**Draft Nursing Informatics: Scope and Standards**

**of Practice, Third Edition**

**For Public Comment**

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**Introduction**

The American Nurses Association (ANA) identified nursing informatics (NI) as a nursing specialty in 1992. Two years later, the first scope of practice statement for this specialty, *Scope of Practice for Nursing Informatics*, was published, followed by the 1995 release of an accompanying resource, *Standards of Practice for* *Nursing Informatics*. Those early publications were replaced in 2001 by the *Scope and Standards of Nursing Informatics Practice,* combining both the scope and standards of practice into one document and creating an enhanced, more robust definition of nursing informatics to reflect the contemporary healthcare informatics environment. In 2008 *Nursing Informatics: Scope* *and Standards of Practice* was published with a slightly revised specialty definition of nursing informatics and inclusion of an expanded presentation of competencies for the informatics nurse and informatics nurse specialist. This was followed by *Nursing Informatics: Scope and* *Standards of Practice, Second Edition,* in 2015.

The publication of this third edition of *Nursing Informatics: Scope and Standards of Practice* is the culmination of a 2-year intensive professionalreview and revision initiative, complicated by the significant interruption of the 2020 COVID-19 pandemic. In January 2019 ANA convened the 27-member workgroup of diverse nursing informatics experts from practice, education, administration, research, innovation, industry, government, and other stakeholder groups for twice a month telephone conference calls. Additional small group virtual meetings and consultation with other experts facilitated completion of the draft submitted for the 30-day public comment in early 2020. Workgroup members evaluated every public comment response during the preparation of the final draft document. Publication followed completion of a two-step ANA review process with examination by the ANA Committee on Nursing Practice Standards and final approval by the ANA Board of Directors.

**The Scope of Nursing Informatics Practice**

**Revised Definition of Nursing Informatics**

***Nursing informatics* is the specialty that supports nurses, patients, healthcare consumers, and other stakeholders in their decision-making to achieve desired outcomes through the identification, management, and communication of data, information, knowledge, and wisdom via the use of information structures, processes, and technologies.**

The nursing informatics specialty and its constituent members of informatics nurses (INs) and informatics nurse specialists (INSs) contribute to achieving the important goal of improved health of populations, communities, groups, families, and individuals. Supporting activities include, but are not limited to, the design, development, implementation, and evaluation of effective informatics solutions and technologies within the clinical, administrative, educational, and research domains of practice. Advocacy, policy development, and identification of issues, challenges, and opportunities are also important practice initiatives. The value of nursing informatics becomes evident through this lens.

The identification of Informatics Nursing Specialty Components and Relationships in Figure 1 provides a rich representation of the diverse concepts and relationships important to this specialty and incorporated in the definition of nursing informatics. Nurses, healthcare consumers, patients, and other stakeholders are the center of interest or focus. The immediate surrounding concentric circle represents the action of decision-making to achieve desired outcomes. The next adjacent concentric circle bearing the people, processes, structures, and technologies terms is intended to characterize those important active supports/facilitators/agents incorporated within nursing informatics practice. The externally positioned identification, management, communication, and integration terms are collocated and aligned respectively with data, information, knowledge, and wisdom. Movement from the outer to most inner circle in each quadrant reflects the transitions identified in Nelson’s Revised Data Information Knowledge Wisdom (DIKW) Model presented in Figure 3.

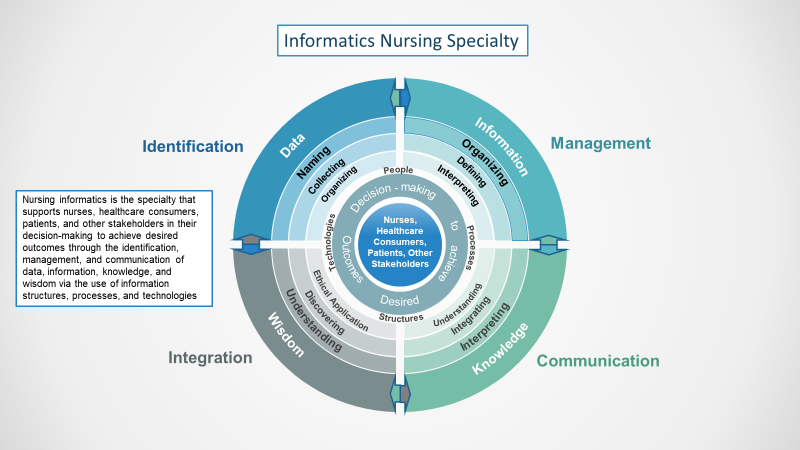


Figure 1. Informatics Nursing Specialty Components and Relationships

**Value Statements**

With a unique contextual understanding of the healthcare ecosystem, informatics nurses are essential in harnessing the rapidly increasing power of technology, information, and communications to advance healthcare delivery across the spectrum of human experience. Using their continually evolving knowledge and skills, INs and INSs provide value in the following ways by:

*Unique combination of nursing profession and informatics practice in rapidly evolving digital age*

* Serving as lead innovators and entrepreneurs for nursing’s advancement
* Meeting essential end-user needs for technology, data, information, and communication
* Ensuring the quality of data assets as crucial aspects of current and emerging analytics and resulting outcomes
* Maximizing the benefits derived from effective communication among diverse experts involved in health information technology and the delivery of health care
* Ensuring clinical context is brought to bear on technology, data, information, and communication by playing an essential role in systems design intended for clinician and/or patient access and use that effectively support information needs and decision making, monitoring and interventions
* Translating the ethics of practice, education, administration, and research in informatics solutions
* Interpreting security needs and intervention from a clinical context

*Expert understanding of nursing and healthcare delivery and operational flow*

* Developing technology, data, information, and communication solutions to create efficiencies and effectiveness in achieving desired goals
* Collaborating with healthcare providers and consumers to advance safe, quality, patient-centered care in the digital age
* Providing an in-depth understanding of clinical care delivery and operations in nursing and other areas
* Capturing the evidence to develop an in-depth understanding of delivering clinical care and operations in nursing and other areas
* Explaining possibilities and capabilities of technology, data, information, and communication to clinical end-users
* Amplifying the benefits of informatics knowledge-based collaboration with vendors, quality and safety, information technology (IT) professionals and other stakeholders to develop efficient and effective solutions for clinical problems and opportunities
* Using usability and design principles to minimize negative impacts and maximize positive impacts of technology, data, information, and communication on workflows found in healthcare systems
* Analyzing, designing, and implementing effective user experiences for nurses, patients, and families as well as other members of the healthcare team
* Using expertise in applied clinical informatics to reduce or eliminate the burdens of current and developing technology, information, and communication solutions

*Data, information, and knowledge management for individuals, groups, communities, and populations*

* Ensuring the right information is available in the right way to the right people at the right time
* Applying concepts of nursing theory during management of data, keeping at the forefront concepts of caring and improving patient outcomes
* Extracting information and knowledge from multiple data sources as subject matter experts in content and context
* Developing the priorities, management strategies, and monitoring initiatives associated with achievement of the outcomes for health programs and population health initiatives
* Adding clinical expertise to efforts in data science, natural language processing, machine learning, precision medicine and other developing strategies
* Providing useful meaning from clinical data that non-clinicians do not always recognize
* Eliminating biases in in data and analytics

*Executive informatics leadership during acceleration of digital age*

* Developing, implementing, and evaluating operational and strategic plans related to technology, data, information, and communication solutions
* Making the business case for technology, data, information, and communication solutions
* Collaborating with appropriate individuals and groups in the evaluation and selection of vendor solutions
* Presenting the total costs of ownership and return on investment
* Developing efficient and effective project plans to share with key stakeholders
* Implementing projects on-time, on-budget, and in-scope
* Collaborating with appropriate individuals and groups to identify, implement and evaluate strategies involving risk, safety, and security as well as prevention, impact, and mitigation
* Collaborating with appropriate individuals and groups to ensure current legislation, accreditation, and other policies related to technology, data, information, and communication are included in operational and strategic plans

*Scientific research and discovery*

* Using current evidence in the design, implementation, and evaluation of informatics solutions
* Conducting applied research using existing knowledge to improve the design, implementation, and use of technology, data, information, and communication solutions in healthcare delivery
* Conducting basic research to identify new knowledge involving technology, data, information, and communication used to improve healthcare outcomes

*Healthcare policy influence*

* Informing state and federal decision-makers on legislation that impacts the direction of technology, data, information, and communication solutions used by healthcare professionals, patients, families, consumers, communities, and populations
* Communicating the need for new advisory opinions, declaratory rulings, or position statements to appropriate entities
* Developing new policies and standards of practice
* Advocating for ethical standards and principles during policy development

*Integration of sociotechnical approaches with the science of quality, safety*

* Providing optimization of technology for improvements in patient safety, quality, population health, and clinical team efficiencies, effectiveness, and satisfaction
* Improving user experience with technology, information, and communication solutions by incorporating a sociotechnical framework
* Assisting organizations in becoming learning organizations through effective use of technology to manage knowledge
* Applying quality and safety principles in technology, data, information, and communication solutions

*Learning across the spectrum of healthcare systems*

* Designing learning solutions to meet end-user needs
* Uses NI scope and standards and validated tools to assess informatics competencies levels
* Implementing educational programs to achieve informatics competencies
* Educating undergraduate and graduate-level nursing and healthcare professionals on the specialty of nursing informatics
* Developing curriculum to strengthen competencies to improve outcomes using technology and data

**Metastructures, Concepts, and Tools of Nursing Informatics**

**Metastructures**

***Nursing Metaparadigm***

The nursing metaparadigm is comprised of four key concepts: nurse, person, health, and environment (Francis, 2017). The nurse continuously collects data about persons, health, and environmental factors that influence health maintenance and the healing process. Nurses, using their education, intellect, and experiential knowledge, place these data into categories to create information. Finally, using critical thinking and wisdom, the nurse can formulate a plan and prioritize interventions or actions that effect the most positive outcomes possible for the situation.

Clinical judgement is the “observed outcome of critical thinking and decision-making” (NCSBN, 2019, p. 1). Decision-making is the process of choosing among alternatives and is dependent upon access to quality data. Decision-making in health care is guided by critical thinking, an intellectually disciplined process. The decisions are characterized by the outcomes of the resulting actions, and clinicians, as knowledge workers make numerous decisions that influence the lives and well-being of individuals, families, groups, communities, and populations.

For example, the nursing process includes assessment, diagnosis, outcomes identification, planning, implementation, and evaluation, and is dependent upon quality data and critical thinking skills that are supported by information and communication technologies. Effective clinical judgement is dependent upon the ability of the nurse to use their nursing knowledge to interpret available data and information. Properly designed and implemented technologies optimize the nurse’s ability to collect, categorize, and analyze data. This enables sharing of relevant information between all members of the healthcare team, including the patient, to promote team collaboration and enhance the continuity of care. The informatics nurse is ideally suited to select, implement, and evaluate technology that assists members of the care delivery team in reaching the goal of positive patient safety and quality outcomes.

## *Data, Information, Knowledge, and Wisdom*

## In 1989, Graves & Corcoran expanded on the work of Blum (1986) to describe nursing informatics concepts of data, information, and knowledge. Their seminal work provided a definition of nursing informatics and an information management model that identified data, information, and knowledge as key components of NI practice (Figure 2).

The three concepts as defined by Blum are:

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

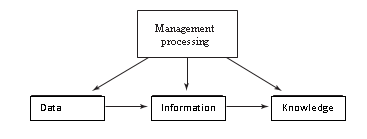


Figure 2.Conceptual Framework for the Study of Nursing Knowledge

Source:Graves & Corcoran (1989). Reprinted with permission of the publisher.

*Data, information*, and *knowledge* are of value to all healthcare providers across the continuum of care. Nelson expanded upon their original model by adding the concept of wisdom (Figure 3). This model depicts how data are transformed into information and information into knowledge, with each level increasing in complexity and requiring greater application of human intellect. The x-axis represents the non-linear interactions and interrelationships between the four concepts. The y-axis represents the increasing complexity of the concepts, as well as the dynamic interactivity of the inter- and intra-environmental factors that influence the movement across and within the data-to-wisdom continuum.

