to do. This change made access to buildings easier and safer for people. Universal design can increase access for all, not just those with a particular disability. Information accessibility becomes a critical component that perioperative nurses must address with each new encounter.

**SUMMARY**

Give thought to how informatics are applied in perioperative practice; how we teach, organize work groups, and communicate information to patients. The everyday practice is integrated with NI to allow us to improve patient outcomes by reviewing data, evaluation strategies, and testing working assumptions and theories. Perioperative RNs use computer technology when posting patient assessments to the EHR. They incorporate information science as they gather trend data to make knowledgeable (cognitive) decisions well-supported from the nursing science literature (see Fig. 1). We do not always give conscious thought to the NI supporting us behind the scenes, unless it is not working, any more than we consciously think about the stethoscope we use to listen to a patient’s lungs or heart. However, without these supporting tools and systems we would be quite lost. It is the balance of technology, knowledge, and the art of nursing that makes up quality outcomes for patients.

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Perioperative Nursing Clinics 7 (2012) 151–160

doi:10.1016/j.cnep.2012.02.010