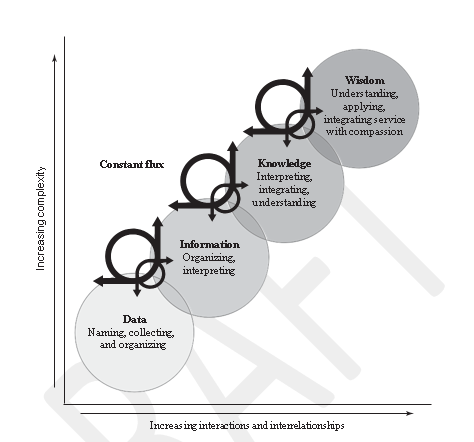


Figure 3.Revised Data Information Knowledge Wisdom (DIKW) Model—2013 Version

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*Wisdom*, defined as the application of knowledge in the management of human problems, consists of knowing when and how to apply knowledge to deal with complex or specific human needs (Nelson & Joos, 1989; Nelson & Staggers, 2018). Whereas knowledge focuses on what is known, wisdom focuses on the appropriate application of that knowledge and an appreciation of the consequences of selected actions. For example, a knowledge base may include several options for managing an anxious family, wisdom involves nursing judgment about which of these options is most appropriate for a specific family and applying the selected option in the delivery of nursing care.

The following example highlights the differences in and relationships between data, information, knowledge, and wisdom in a typical patient care situation. For example, when a nurse receives a list of numbers such as 28, 68, 94, 98, and 110 (data) without context, it is meaningless. However, if the numbers are ordered, structured, and identified, the nurse recognizes this series of numbers as vital signs and will regard those numbers as information (T 98o, P 94, R 28, and BP 110/68). Once the data are organized into a recognizable format, the nurse must apply experiential, contextual, and situational knowledge of the patient’s past and current situation to interpret the meaning of those values. If these vital signs were obtained from a newborn, they mean one thing, but if they were obtained from an adult, they have a very different meaning. The nurse’s knowledge of normal vital sign values for different types of patients, and the condition of the patient from whom the numbers were obtained, provide a context within which the nurse can interpret the information. Then the nurse will know if the numbers represent a normal, expected result or an abnormal, even pathological result. The numbers must be then placed in a context so that the nurse can take appropriate clinical action, thereby demonstrating “knowledge-in-use” or wisdom.

Benner (1982) defined the experiential stages of the nursing professional and later contributed Thinking-in-Action as an approach to administration of care (Benner, Hooper-Kyriakidis, & Stannard, 2011). The addition of wisdom raised new and important research questions, challenging the profession to develop tools and processes for classifying, measuring, and encoding wisdom as it relates to nursing and informatics education.

ANA added wisdom as a core nursing metastructure integrally connected to nursing actions and supported by nursing informatics: wisdom is the appropriate use of knowledge to manage and solve human problems (ANA, 2015b). Nurses seek to better understand how to gain nursing *wisdom* and apply it in daily practice.

***The Theory of Wisdom in Action for Clinical Nursing***

The concept and experience of wisdom in nursing *practice* were not well defined, hence the development of Matney’s *Theory of Wisdom-in-action (WIA) for Clinical Nursing.* Matney sought to remedy that gap and initially described the development of wisdom using knowledge in her model, Wisdom-in-Action for Clinical Nursing© (Figure 4). Although this model has not been applied within the context of nursing informatics, it denotes that knowledge encompasses:

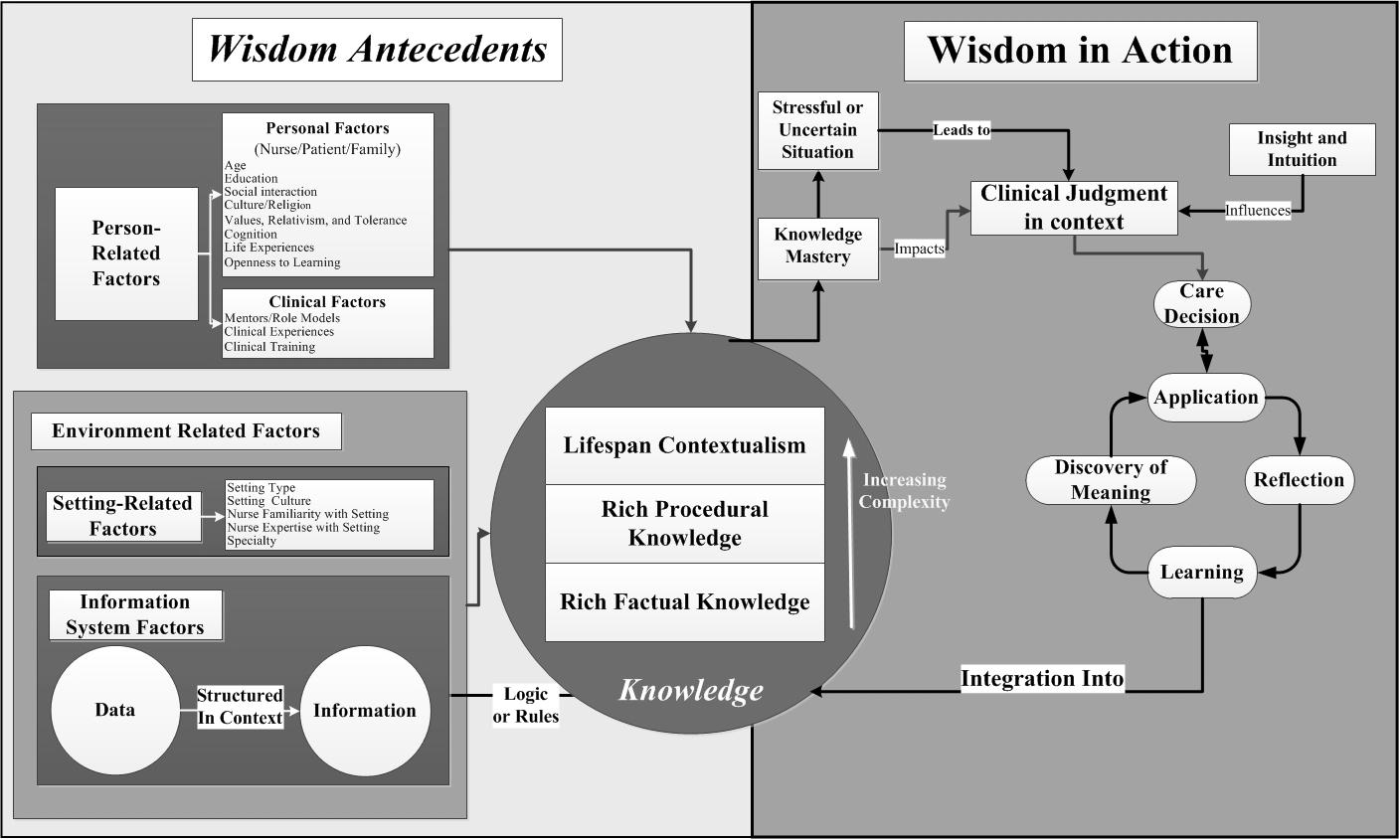
* The center core of clinical judgment
* Values, relativism, and tolerance
* Life span contextualism
* Rich procedural knowledge
* Rich factual knowledge

Figure 4. Matney Model of Wisdom-in-Action for Clinical Nursing© (Matney, 2015)

Antecedents to this knowledge are both person-related factors and the environmental

factors of settings and systems. When nurses are put into stressful, complex, and uncertain

situations, specialized knowledge offers insight and intuition into the decision-making needed for action. This learning, reflection, and discovery of situation-specific meaning has become integrated into the inherent knowledge base or “wisdom” for future actions. The informatics concepts of data, information, and knowledge are the foundational elements upon which wisdom is developed and can support the nurse in the decision-making process.

The theory was created in three phases. In phase one, a preliminary theory was developed deductively using derivation and synthesis, based on theories and models from psychology, education, and nursing (Matney, Avant, & Staggers, 2016). Pertinent concepts were identified, and nursing-specific definitions created. Secondly, a constructivist grounded theory approach inductively captured the experience of wisdom in nursing practice, based on wisdom narratives from 30 emergency department nurses (Matney, Staggers, & Clark, 2016). Finally, the theories were synthesized into the resultant *Theory of Wisdom In Action (WIA) for Clinical Nursing* presented in Figure 5(Matney, Avant, Clark, & Staggers, 2020*)*.

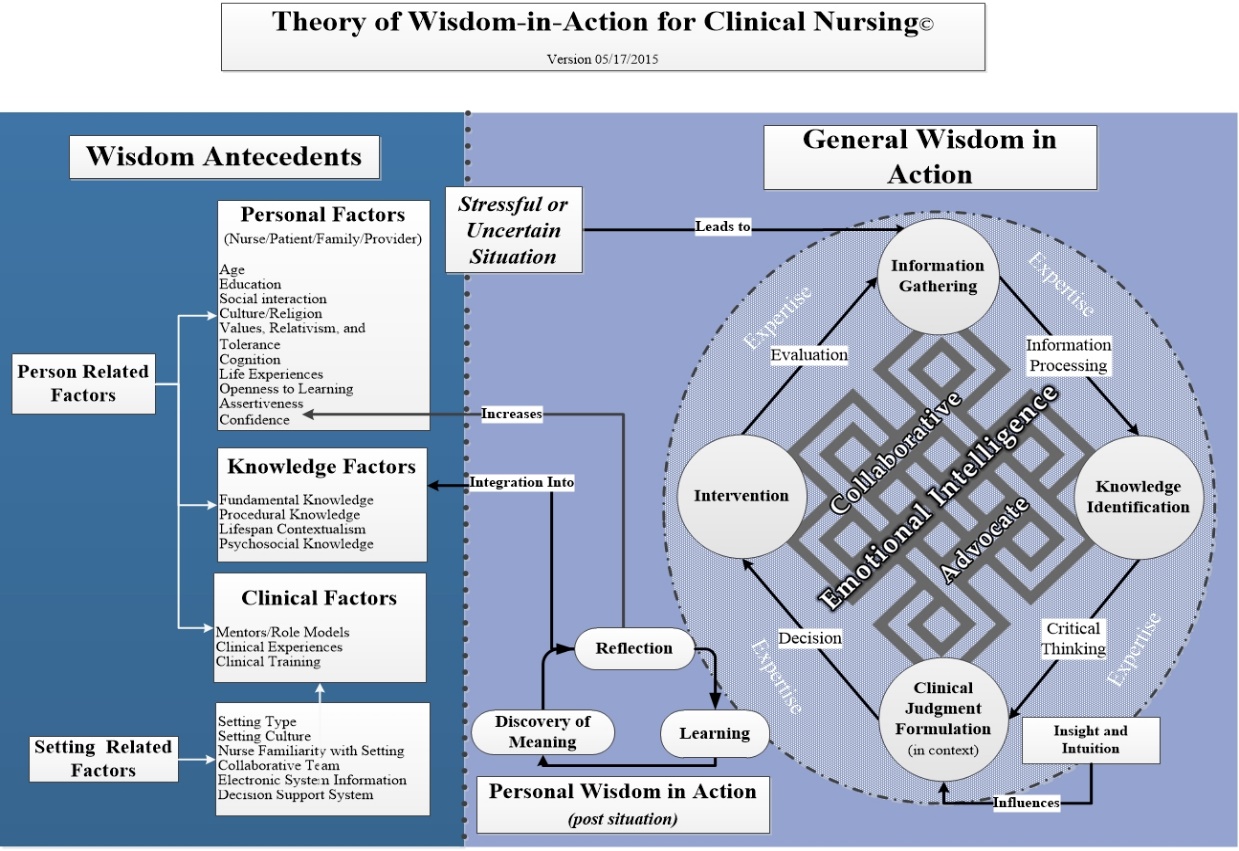


Figure 5. Theory of Wisdom-In-Action for Clinical Nursing (Matney, 2020)

The theory describes two antecedent dimensions: person related and setting related factors and two types of wisdom processes. General wisdom processes apply to patient care and describe the actions nurses take during a stressful or uncertain event. Personal wisdom develops afterwards, as a feedback loop with reflection, discovery of meaning, and learning, followed by increased knowledge and confidence.

The theory demonstrates how wise nurses make decisions in stressful or uncertain situations using an iterative process that includes applying knowledge based on skilled clinical judgment. Implemented decisions produce consequences, which, in turn, imitate reflection, discovery of meaning, and learning. Finally, new information is integrated back, refining knowledge and judgment when necessary.

The theory of WIA expands well beyond what is encompassed by the processing and transformation of data to information and synthesis of information to uncover knowledge. Having knowledge supports decision making regarding the science of nursing, but those components are insufficient when it comes to the affective emotional processes that occur simultaneously with technical processes, during wisdom in action.

The theory can guide the informaticists regarding the use of the types of information accessed and knowledge needed. This will be of importance to nurse informaticists who need to understand and articulate what is valuable information within an electronic health record. The Theory of Wisdom-in-Action provides nursing informatics practitioners a beginning understanding of the psychosocial process of wisdom in nursing practice. It clearly articulates that some aspects of wisdom are amenable to informatics methods and tools, whereas other aspects are personal and reflective.

Wisdom is critical for all areas of nursing practice. The Theory of WIA for Clinical Nursing provides a working framework for translating wisdom in clinical nursing practice into theoretical and practical terms, depicting both the science and the art of nursing. This novel theory displays how nurses’ practice incorporates wisdom and reveals that wisdom-in-action requires clinical skills, experience, knowledge, and affective proficiency.

## *Value of Integration of Nursing Informatics into Practice*

Data, information, knowledge, and wisdom are central to effective healthcare delivery systems. Nurses are skilled in managing and communicating information and delivering quality care. Nursing informatics is also concerned with the creation, structure, storage, delivery, exchange, interoperability, and reuse of nursing and clinical information along the continuum of care. As electronic health information systems are integrated into every nursing role and setting, the use of technology at the point of care delivery; the external use of clinical information for quality, legal, and regulatory activities; and the use of analytics of data and metadata contribute to the creation of new nursing knowledge. Such an evolution in the healthcare environment and ubiquitous use of data, information, and knowledge resources contribute to the blurring of the boundaries between the roles of nurses, informatics nurses, and informatics nurse specialists.

### ***Nursing Knowledge Representation***

*“If we cannot name it, we cannot control it, finance it, teach it, research it or put it into public (Clark & Lang, 1992, p109).in*

Standardized nursing terminologies are essential to representing nursing in the documentation of patient care and the continued evolution of the nursing body of knowledge. Nursing leaders have developed many different vocabularies and ways of organizing data, information, and knowledge pertinent to nursing through numerous established research initiatives that have spanned decades. In the early 1990s, ANA began to formally recognize these languages, vocabularies, and terminologies as valuable representations of nursing practice and to promote the integration of standardized terminologies into information technology solutions. In its 2018 position statement the ANA reaffirmed support for standardized nursing terminologies: “The American Nurses Association continues to advocate for the use of the ANA recognized terminologies supporting nursing practice within the Electronic Health Record (EHR) and other health information technology solutions”(ANA, 2018, <https://www.nursingworld.org/practice-policy/nursing-excellence/official-position-statements/id/Inclusion-of-Recognized-Terminologies-Supporting-Nursing-Practice-within-Electronic-Health-Records/> ).

Table 1 provides the ANA currently recognized standard nursing terminologies.

|  |  |
| --- | --- |
| **Interface Terminologies** | **Minimum Data Sets** |
| Clinical Care Classification System (CCC)  International Classification for Nursing Practice (ICNP)  NANDA  Nursing Interventions Classification System (NIC)  Nursing Outcomes Classification (NOC)  Omaha System  Perioperative Nursing data Set (PNDS)  Alternative Medicine Billing and Coding (ABC Codes) | Nursing Minimum Data Set (NMDS)  Nursing Management Minimum Data Set (MMMDS) |
| **Reference Terminologies** |
| Logical Observation Identifiers Names and Codes (LOINC)  Systemized Nomenclature of Clinical Terms of Medicine – Clinical Terms (SNOMED CT) |

Table 1: ANA-Recognized Standard Nursing Terminologies

According to the International Organization for Standardization (ISO) Joint Initiative for Global Standards Harmonization, Health Informatics Document Registry and Glossary, a Reference Terminology “aggregates data at a prescribed level of abstraction for a particular domain” [Health Informatics Document Registry and Glossary: Standards Knowledge Management Tool (SKMT)4 Available at [www.skmtglossary.org](http://www.skmtglossary.org)]. The SNOMED-CT reference terminology includes clinical concepts describing nursing care such as diagnosis, intervention, and outcome. Of note, while nursing concepts are included in SNOMED-CT, “the concepts were not developed exclusively for nursing” (Coenen, et al, (2001). “Data in healthcare systems must persist in content and meaning across organizations and time to support direct patient care…” and “…the specification of data has a direct relationship to patient safety and the effective re-use of clinical data for knowledge acquisition..” (Coenen, et al, (2001). In the use of mappings between terminologies for interoperability to represent coded concepts from one code system to another, maps are published to support interoperability. The mapping from one terminology to another to enable data to be passed between them persists and despite the significant adoption of “maps”, there is no normative guidance on how maps should be used nor an objective quality measurement for the terminology mappings (Coenen, et al, 2001).

Today’s federal standards related to implementation and use of healthcare terminologies and clinical information systems is under the oversight of the Health Information Technology Advisory Committee (HITAC). “The Health Information Technology Advisory Committee (HITAC) was established in the 21st Century Cures Act (P.L. 114-255) and is governed by the provisions of the Federal Advisory Committee Act (FACA), P.L. 92-463, as amended, 5 U.S.C. App. 2, which sets forth standards for the formation and use of federal advisory committees. The Health Information Technology Advisory Committee (HITAC) will recommend to the National Coordinator for Health Information Technology, policies, standards, implementation specifications, and certification criteria, relating to the implementation of a health information technology infrastructure, nationally and locally, that advances the electronic access, exchange, and use of health information. HITAC unifies the roles of, and replaces, the Health Information Technology Policy Committee and the Health Information Technology Standards Committee, in existence before the date of the enactment of the 21st Century Cures Act.” (Health IT Advisory Committee <https://www.healthit.gov/hitac/committees/health-information-technology-advisory-committee-hitac>)

Such diversity and disparity confirm that informatics nurses must seek a broader picture of the implications of their work and the uses of languages and vocabularies for documentation by end users and in outcomes analysis. For instance, nurses mapping a home care vocabulary to an intervention vocabulary must see beyond the technical aspect of the work to understand how a case manager for a multisystem health organization or a home care agency may be basing knowledge of nursing acuity and case mix on the differing vocabularies. By envisioning the varied uses of the terminologies, the IN and INS promote continuity in the patient care process by harmonizing concepts across disparate organizations and EHR systems. Success in this area mandates active informatics nurse participation in associated standards initiatives, such as the work being done by Health Level Seven International (HL7) and the International Health Terminology Standards Development Organization (IHTSDO).

**Concepts and Tools from Information Science and Computer Science**

### ***Clinical Decision Support and Expert Systems***

Nurses’ decision-making is the cognitive evaluation of one or more factors in relation to the delivery of nursing care. Proficiency in decision-making is a requirement for the execution and delivery of nursing care to improve the health of persons, families, groups, communities, and populations. An expert, or decision-support based system, can augment the clinical decision-making process through system evaluation of specific data points and information such as abnormal lab results, active procedural or medication orders, or clinical documentation.

With data and information, an expert system can generate care suggestions or warnings, such as potential medication interactions that might result in an adverse drug event, based on a pre-defined set of rules, augmenting nurses’ existing knowledge. These care suggestions can take the form of active alerts or passive reminders and should be designed to include interventions supported by evidence that promote safety and improve quality of care. Nurses must thoroughly evaluate system generated data, information, and knowledge-based recommendations and employ wisdom in the decision-making process.

***Big Data, Data Lakes, Analytics***

The NI practice environment is constantly advancing with the emergence of new technologies and tools. With the advent of Big Data and the move towards data lakes, there is an expanded capacity for greater precision in the IN and INS roles for analyzing and querying data. The IN and INS systematically extract and analyze healthcare data from these large or complex datasets to actively improve system and care efficiencies and population outcomes. In documentation frameworks, the IN and INS use Big Data by supporting the use of standardized nursing terminologies mapped to nationally accepted clinical nomenclatures (e.g., SNOMED CT®, LOINC). In doing so, endorsement of research-based assessment scales and instruments readily allows interoperable nursing EHR data reuse for comparative effectiveness research, quality metric implementation, and knowledge generation (Harper & Sensmeier, 2015; HIMSS, 2015; Keenan, 2014).

Working with data requires the IN and INS to have knowledge of the different data storage options and approaches to processing stored data. Databases and data warehouses are characteristically relational databases and position data in structured or modeled formats creating discrete and unconnected “silos”. Data lakes are centralized repositories accommodating structured, semi-structured, and unstructured data (O’Dowd, 2018; Rouse, 2019; Watts, 2017). While each supports Big Data analytics, highly structured data are less agile in configuration and reconfiguration for analytic models, queries, and machine learning applications to allow discovery of patterns and relationships between the data (HIMSS, 2015; Watts, 2017).

The IN and INS collaborate with data scientists and other stakeholders to prepare, manage, and examine data to extract specific meaning based on the initial requirements of the data warehouse. Configuration of the data warehouse is based on which data type to include or exclude to accommodate the objectives for end users. For example, a query on pressure injury for a specific hospitalized patient population occurring within a specified time frame would require patient care data. The identified data elements extracted from the database for the query would be represented in the report or data visualization board for analysis of cost and quality of care delivery.

Data scientists actively partner with the IN and INS to help scale algorithms needed to extract meaningful information from data lakes. A data lake accepts and retains all forms of data in an unstructured, unorganized, and nonhierarchical configuration and uses cloud-based distributed frameworks because of the magnitude of data volume (Marr, 2018; O’Dowd, 2019). The data scientist employs data analytic models guided by the expertise of the IN and INS to verify the accuracy of data requirements for and outputs from the analytic applications that use artificial intelligence (AI), machine learning (ML), natural language processing (NLP) and deep learning (DL). The primary goal is for the information generated to improve the quality, cost, efficiencies and outcomes of a care ecosystem.

***Artificial Intelligence (AI), Machine Learning (ML), Natural Language Processing (NLP), and Deep Learning (DL)***

Artificial Intelligence, the mathematical expression of human intelligence to engineer expert systems, software as a medical device, and adaptive statistical models used to optimize device performance (FDA, 2019.; McCarthy 2007), encompasses the algorithm platforms of NLP, ML and DL (Figure 6). Application of AI in health care is quickly evolving as a transformative change agent in both clinical and outpatient care environments, in addition to personalized medicine initiatives (FDA, n.d.; FDA, 2019; Rigby, 2019; DHHS, 2017). The IN and INS are active participants in scoping the requirements and workflows to facilitate development of AI modeling techniques (Figure 6). Guided by the requirements for the target clinical application, each unique AI technique contributes to the discovery of information from data patterns or images.

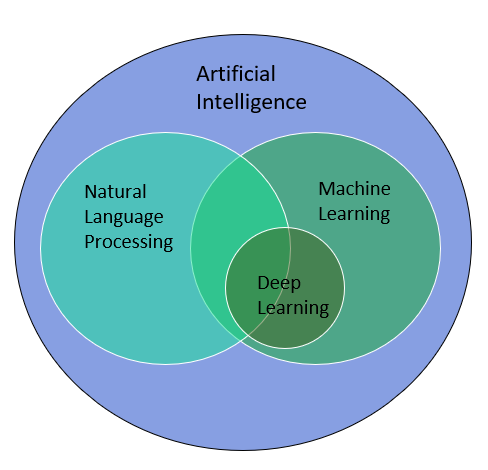


Figure 6. Relationship between AI, NLP, ML, and DL. Adapted from R. Mulkar, 2019, https://rutumulkar.com/blog/2016/NLP-ML

Figure 7. AI, NLP, ML and DL Operations details additional relationships. Natural language processing is the confluence between AI and computational linguistics (Mulkar, 2016; Nadkarni, Ohno-Machado & Chapman, 2011; Sarkar, 2018). Working from unstructured data, NLP rules and analytical models extract semantic concepts by converting text into machine-readable structured data (Jiang et al 2017; Nadkarni et al., 2011). While NLP relies on linguistics and the human use of language, ML procedures only utilize statistical techniques and structured data, and are often applied within the NLP space. Machine Learning techniques cluster patients’ traits and outcomes targeting disease indicators for individual and population health interventions (Jiang et al., 2017). The linear regression models applied to ML form neural networks with many layers and provide the foundation for DL (Jiang et al., 2017; Mulkar, 2016). Also used in NLP, DL focuses on the quantitative interpretation within data sets and vision-based classifications primarily in medical imaging (Mulkar, 2016; DHHS, 2017).

Figure 7. AI, NLP, ML and DL operations. Adapted from T. Danner, 2020, https://www.aunalytics.com/artificial-intelligence-machine-learning-and-deep-learning%E2%81%A0/

### ***Forecasting and Predictive Analytics***

### Forecasting and predictive analytics can be applied in nursing practice to improve relevance and performance of nursing interventions. Informatics nurses collaborate with data scientists or directly engage in data preprocessing to create machine learning algorithms used in the EHR to promote knowledge discovery from direct patient care information. By combining clinical nursing knowledge along with discovery of unique patterns in patient data, evidence-based personalized and precise interventions are created for each patient. Patient-centric algorithms enable development of forecasting and predictive analytics that contribute to high value care individualized for the patient to forecast future health patterns and prevent advancement into high-risk groups requiring expensive and suboptimal interventions.

***User Experience and Related Concepts***

What is the primary goal of informatics nurses? What do they ultimately seek to accomplish? Answers to these questions are important and help define what makes nursing informatics practice unique and how it creates demonstrable value.

The fundamental answer involves creating an environment of technology and data systems that enable those in that environment to successfully accomplish their desired goal(s). Members of the environment are referred to as a user, “the person who interacts with the system, product or service” and includes nurses, patients, consumers, and others. [International Organization for Standardization. (2018). *Terms and definitions* (9241-11:2018, 3.1.7). Retrieved <https://www.iso.org/obp/ui/#iso:std:iso:9241:-210:ed-2:v1:en>]

The strategy of informatics nurses when creating and maintaining this environment is to make all aspects of users’ interactions with technology and data both easy to use and beneficial. As such, informatics nurses are the barons of what is referred to as “user experience”. The International Organization for Standardization (ISO) defines user experience as the “user’s perceptions and responses that result from the use and/or anticipated use of a system, product or service.” [International Organization for Standardization. (2018). *Terms and definitions* (9241-210:2018, 3.2.3). Retrieved <https://www.iso.org/obp/ui/#iso:std:iso:9241:-210:ed-2:v1:en>]

Note the definition provides additional information:

* Concepts of users’ perceptions and responses are described as “the users’ emotions, beliefs, preferences, perceptions, comfort, behaviors, and accomplishments that occur before, during and after use.”
* The user experience is created as “a consequence of brand image, presentation, functionality, system performance, interactive behavior, and assistive capabilities of a system, product or service. It also results from the user’s internal and physical state resulting from prior experiences, attitudes, skills, abilities and personality; and from the context of use.”
* The context of use is “a combination of users, their goals and tasks, resources and environment**.”** The “environment” in the context of use includes the technical, physical, social, cultural and organizational environments.[SOURCE: ISO 9241-11:2018, 3.1.15]

Concepts within the ISO definition and notes are important to examine as together they paint a picture of user experience that should always be considered by informatics nurses when planning, implementing, evaluating, and maintaining technologies and data systems in nursing practice environments. User experience envelopes a wide range of experiences from nursing units to complex environments with many users interacting to mobile health applications (apps). The design of user experience in health care is less about technology and data or even aesthetics. It is about the best way to deliver patient care.

Anything informatics nurses do that changes the practice environment impacts the user experience and patient care. From software updates to new technologies, small projects to large endeavors, the individual and collective impact of these on the user experience should be evaluated before and after implementation. How does the technology, software, or other change impact user experience? Does it make work in the technical, physical, social, cultural, and organizational environment easier and more beneficial to nurses? What are the risks, and can those risks be mitigated? And what is the impact on the attainment of desired goals?

User experience encompasses several related concepts of fundamental interest to informatics nurses. These include human factors, ergonomics, human computer interaction (HCI), and usability. Nelson and Staggers (2018) identified the interrelationship of these terms as displayed in Figure 8. below.

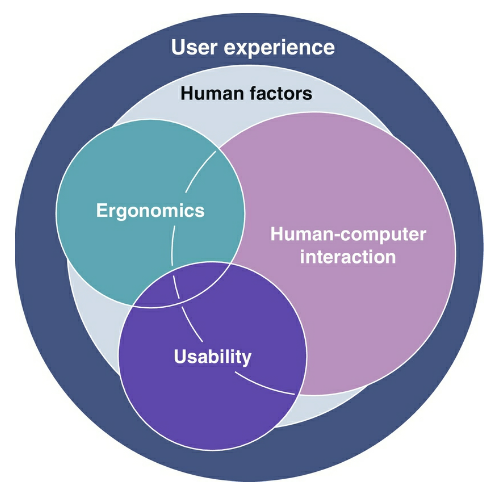


Figure 8.Terms and Their Relationships, Nelson and Staggers, 2018, p.353

*Human Factors***.** ISO defines human factors as “scientific discipline concerned with the understanding of interactions among human and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance.” [SOURCE: ISO 6385:2016, 2.3] An example would be the use of a human factors approach to study prescribing errors in order to plan effective mitigation strategies for slips and lapses, rules-based mistakes, nd knowledge-based mistakes (Sutherland, Ashcroft, & Phipps, 2019).

*Ergonomics***.** ISO defines ergonomics as, “the study and design of working environments and their components, work practices, and work procedures, for the benefit of worker’s productivity, health, comfort and safety.” (SOURCE ISO 21745L2019, 3.13) An often used example of ergonomics and nurses involves back injuries and the transfer of patients (Anderson, Vinstrup, Villadsen, Jay, & Jakobsen, 2019).

*Human-Computer Interaction***.** Human-computer interaction (HCI) refers to "a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them" [Association for Computing Machinery (ACM), 1996]. Perhaps the best example of technology where HCI design is limited involves the electronic health record where the highest number of EHR patient safety incidents has been reported. (Palojoki, Makela, Lehtonen, & Saranto, 2017).

*Usability.*ISO defines usability as, “the extent to which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.” [SOURCE: ISO 9241-11:2018, 3.1.1] An ISO note to this definition further describes the specified users, goals, and context of use as the specific combination being considered. As an example, the American Academy of Nursing recently released a position statement advocating for the need to improve usability in EHRs in order to improve nurses’ well-being and joy in work, a goal consistent with optimal user experience. (Boyle, et al, 2019).

***Value of User Experience***

It is imperative that informatics nurses demonstrate the value of user experience to their organization. While it would be great to create a practice environment that nurses love, without demonstrable value to the organization, that practice environment is not likely to be built. For the organization, the greatest value of user experience involves improved productivity, enhanced patient outcomes, and reduced costs.

Improved productivity of individuals or groups occurs through greater efficiency, effectiveness, and satisfaction in an environment that is created specifically to enhance user experience. For example, documentation is key for quality assessment and outcomes, but the burdens imposed by EHR documentation can create significant unintended consequences. Enhanced usability and clinical decision support can enhance cognitive support and improve patient outcomes. This results in a reduction in costs associated with user learning and support needs as well as a reduction in use errors. Significant cost savings also occur with reduced development failures and associated rework resulting from a mismatch in what nurses need to practice to optimally achieve desired patient- and consumer-centered goals in contrast with what is actually delivered and implemented.

To achieve these outcomes requires a team of experts working together to create a successful user experience. Knowledge and skill in the following areas is important (<https://www.usability.gov/what-and-why/user-experience.html>) (Tutty, Carlasare, Lloyd, & Sinsky, 2019):

* Project management
* Content strategy
* Information architecture
* User research
* Usability evaluation
* Information architecture
* User interface design
* Interaction design
* User centered design
* Visual design
* Accessibility
* Analytics
* Interoperability
* Governance

Equally important is working collaboratively with others whose decisions also influence user experience, such as IT professionals, vendors, regulatory bodies, and payers. Free online resources to assist in these efforts include the following:

* DesignModo UX (<https://designmodo.com/design/ux-design/>)
* Nielsen Norman Group ([www.nngroup.com](http://www.nngroup.com))
* Smashing Magazine UX Design (<https://www.smashingmagazine.com/category/ux-design/>)
* Stanford User Experience Community (<https://ux.stanford.edu/content/resources>)
* UX Booth ([www.uxbooth.com](http://www.uxbooth.com))
* UX Magazine ([www.uxmag.com](http://www.uxmag.com))
* UX Myths (<https://uxmyths.com/>)
* UX Pin ([www.uxpin.com](http://www.uxpin.com))
* usability.gov ([www.usability.gov](http://www.usability.gov))
* UsabilityGeek (<https://usabilitygeek.com/>)
* Health IT Usability (NIST) <https://bit.ly/30eAop8>

The need for informatics nurses knowledgeable in user experience will continue to grow. Successful incorporation of emerging technologies, new data sources, and the continued need for interoperability will challenge environments. Wearables, augmented and virtual reality, chatbots, artificial intelligence, natural language processing, robots, and more will require expert ability in user experience redesign. The healthcare environment must be continually reshaped to enhance the capabilities of technology and data systems that best enable the successful accomplishment of patient-centered goals by users. As such, it is important for informatics nurses to routinely advocate for users in planning, implementing, evaluating, and maintaining optimal user experience environments. Otherwise, user experience will continue to “just happen” along with negative consequences and the loss of important benefits.

**Professional Practice Areas**

Informatics nurses, informatics nurse specialists, and other stakeholders are helping to transform health care through the use of project management and informatics processes, tools, and structures. Across all healthcare environments, INs and INSs most commonly practice in interprofessional healthcare environments and interact with information technology (IT) professionals during all phases when developing and implementing a plan or project. One common example today involves the implementation of a new electronic health record (EHR) system.

INs and INSs use scientific, project planning, management, and informatics principles to employ creative strategies to provide the best informatics solutions based on the current evidence. They bring the perspectives of nursing and healthcare consumers to interprofessional work through a solid understanding of operational processes and the value of consumer advocacy. INs and INSs may need additional education or other types of advanced preparation, such as courses in project planning management, to better understand the application of management principles and concepts to effectively plan and manage an informatics or any other related project.

Because of the common tendency to confuse roles with titles, this section describes the following examples of dynamic and evolving practice areas of nursing informatics:

* Management, Administration, and Leadership
* Clinical Informatics
* Data Management and Analytics
* Patient Safety and Quality
* Research and Evaluation
* Compliance and Integrity Management
* Coordination, Consultation, Facilitation, and Integration

**Management, Administration and Leadership**

*Management* is defined as “an art of getting things done through and with people in formally organized groups and involves working with others to achieve organization's goals by efficiently deploying limited resources in the evolving world” (Ranjan, 2017).

*Administration* refers to the process of running an organization, office, or business. This includes creating rules and regulations, making decisions, management of operations, creating organization of staff/employees/people to direct activities towards achieving a common goal or objective. (Machado, 2018)

*Leadership* is the ability to adapt the setting, so everyone feels empowered to contribute creatively to solving the problems. Leadership is an ability, meaning a leader has a capacity to do something through talent and skill (Smith, 2010). Ward (2019) suggests that leaders provide inspiration as they direct action and are persons who others want to follow as they exhibit leadership skills and personality.

At all levels, leadership is characterized by the combination of superb communication skills, collaboration, change management, risk assessment and mitigation, as well as coalition building using political finesse, business acumen, and strategic application knowledge with all levels of stakeholders. INSs serving in the professional practice area may put most of their energy into leadership and management. In other positions, administration may be part of a position merged with other practice areas depending on the size of the organization and may focus on determining utilization of organizational resources.

Administration and leadership practice in nursing informatics incorporates both higher-level and mid-level administrative tasks. Increasingly, INSs are attaining senior leadership positions. Positions may be titled Chief Nursing Informatics Officer (CNIO), Chief Information Officer (CIO), and more recently, Nursing Informatics Executive Leader, director, or similar leadership titles. In these professional practice areas, nursing informatics leaders are expected to be visionary and establish the direction and strategies for large-scale informatics solutions. The nursing informatics leaders often serve as catalysts for developing strategic plans and creating national or system policies and procedures, while serving as the champion for integrated projects and systems. In mid-level management positions, INSs may supervise resources and validate activities for all phases of a project.

A crucial responsibility for any nursing informatics leader and innovator is fostering teams and interprofessional collaboration in designing, planning, deploying, and evaluating technology in healthcare settings. The Interprofessional Collaboration and Teams (IPEC) provides this definition:  “Interprofessional collaboration is the collective involvement of various professional healthcare providers working with patients, families, caregivers, and communities to consider and communicate each other’s unique perspective in delivering the highest quality of care” (Sullivan et al., 2015). The Interprofessional Education Collaborative Expert Panel (2016) described multiple core competencies for interprofessional teamwork that included technologies for communication and coordination (i.e. Informatics), emphasizing how vital it is for all informatics nurse leaders to work collaboratively with all members of the healthcare team (Moss, E., Seifert, C.P., O’Sullivan, A., 2016). Although the INS may lead teams and projects, the output of these teams is generally enterprise wide and reflects concerns and actions of interprofessional stakeholders.

*Project Management (PM)*

Project management concepts are deployed in many settings. Project management is defined as a planned set of interrelated tasks that need to be completed within a certain time frame, involves knowing what the goals are, how to achieve them, what resources are needed, and how long it will take to achieve a specific goal, not just specific to systems development but general practice (Sipes, 2020). The Project Management Institute (PMI) has developed *A Guide to the Project Management Body of Knowledge* [**PMBOK**® Guide-6th Edition (2017)] which defines the discipline and contains the project management framework comprised of five basic stepwise phases of project management: 1) Initiation and Design, 2) Planning, 3) Implementation/Execution, 4) Monitor and Control, and 5) Close-out and Evaluation/Lessons learned (Table 2).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Initiation/Design**  Goals and Objectives Charter  Scope  Feasibility | **Planning**  Current State  Future State  Risk Analysis | **Implementation/ Execution**  Implement all tracking tools develop in planning | **Monitor & Control** Ongoing | **Close Out & Evaluation**  Lessons Learned Knowledge Transfer Performance Metrics |

Table 2. Project Management Phases [Sipes, (2020) *Project Management for the Advanced Practice Nurse, 2nd Ed.*]

The PMI provides updates standards of practice for project managers and supports best practices. PMI’s certification - the Project Management Professional (PMP) - is becoming more recognized by clinicians as a foundation to enhance and organize practice. Typical examples of roles utilizing project planning and management concepts and principles include:

* An INS at a large hospital system, manages and supervises an electronic health record implementation and associated education teams, consults and represents nursing interests on various IT committees, performs project management for multiple systems such as documentation, data analysis, resource management and other projects, and also provides oversight of nursing standards and vocabularies used in applications.
* A project director or higher-level leader for a clinical software company manages implementation teams for various client projects (hospitals to ambulatory facilities to home health) and consults with clients on all aspects of systems selection, customization, adoption, and use of software.
* A grants administrator and researcher for an information science research agency seeks and writes grants that would fund NI-related projects, designs budgets, and ensures optimal allocation of resources.

The IN and INS will also apply concepts of project planning and management to many other facets of clinical practice, such as quality improvement and policy development.

According to the Institute for Healthcare Improvement (IHI, 2019), managing a quality improvement project is a critical skill for anyone, including INs and INSs, interested in providing and making care delivery — and systems of care — better in their healthcare organization. To successfully manage improvement, team leaders need specialized skills in quality improvement (QI) project management, which has not typically been part of the QI curriculum. IHI has developed tools to effectively manage quality improvement projects, specific ideas to try within each strategy, and offers a workspace to note next steps to implement the strategy at <http://www.ihi.org/resources/Pages/Tools/default.aspx>.

*Systems Development Life Cycle (SDLC)*

Another concept integrated within nursing informatics is the Systems Development Life Cycle which is more specifically focused on IT, EHR, or systems development projects. The SDLC provides a framework for technical and non-technical activities to deliver a quality system that meets or exceeds expectations, and involves end-to-end people, process, and software/technology deployment. The system development life cycle phases include planning, systems analysis and requirements, systems design, development, integration and testing, implementation and deployment, operations and maintenance (Innovative Architects, n.d.). The IN and INS may engage in discrete work elements, hold leadership and management positions, or contribute in many diverse ways.

The software development life cycle (also known as SDLC) focuses on software components development planning, technical architecture, software quality testing, and deployment of working software.

# **Clinical Informatics**

**“Clinical Informatics** is the application of informatics and information technology to deliver healthcare services. It is also referred to as applied clinical informatics and operational informatics” (Clinical Informatics, n.d.). “Clinical informaticians transform health care by analyzing, designing, implementing, and evaluating information and communication systems that enhance individual and population health outcomes, improve patient care, and strengthen the clinician-patient relationship." (Gardner, et al, 2009). Clinical informatics includes topics ranging from clinical decision support to visual images (e.g., radiological, pathological, dermatological, ophthalmological, etc.), from clinical documentation to provider order entry systems, and from system design to system implementation and adoption issues. (Clinical Informatics, n.d.). It should be noted that as informatics evolves, Clinical Informatics is giving way to a more global practice and definition, i.e., Health Informatics.

In addition to nursing informatics, Health Informatics includes:

* *Pharmacy informatic*s - “Pharmacy informatics is the scientific field that focuses on medication-related data and knowledge within the continuum of healthcare systems - including its acquisition, storage, analysis, use and dissemination - in the delivery of optimal medication-related patient care and health outcomes.” (Pharmacy Informatics, n.d.)
* *Medical informatics* - “Medical Informatics is the interdisciplinary study of the design, development, adoption and application of IT-based innovations in healthcare services delivery, management and planning.” (HIMSS TIGER Interprofessional Community, 2020)
* *Nutritional informatics* - Nutrition Informatics is "the effective retrieval, organization, storage and optimum use of information, data and knowledge for food and nutrition related problem solving and decision-making. Informatics is supported by the use of information standards, processes and technology."*-Academy of Nutrition and Dietetics* (HIMSS TIGER Interprofessional Community, 2020)

This is only a small sample of the numerous disciplines that now recognize informatics principles and are utilizing those principles to enhance research, education, and patient care.

# **Data Management and Analytics**

Data management, measures, and analytics are the foundation of improvement initiatives. Tremendous volumes of healthcare data are available, but the amassed electronic data remain uncapitalized. The information and knowledge that generate the wisdom and critical thinking needed in the industry are lacking. However, value-based purchasing models are driving use of data in significant new and innovative ways to compete in the healthcare industry (McBride and Tietze, 2019, p. 426). Informatics nurses can contribute significantly to healthcare organizations’ ability to manage data, create, and maintain measures of quality, safety, cost, and population health.

## *Data Management*

Healthcare organizations are now competing and being paid for performance. This requires the healthcare industry manage data effectively for valid and reliable information upon which performance can be evaluated. The INS may have a significant role in how effectively organizations capture data within the clinical workflow in structured and reliable ways such that data can be exported for electronic reporting. The American Hospital Association (AHA) reported in 2011 that 80% of the effort to validly and reliably capture data is related to the hospital collecting the correct data within the clinical workflow of the clinicians, with 20% of the effort dependent on the vendor designing the EHR to appropriately capture the information (Eisenberg, et al, 2011). The INS can be involved in analyzing end-user patterns, assuring data integrity, and helping to design improvement strategies to ensure information reflects practice quality within organizations. INSs support planning, analysis, development and implementation solutions, data validation, submission, evaluation, and maintenance of measures (Norris, Hinrichs, and Brown, 2015).

## *Master Data Management and the INS Practice Role*

The National Quality Strategy (NQS) ‒ better care, healthy people and communities, and affordable care ‒ requires that healthcare organizations (HCO) invest time and resources to effectively and efficiently manage enterprise data. To meet NQS goals and to competitively survive in the new healthcare payer market, HCOs must now make integrated data and analytics a core asset to meet the challenges of accelerating payment reform. HCOs compete based on how well they manage and use analytics within their organizations to achieve their strategic plan goals. Such goals include quality and efficient care, population health improvement, and often their research and education efforts.

The INS role in supporting master data management is focused on developing people, technology, and processes to support the organization in designing effective enterprise data use. The INS engages in activities associated with culture, governance, and organization in the people domain. In the technology area, the INS may address source system data accuracy and reliability and the Enterprise Data (ED) Strategies/ Business Intelligence (BI) infrastructure and data models. The process domain encompasses such initiatives as:

* communication of program and releases
* ensuring existing reports and key performance indicators (KPIs) are inventoried and reconciled for accuracy
* incorporating the Voice of the Customer (VOC) as an integral business requirement
* employing Agile design/build/deploy
* Use-based data quality.

*Use of Human-Computer Interaction (HCI)Tools and Methods*

In the domain of professional practice for data management and analytics, INs and INSs use HCI tools and methods, such as heuristics and cognitive walk-through, to evaluate the match of systems to users, tasks, and contexts. An excellent example of this type of data management and analytic work product is from the Nursing Knowledge and Big Data Science Work working group on Encoding and Modeling nursing sensitive data. The goal of this working group is to “develop and disseminate LOINC and SNOMED Clinical Terms for electronic health record nursing assessments and incorporate them into a framework and repository for dissemination.” Recent work has included wound and pain assessment mapping and modeling. (NKBDSC, 2019)

*Standardization of Data Capture*

Data management through standardization of data capture is required for valid and reliable use of data for analysis. This practice area includes the development, use, and maintenance of clinical vocabularies, languages, and taxonomies. Nursing languages must be periodically re-evaluated for their applicability and currency. Analysis of a meta-database, such as the Unified Medical Language System (UMLS), requires knowledge of nursing and medical vocabularies to analyze groups of taxonomies and map them to similar terms. An example is the effort to map SNOMED CT to the International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) to aid in meeting and attesting to meaningful use requirements and electronic clinical quality measures (eCQMs). IN and INS expertise should be included in these efforts to support the collection, reporting, and analysis of nursing-sensitive data, as well as eCQMs required for many of the new and emerging payer models.

## *Analytics*

INs and INSs engage in the process of knowledge discovery in databases (KDD). Using sound methodologies and practical evidence-based recommendations, the INS can discover information and knowledge related to diverse areas of nursing practice. Knowledge discovery methods (data mining and machine learning methods), combined with statistical analysis and data visualization techniques, help identify and understand patterns in very large data stores, such as enterprise data warehouses.

Outcomes analysis may be related to any domain of nursing practice: clinical, education, research, or administration. The complexity and levels of outcomes must be determined for healthcare consumers, populations, and institutions. Analysis can include the use of human computer interaction principles and methods.

Informatics nurses serving as analysts use many tools and methods to: (1) maintain data integrity and reliability, (2) facilitate data standardization, aggregation, and analysis, (3) develop and analyze process, outcomes, and balancing measures. These techniques allow nurses to contribute to building a knowledge base consisting of the data, information, theories, and models used by nurses and other stakeholders in decision-making that supports quality health care. The levels of competencies for informatics nurses in analytical roles range from basic to advanced, such as those of data scientists. Examples of INS competencies for intermediate analytics include the ability to:

* analyze data and information accurately, using the appropriate tools and techniques
* utilize data from within the EHR, including analyzing, generating or contributing to performance, workflow, quality, management and other reports
* utilize data management, data mining, and data sharing techniques, resources and tools (<http://hitcomp.org/competencies/>)

Examples of analysis activities include:

* An INS in an acute care setting retrieves electronic data from the EHR to determine if a sepsis alert is triggering correctly as the clinical decision support (CDS) strategy was designed to perform. Analysis continues to determine if the algorithm within the CDS is properly identifying sepsis risk.
* An INS with expertise in quality improvement (QI) manages the electronic clinical quality measures data for a large healthcare system. The INS retrieves data from the EHR and the enterprise data store to determine if the data are being accurately reported to CMS and The Joint Commission.
* An INS in a clinical analytics role supports the organization by designing and retrieving reports from the enterprise data store using business intelligence tools to support the information requirements of senior management in evaluating quality, cost, and safety.
* An analyst applies knowledge discovery methods to warehoused electronic data to build a predictive model of patient falls.

**Patient Safety and Quality**

## *Managing Regulatory Requirements*

Managing regulatory requirements is a significant professional practice component for the INS. Healthcare regulatory requirements have historically been influenced by major events such as the landmark reports *To Err Is Human: Building a Safer Health System (IOM, 1999)*, *Crossing the Quality Chasm: A New Health System for the 21st Century* (IOM, 2001), *Health IT and Patient Safety: Building Safer Systems for Better Care* (IOM 2011), *Taking Action Against Clinician Burnout: A Systems Approach to Professional Well-Being* (NAM, 2019); the downfall of Enron, passage of the Sarbanes-Oxley Act of 2002 (SOX); and pay-for-performance incentives adopted by the Centers for Medicare & Medicaid Services (CMS).

*Compliance and Integrity Management*

Health information technology (HIT) has been promoted as a key element in the National Quality Strategy (NQS) to achieve three aims: better care, affordable care, and healthy populations and communities (AHRQ, 2017). These requirements have resulted in a demand for healthcare organizations to have robust reporting systems to monitor compliance and integrity of their information and reporting activities, infrastructures, employees, and business partners, along with the ability to capture and manage reporting of quality indicators for all three triple aims.

### *Privacy and Security*

The significance of safeguarding the privacy and security of health information has become a primary and critical issue for healthcare providers and informatics professionals. Though not a new issue, the relevance to INS practice is more pressing than ever as new ways in which health data are collected, used, and shared not only promise innovation but also increase the potential for misuse and breach.

Computerized information systems must support compliance with the 1996 Health Insurance Portability and Accountability Act (HIPAA) efforts by limiting access to personally identifiable health information to only those who require and are authorized access. HIPAA was subsequently amended and expanded in 2013 to address the increasing need for privacy of personal health information (PHI). The HIPAA regulations apply to organizations defined as covered entities (CEs), such as health plans, healthcare clearinghouses, and certain healthcare providers. These regulations have significant implications to the INS professional role in organizations that are covered entities.

With the passage of the HITECH Act of 2009 as a part of the American Recovery and Reinvestment Act, unprecedented amounts of PHI data were being exchanged in electronic format along with increased vulnerabilities of exposure. As a result, along with the HITECH Act came additional provisions for HIPAA that went above and beyond the original protections established in 1996. These updated requirements are also known as the Omnibus HIPAA rule. These changes significantly expanded individual rights and provide increased protection and control over health information, along with significant penalty increases for violations. The HITECH Act requires the Department of Health and Human Services (HHS) to perform audits, increases penalties for noncompliance based on level of negligence, and outlines breach notification requirements.

In addition to HIPAA and the Omnibus HIPAA rule, the INS must consider other important regulatory requirements for privacy and security such as the:

* Genetic Information Nondiscrimination Act (GINA)
* Updates to any state regulatory requirements
* International laws such as the General Data Protection Regulation (GDPR) effective May 6, 2018.

The resultant practice functions include activities such as privacy and security assessments and audits to detect red flags, use of reporting systems that will preserve confidentiality or anonymity, and timely enterprise risk management (ERM) reporting of risks and opportunities at a high level for immediate leadership attention through risk scoring and mapping (ASHRM, 2011).

*Other Standards, Directives, Guidelines, or Mandates*

The 2009 American Recovery and Reinvestment Act (ARRA) and Health Information Technology for Economic and Clinical Health (HITECH) Act have driven information technology and EHR installations in the United States to a new national level, emphasizing the use of technology for patient safety and error reduction in healthcare delivery. Organizations such as the Agency for Healthcare Research and Quality (AHRQ) and the Institute for Healthcare Improvement (IHI), as well as non-healthcare organizations like Leapfrog, provide incentives for health institutions to implement informatics solutions.

The continuing requirement to meet meaningful use standards has supported the increased pace of adoption. Mandates now direct organizations to use value-based rather than return-on-investment models to justify health IT, and the pay-for-performance models are accelerating EHR installations. Online quality data and reported metrics are more visible to both consumers and hospital and organizational boards. Organizations will continue to increase the transparency of data and, more importantly, improve the care being delivered. Regulatory requirements and standards will continue to shape the future. INSs are involved in defining these and future standards, and in designing, building, implementing, using, and certifying products that comply.

*Unintended Consequences of HIT*

Today, healthcare organizations attempt to achieve high reliability in a time when technology outpaces our ability to use it. The cost of this fast pace of adoption becomes less clear as medical errors are the third leading cause of death in the United States. The distance between healthcare’s search for high reliability, innovative HIT, and skills to equip informatics nursing will be the marathon for the next decade (Classen et al., 2011; Makary & Daniel, 2016).

It is foundational to the practice of nursing to assess, plan, intervene, evaluate, and advocate for the safety of patients. In the era of technology-assisted health care, the informatics nurse is prepared and alert to unintended consequences of HIT. The informatics nurse can view the indelible link between quality and safe care in the context of the entire continuum, complexity of the system, and high risk of healthcare delivery which is highly augmented by HIT. As a member of the interprofessional team, the informatics nurse offers perspective and a deep understanding of the interrelated systems and factors that contribute to risk. Advocacy for patient safety is core to informatics nursing and will remain the challenge for informatics nurses in the future.

The unintended consequences of HIT have generated an urgent imperative for increased application of safety science in health care. Studies by significant healthcare quality organizations such as the Institute of Medicine, Joint Commission, ECRI, ISMP, FDA, and others have begun to explore HIT related safety issues. However, unanswered questions remain and no remedies have been identified for untoward outcomes for even simple applications of technology (“A Brief Look at ECRI Institute’s 2019 Top 10 Health Technology Hazards,” 2019; Anonymous;, 2009; Harrington, Kennerly, & Johnson, 2011; Yao, Kang, Wang, Zhou, & Gong, 2018). Simple questions regarding workflow and HIT persist despite widespread EHR adoption (Medicine, 2011; Piscotty, Kalisch, & Gracey‐Thomas, 2015).

While alarms, barcoding, copy-paste, and smart pumps were considered patient safety enhancements, a deeper understanding of the impact and consequences of rapid adoption are emerging (Kelly, Harrington, Matos, Turner, & Johnson, 2016; Yao et al., 2018). Although usability, human factors, summative and formative testing, and standardization are clearly linked to increased patient safety in critical tasks, large knowledge gaps remain in new graduates, leaders, and the general workforce (*How to Identify and Address Unsafe Conditions Associated with Health IT*, 2013; Howe, Adams, Hettinger, & Ratwani, 2018; Kelly et al., 2016; McBride, Tietze, Hanley, & Thomas, 2017; Murray, Sundin, & Cope, 2018; Murray et al., 2018; Strudwick, Nagle, Kassam, Pahwa, & Sequeira, 2019; Svetlana Z. Lowry, Mala Ramaiah, Sheryl Taylor, Emily S. Patterson, Sandra Spickard Prettyman, Debora Simmons, David Brick, Paul Latkany, Michael C. Gibbons, 2015). Legal implications of HIT continue to surface, emphasizing the need for nursing informatics expertise and foresight in healthcare organizations to prevent liability (Schencker, 2016). Currently, HIT implemented with the assumption of increasing safer care has created struggles to identify and understand the untoward outcomes. The IN and INS provide expertise and remedy by closing the gaps.

**Research and Evaluation**

Informatics nurses and informatics nurse specialists, particularly those with formal research training, may conduct research into the design, development, implementation, and evaluation of informatics solutions, models, and theories. INS researchers use systematic methods of inquiry (including traditional and newer techniques) to identify, retrieve, represent, and evaluate data, information, and knowledge within informatics solutions and data repositories.

Research in nursing informatics may span a range of activities, including exploratory research (such as data mining/visualization), experimental research (randomized trials), or process/quality improvement. For example, an INS might conduct research projects to develop and refine standardized nursing vocabularies or to link nursing interventions to outcomes in large data sets. This work may include the evaluation of organizational attributes for successful optimization of documentation systems or the usability and usefulness of hardware, software, or consumer-based interactive solutions. Nursing informatics research and evaluation examples include:

* Evaluation of effectiveness of methods for information systems implementation, acceptance, utilization, and optimization:
* clinical decision making in nursing
* documentation burden
* Research about the effects of systems/consumer applications:
* care processes/workflow/quality
* outcomes of individuals/populations
* clinician/consumer satisfaction
* Research in theoretical/applied informatics:
* representation of concepts/terms including clinical vocabularies
* extracting data from nursing/consumer text
* Research in consumer communication and usage of technology:
* tools for social/behavioral determinants of health reporting
* technology-based support groups
* tools for communicating with the health care team
* user experience: design, use, and usability

**Compliance and Integrity Management**

Following the report *To Err Is Human: Building a Safer Health System* (IOM, 1999), compliance and integrity management have increased importance. Healthcare organizations must have robust reporting systems to monitor compliance and integrity of their information and reporting activities, infrastructures, employees, and business partners. Along with developing organizational cultures that encourage ethical conduct and regulatory compliance, mechanisms must be in place to prevent and detect inadvertent omission or commission, civil and criminal conduct.

Accreditation organizations, such as The Joint Commission (TJC), Healthcare Facilities Accreditation Program (HFAP), and Det Norske Veritas Healthcare, Inc. (DNV), affect care delivery via their directives. Robust reporting requirements accompany the initial application and continued monitoring activities. Government agencies, such as the Centers for Medicare & Medicaid Services (CMS), the Food and Drug Administration (FDA), the Centers for Disease Control and Prevention (CDC), the National Institutes of Health (NIH), and the National Institute of Standards and Technologies (NIST), provide regulatory guidance.

Examples of compliance and integrity management activities for informatics nurses in these roles include:

* The security officer for a hospital ensures that HIPAA standards are met by software vendors within the organization, periodically monitors software audit logs for breaches, ensures that passwords are not shared, and confirms that backup and disaster procedures are in place and operational.
* A compliance officer for a state health agency writes and enforces policies that conform to state and national laws respecting records retention.
* A care coordinator administrator for a hospital system ensures the confidentiality of data transmitted via telehealth and telemedicine devices.
* An internal auditor reviews charges to documented care given for appropriate reimbursement or abnormal billing practices.

The IN and INS must have and maintain the knowledge to effectively apply current ethical standards and regulatory requirements to help healthcare organizations to:

* Revise operational procedures for staff.
* Establish technical processes to maintain compliance.
* Meet new regulatory mandates at local, state, national, and global levels.

**Coordination, Consultation, Facilitation, and Integration**

The IN and INS apply informatics knowledge and skills to serve as transformational leaders and resources for clients, both formally and informally, in external and internal settings. At different levels, they apply and facilitate competencies to organize and implement plans. They collaborate with others to manage and effect change. INS consultants are expected to have solid expertise in clinical nursing and project management areas such as process design/redesign, strategic IT planning, system implementation, writing for informatics and other publications, evaluating clinical software products, working with clients to write requests for proposals, perform market research, and assist in the planning and development of conferences, academic courses, and professional development programs. Through this the IN and INS disseminate and exemplify the role of technology in the delivery of healthcare.

Expert INSs may serve as internal consultants, work for a consulting firm, own an independent practice, and be recognized as experts by publishing research and speaking at NI-related events. Flexibility, good communication skills, solid nursing/healthcare delivery background, breadth and depth of clinical and informatics knowledge, and excellent interpersonal skills with the ability to facilitate collaboration are needed to respond to rapidly changing projects and priorities. Consultant examples include:

* Coordinating and consulting with individuals and groups in defining healthcare information issues, problems and applying project management methods and tools for implementing, utilizing, and modifying IT solutions and data structures to support healthcare access, delivery, and evaluation.
* Consulting as the project manager and applying project management tools and concepts to identify strengths, weaknesses, opportunities, and threats (SWOT); ensuring that team members are performing duties as assigned; completing the project on time and within budget; and collaborating and facilitating decision-making by involving healthcare teams, stakeholders, and consumers in the process.

**Evolution of Nursing Informatics Competencies**

The greater visibility and use of information and technology in healthcare settings and professional educational programs have created the need for increased informatics competencies for all. Very few of today’s nurses have worked in only one role or even one specialty of nursing throughout their careers, and this will likely hold true for coming generations of nurses. This section examines the informatics competencies required for all practicing nurses, regardless of role or specialty. Many stakeholders are engaged in defining informatics competencies for every registered nurse, advanced practice registered nurse, and those who specialize in nursing informatics practice. Employers, human resource managers, supervisors, and educational planners are examples of stakeholders who have an interest in having defined competencies for nursing informatics.

**Informatics Competencies Requisite for All Registered Nurses**

The increasing complexity of healthcare services and practice, combined with the evolving mandate for ubiquitous electronic health information systems and technology tools which support patient care, have raised the bar for nursing professionals. Additionally, healthcare professionals at all levels should acknowledge and recognize the value of patient data, data standards, and governance (Hovenga, 2013). Furthermore, nurses must be able to obtain, process, and understand health information within the context of services provided to make the best clinical decisions based on evidence (Nelson & Carter-Templeton, 2016).

Select informatics competencies will soon be required in all prelicensure, undergraduate, graduate, and doctoral nursing curricula. The American Association of Colleges of Nursing (AACN) convened the Essentials Task Force to move ahead with its charge to update all three Essentials documents, which are used to ensure quality in nursing programs offered at the baccalaureate, master’s, and doctor of nursing practice (DNP) levels. Informatics is one of the ten identified domains with its associated competencies that must be threaded throughout nursing educational program levels. Details about this contemporary effort are available at <https://www.aacnnursing.org/About-AACN/AACN-Governance/Committees-and-Task-Forces/Essentials>. The National League for Nursing has long advised nursing faculty to participate in programs to advance informatics development and to incorporate principles of informatics into each level of a nursing curriculum.

According to the Technology Informatics Guiding Education Reform (TIGER) initiative, a grass roots initiative begun in 2006 within the nursing community, all practicing nurses should be equipped with the skills necessary to practice in the technology-driven world of health care (Hubner, et al., 2018). TIGER gradually extended its scope to include other clinical disciplines, moved into the interprofessional area in 2014, and today focuses on education reform, fostering community development and global workforce development using an interdisciplinary approach (<https://www.himss.org/membership-participation/technology-informatics-guiding-education-reform-tiger-interprofessional-community> and <https://www.himss.org/what-we-do-technology-informatics-guiding-education-reform-tiger>). The Evolution of TIGER Competencies and Informatics Resources Executive Supplemental Report is available at <https://www.himss.org/sites/hde/files/media/file/2020/03/10/the-evolution-of-tiger-competencies-and-informatics-resources-final-10.2017.pdf>. **Organizational Discussions on Informatics**

Multiple organizations have provided input to the informatics competencies. This section provides an overview of several of these discussions.

Healthcare Leadership Alliance

* The Healthcare Leadership Alliance (HLA) announced the creation of the HLA Competency Directory in the fall of 2005 and updated in 2017. This directory (HLA, 2017) identifies 300 competencies across multiple healthcare management roles, categorized into 5 domains: leadership, communications and relationship management, professionalism, business knowledge and skills, knowledge of the healthcare environment.
* According to the web site (HLA, 2017, para. 3), the “The Directory provides a comprehensive listing of the competencies managers and leaders need to meet the challenges of managing the nation's healthcare organizations”, including healthcare information management. These competencies may assist in the development and evaluation of informatics role definitions, including management roles.

American Organization of Nurse Leaders

* The American Organization of Nurse Leaders (AONL), formerly known as the American Organization of Nurse Executives (AONE), demonstrated its support for informatics nurse leaders in the 2012 position paper “Nursing Informatics Executive Leader,” which stated: “The NI Executive leader represents the bridge between clinical practice and informatics that transforms patient care delivery for the entire organization” (AONL, 2012, pg. 1).

Quality and Safety Education for Nurses

* The Quality and Safety Education for Nurses (QSEN) initiative project began in 2005 with the stated goal to “address the challenge of preparing future nurses with the knowledge, skills, and attitudes (KSAs) necessary to continuously improve the quality and safety of the healthcare systems in which they work” (QSEN Institute, 2012a, para. 1).
* QSEN has added informatics competencies for prelicensure nursing education, based on work by Cronenwett et al. (2007), and for graduate nursing programs (QSEN Institute, 2012b). Additional resources can be found at <https://qsen.org/informatics/>.

National League for Nursing

* In 2008, the National League for Nursing (NLN) released its “Position Statement Preparing the Next Generation of Nurses to Practice in a Technology-Rich Environment: An Informatics Agenda” (<http://www.nln.org/docs/default-source/professional-development-programs/preparing-the-next-generation-of-nurses.pdf?sfvrsn=6>).
* To assist in that effort, NLN created tool kits to help educators assess their own competencies and provide teaching/learning strategies to assist with implementing informatics competencies into nursing education programs - NLN Informatics Education Toolkit (<http://www.nln.org/professional-development-programs/teaching-resources/toolkits/informatics-teaching>)

Office of the National Coordinator for Health Information Technology

The Office of the National Coordinator for Health Information Technology (ONC) sponsored four programs using American Recovery and Reinvestment Act funds to prepare healthcare and IT professionals who wanted to become knowledgeable about and obtain jobs in the health IT sector. These four programs included:

* Curriculum Development Centers - fund and make resources available for curriculum building in higher education institutions
* Community College Consortia to Educate Health Information Technology Professionals (Community College Consortia, n.d.) - 82 member colleges in 5 regions across the United States
* Program of Assistance for University-Based Training
* Competency Examination Program (HealthIT.gov, 2014)

Under the Curriculum Development Centers Program, the Oregon Health and Science Center was appointed to be the National Training and Dissemination Center (NTDC) and tasked with creating a standard curriculum with competencies for all educators to use and students to understand and achieve (Curriculum Development Centers, n.d.). Subsequently, the materials and curriculum created by the NTDC were used by the community college consortium.

Even though initial funding for the program expired, most educational institutions have committed to continuing their programs.

In addition to the community college consortium curriculum, funding was also allocated to develop university-based programs to increase the number of focused health IT professional roles. The six roles targeted by these programs are:

1. Clinician/public health leader

2. Health information management and exchange specialist

3. Health information privacy and security specialist

4. Research and development scientist

5. Programmer and software engineer

6. Health IT sub-specialist (Morganti, 2011)

Lastly, the ONC funded the development and administration of a nationwide program of competency examinations. The purpose was to create “a mechanism to assess whether examinees have attained a certain set of health IT competencies” (HealthIT, 2011). Although the project funding ended in April 2013, the resources from these federally funded initiatives remain available in the public domain and have garnered significant national and international interest and use.

**Research About Nursing Informatics Competencies**

In their seminal work on informatics competencies for nurses, Staggers, Gassert, and Curran (2001) studied the relationships between nursing roles and informatics competencies for nurses at four levels of practice: beginning, experienced, specialist, and innovator. This framework aligned with educational requirements for nursing specialties at the beginning and experienced levels identifying specific competencies. The work of these authors not only promoted the integration of informatics competencies into educational curricula, but also influenced policy documents.

Research has progressed from determination to validation and implementation of nursing informatics competencies. Choi (2012) examined the informatics competencies of students in three undergraduate tracks: Traditional Pre-Licensure, Registered Nurse (RN) to Bachelor of Science in Nursing (BSN), and Accelerated BSN. Hsu et al. (2012) looked at the informatics competencies for mid-tier public health practitioners in the public health sector. Remus and Kennedy (2012) focused on the need for nursing informatics competencies in Canadian nurse leaders.

Other researchers continue to advance the work of Staggers, Gassert, and Curran. Hill, McGonigle, Hunter, Sipes, and Hebda developed “a reliable and valid instrument for self-assessment of perceived level 3 informatics specialist and level 4 informatics innovator competencies in selected informatics activities” (Hill, et al., 2014). Choi and Bakken (2013) reported on the validation of the self-assessment scale among undergraduate and graduate nursing students. Chang, Poynton, Gassert, and Staggers (2011) provided insight into the international use of Staggers, Gassert, and Curran’s 2002 work. The ongoing work has been foundational in the development of this version of the nursing informatics scope, standards of practice, and accompanying informatics competencies for the IN and INS.

While there are obvious concrete informatics competencies (Hill, McGonigle, Hunter, Sipes, & Hebda, 2014) that every informatics nurse must have, other advanced competencies will likely never be included in an educational curriculum or added to a formal list of competencies. An example is the ever-changing landscape of meaningful use criteria and Merit-based incentive Payment System (MIPS) which focus on the transition to value-based practice through the utilization of technology.

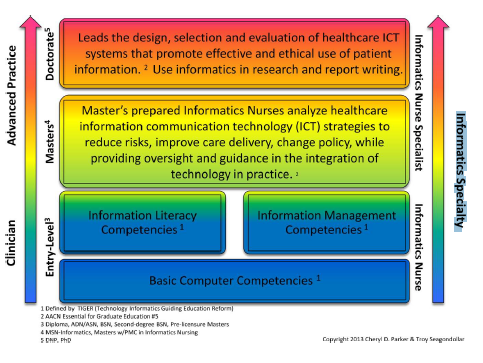
Another example is the numerous ways in which technologies are enhancing practitioners’ ability to monitor patients and coordinate care remotely via telehealth and connected health methodologies. Of critical importance for nursing is measuring the value of nursing care and patient outcomes through the utilization of technology. All these areas require informatics nurses and informatics nurse specialists to be involved in defining benefit versus impact, although it may be difficult to predict how the evolving technologies will be used in the future.

In addition to numerous researchers, academics, and employers, many professional organizations are actively working toward validating, creating resources, and providing education in nursing informatics. These include the:

* American Academy of Nurses (AAN) <https://www.aannet.org/expert-panels/ep-informatics--technology>
* Alliance for Nursing Informatics (ANI) <https://www.allianceni.org/>
* American Nursing Informatics Association (ANIA) <https://www.ania.org/>
* American Medical Informatics Association (AMIA) Nursing Informatics Working Group (NIWG) <https://www.amia.org/programs/working-groups/nursing-informatics>
* Health Information and Management Systems Society (HIMSS) Nursing Informatics Community <https://www.himss.org/membership-participation/nursing-informatics-community>

**Preparation and Certification for Nursing Informatics Specialty Practice**

Today’s evolving healthcare system with its global complexity and insatiable reliance on data, information, knowledge, and technology substantiates the call of multiple organizations for nursing and healthcare informatics competencies as a part of professional practice. Figure 9. Informatics Competencies for All Registered Nurses depicts the need for informatics education

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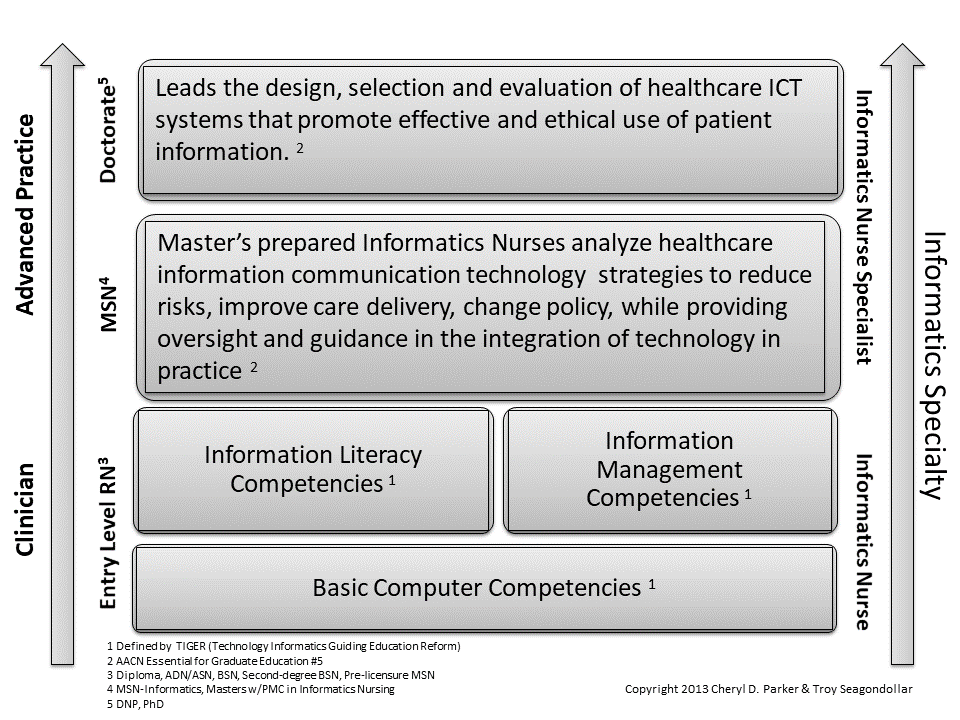


Figure 9. Informatics Competencies for All Registered Nurses

(black and white model for publisher)

in all levels of nursing, from both the clinical and educational points of view, as well as for

those nurses who specialize in informatics. Informatics education must be foundational for all entry-level nurses. Over time, as their education, knowledge, and skills increase, nurses grow in their understanding of how to use information and technology to enable them to provide better patient care. Finally, as newer and better ways of using technology (innovation) emerge, nurses who specialize in informatics nursing will have a leading role.

In the future, the rapid pace of technological change, along with the generation of information and knowledge, will present challenges for the maintenance of competencies for nursing informatics. Nurses must understand the need for achieving basic competence in nursing informatics; professional organizations must continue to embrace informatics as a foundation for professional practice; and faculty must make NI an integral part of curricula at all levels of nursing education, as well as stimulate continued research. It is the responsibility of informatics nurses to be the resource for these initiatives.

Because nursing informatics requires a significant understanding of numerous clinical workflows, it is advisable for an aspiring informatics nurse to spend several years in patient care or in other clinical practice experiences in numerous departments and roles. As informatics nurses continue to educate themselves through formal programs or through work experience in informatics-focused areas of practice, they will become more comfortable in taking on greater levels of responsibility and accountability reflective of nursing informatics practice. Becoming a subject matter expert for a specialty role, whether academic, clinical, or administrative, will further enhance the nurse’s understanding of the nuances involved in developing, maintaining, and optimizing technology that impacts nursing in all realms.

Since 2004, the Health Information and Management Systems Society (HIMSS) has surveyed the nursing informatics community to gain an understanding of the roles and responsibilities of the informatics nurse professional. The most recent Nursing Informatics Workforce Survey (HIMSS, 2020), supported by the HIMSS Nursing Informatics Community, builds on the previous 16 years HIMSS research. This survey captured current professional status and practice trends while identifying changes that have occurred in the nursing informatics workforce. The 1,359 survey respondents reported that 66% had completed graduate or higher degree educational preparation in nursing, nursing informatics, or some other field; 68% worked for a hospital or multifacility health system; and the majority earned a base salary between $61,000 and $115,00. Further details are available at <https://www.himss.org/membership-participation/nursing-informatics-community>.

Accredited graduate-level educational programs for the NI specialty nursing practice were first offered in 1989. Now graduate, doctoral, and postdoctoral degrees are more widely available via online and in-person learning programs. Lifelong learning can easily be accommodated by free nondegree online courses that offer open, unlimited, global enrollment in massive open online courses (MOOCs), other distance education, and online programs. The current trend of requiring a graduate-level informatics degree is expected to continue and become the professional specialty practice standard.

**Certification of Informatics Nurses**

Professional certification as an informatics nurse became a reality in late 1995 when the American Nurses Credentialing Center (ANCC) offered the generalist-level nursing informatics certification exam as its first computer-based examination. As of December 31, 2019, the ANCC reported that 2,816 nurses have active credentials of board certification in nursing informatics (<https://www.nursingworld.org/~49a2df/globalassets/docs/ancc/ancc-cert-data-website.pdf>). Applicants currently must have at least a BSN or baccalaureate degree in another related area, have completed the specified continuing education credits, and have worked in informatics practice for the designated number of hours. (More details are available at <https://www.nursingworld.org/our-certifications/informatics-nurse/>.) Informatics nurses and informatics nurse specialists may elect to pursue other pertinent certifications in areas such as project management, security and privacy, health information systems management, network management, and knowledge management. Employers are beginning to move from a preference to a requirement for certification for hiring, advancement, and promotion decisions.

**An Advancing Professional Nursing Specialty**

The blending of clinical background, on-the-job training, refined and focused informatics competencies, informatics certification, and the increase in formalized informatics education are proof of an advancing professional nursing specialty that is ideally suited to lead in an informatics-based U.S. healthcare system. Employers are beginning to recognize the value and contribution of informatics nurses and are even requiring completion of graduate or higher-level educational preparation for hiring. Similarly, the informatics nurse specialist title is becoming more familiar. As the importance of nursing informatics continues to be recognized, the future should see a rise in executive-level or C-Suite nursing informatics positions, such as “Chief Nursing Informatics Officer,” in clinical, business, vendor, and IT arenas. In addition, the need for nursing informatics professionals in governmental roles will be recognized at the local, state, regional, and national levels. Nurses with an interest in informatics have many avenues through which to pursue their specialty practice over the years.

**Ethics in Nursing Informatics**

Ethics is foundational in the work of the IN and INS. The implementation of an information technology solution (ITS) accrues significant advantages and benefits for patients and care providers. However, often ethical decision-making issues and unintended consequences emerge. The IN and INS serve as an interface and may even be a safety net between the patient and information technology.

The *Code of Ethics for Nurses with Interpretive Statements* (ANA, 2015a) provides a framework for ethical practice for all nurses, including those in the IN and INS roles. This section will discuss how the 9 provisions of the ANA code of ethics apply to the IN and INS in their practice.

**Provision 1: *The nurse practices with compassion and respect for the inherent dignity, worth, and unique attributes of every person.***

The role and responsibilities of the IN and INS involve interaction and collaboration with many different people with various areas of expertise, values, priorities, and views. In working with others, the IN has a responsibility to advocate for the dignity, worth, and unique attributes of patients (including families, groups, communities, and populations) and caregivers. Team collaboration that is essential to successful information systems in health care is created, enhanced, and preserved through the informatics nurse's compassion and respect for each person on the team. For instance, while a hospital is preparing for accreditation, they might propose a technology to solve this problem. However, when discussing implementation, clinical nurse representatives bring examples of how this has unintended effects on the patient. The role of the IN is to carefully listen to all stakeholders, critically think, and communicate back all views to assure the best possible choices and outcomes.

**Provision 2: *The nurse’s primary commitment is to the patient, whether an individual, family, group, community, or population.***

The IN is primarily responsible for assuring that the needs of each patient are recognized and respected when implementing and using safe and effective technologies. The informatics nurse consciously works to achieve results that will directly or indirectly benefit patient care, safety, and well-being. This involves careful consideration of the ethical and unintended effects resulting from the implementation of new and existing technologies. The IN will assess and monitor new technologies and potential harm and assure the patient voice is heard and considered. For example, an institutional committee would like to monitor the smoking status of patients upon admission. A proposal is made to mandate this in the assessment. Staff from the neonatal unit and ICU's express their concerns that these required questions are inappropriate for patients on their units. The IN helps assure that a solution is found that assures that the assessment questions are appropriate for each patient. The IN addresses the system’s mandates and inconsistencies to ensure quality patient centric care and appropriate clinical decision making.

**Provision 3: *The nurse promotes, advocates for, and protects the rights, health, and safety of the patient.***

As the patient advocate, the informatics nurse collaborates in the development, implementation, support, and monitoring of technologies to assure there is a balance between the following priorities: (a) patient safety, autonomy, and rights; (b) quality improvement efforts; (c) provision of safe care; (d) appropriate information communication; (e) data management. The informatics nurse considers and integrates ethical principles (e.g., autonomy, justice) that support the rights and safety of the patient. For example, when new technologies are implemented (such as new-generation wearable insulin pumps or cardiac devices) the IN not only focuses on what the information technology solution does for the patient but also what it does with or to the patient. The IN collaborates with the health team in assuring awareness of ethical and unintended impacts such as a breach of data privacy, loss of autonomy, etc.

**Provision 4: *The nurse has authority, accountability, and responsibility for nursing practice; makes decisions; and takes action consistent with the obligation to promote health and to provide optimal care****.*

The informatics nurse uses best practices in informatics to collaborate in the development, implementation, support, and maintenance of systems that support ethical nursing practice. The informatics nurse supports clinical care providers in their efforts to learn about, understand, and use ITS in a way that supports ethical patient care and promotes the patient's welfare. The IN and INS are responsible for identifying, considering, evaluating, and discussing unintended effects and ethical issues resulting from the implementation of new health technologies. For example, the IN and INS have a responsibility to assure that the privacy and security of the patient data being accessed meet the highest ethical standards and federal privacy requirements with the goal of protecting the rights of the healthcare consumer. The increasing frequency and intensity of cyberthreats create new monitoring strategies and require significant educational programs for patients and staff.

**Provision 5: *The nurse owes the same duties to self as to others, including the responsibility to promote health and safety, preserve wholeness of character and integrity, maintain competence, and continue personal and professional growth.***

The IN and INS are responsible for maintaining currency in informatics and other health technologies theories and practice through lifelong learning. This includes awareness and understanding of ethical issues resulting from the evolution and implementation of new technologies. For example, the IN and INS need to consider how to secure data being collected and integrated into larger systems from wearable technology and how these data should be protected. Systems must be in place to support professional development and learning, including enhanced ethics content that helps address the increasing complexities in healthcare technologies.

**Provision 6: *The nurse, through individual and collective effort, establishes, maintains, and improves the ethical environment of the work setting and conditions of employment that are conducive to safe, quality health care.***

The IN and INS collaborate in the development, implementation, support, and maintenance of informatics systems that support and improve the delivery of care, appropriate communication of health-related information, data storage, protection of confidential information, and management of the enterprise. The IN and INS are responsible for monitoring and evaluating newly implemented health technologies for unintended effects and ethical issues. They also have the responsibility to communicate and problem solve any issues resulting from the implementation of new technologies (e.g., clinical workflow and efficiencies) within their interprofessional and leadership domains.

**Provision 7: *The nurse, in all roles and settings, advances the profession through research and scholarly inquiry, professional standards development, and the generation of both nursing and health policy.***

  The IN and INS seek to advance the quality of nursing and informatics practice. As a specialty, nursing informatics offers both masters and doctoral degrees in which students can gain the advanced nursing education necessary to add to the body of informatics knowledge, including the knowledge of ethics as it pertains to nursing informatics, and the credentials to teach informatics to the next generations of nurses. Informatics nurse specialists are prepared to improve administration, education, and research in nursing informatics and to enhance the dissemination of that knowledge.  Advocacy and policy development are key activities for all informatics nurses.

**Provision 8*: The nurse collaborates with other health professionals and the public to protect human rights, promote health diplomacy, and reduce health disparities.***

The IN and INS collaborate in efforts to develop systems that allow system interoperability and data and information transfer and aggregation yet respect the patient's rights to privacy. They address integration of social determinants of health data within systems to help describe the context of healthcare, identify disparities, promote standardized coding and categorization of concepts.

**Provision 9:*The profession of nursing, collectively through its professional organizations, must articulate nursing values, maintain the integrity of the profession, and integrate principles of social justice into nursing and health policy.***

The IN and INS participate in the informatics work of professional nursing associations, in national and international health informatics organizations, in vendor organizations, and policymaking to articulate nursing values, ensure that patient-centricity is always maintained, and shape social and health policy for the benefit of all persons. The IN and INS are the advocate for the patient by raising issues and concerns at the healthcare and professional organization, local, state, and federal levels.

**The Innovative Future of Nursing Informatics**

In today’s society, our diverse populations have varied experiences and comfort levels with technology. However, technological comfort and expertise is now essential as a baseline to provide health care. For the first time in history, generations exist who have never known a world without the daily use of hardware (e.g., laptops, mobile devices), software (e.g., apps, websites) and networks (e.g., Wi-Fi, internet access). Such individuals, or digital natives, who were raised using this technology, are now entering the healthcare field as knowledge workers, as well as consumers of healthcare services.

As a profession, nurses must recognize the innovative future of nursing informatics and the emerging trends that are already beginning to make an impact on the profession. To be innovative is to bring forth purposeful change through new products, services, and processes that address current unmet or emerging needs within a target population (Kelley, 2019; Weberg, 2009). The specialty of nursing informatics has historically introduced innovative roles in nursing, new technologies to address essential aspects of patient care, and new models of care which often need innovative nursing informatics solutions. As new informatics innovations emerge, new regulatory requirements and care quality standards also emerge to ensure patients are receiving quality care.

Thus, the four identified trends that will continue to influence the innovative future of nursing informatics include: (1) evolving roles of informatics nurses, (2) increasing informatics competency requirements for the nursing profession, (3) applying rapidly evolving technological advances to nursing and health care, and (4) enhancing new and emerging federal regulations and foci to support the delivery of quality care. All four trends are further described within this section.

1. **Evolving Roles of Informatics Nurses**

This edition of the *Nursing Informatics: Scope and Standards of Practice* emphasizes the broad range of roles in which informatics nurses support the delivery of quality health care while leveraging their integral informatics expertise. The scope of nursing informatics roles will continue to expand as further technologic innovations are developed for healthcare delivery solutions. Today, and in the future, nursing informatics represents a world community and touches every nursing professional.

Not a single nurse can provide health care today without the use of informatics knowledge, skills, and abilities to deliver quality care. As a result, nurses who rely on information and technology for virtual care, telehealth services, quality metric evaluation, and/or product invention, design, development, and commercialization may be considered informatics nurses in their professional roles. Therefore, the perceived “traditional” role of informatics nurses as nurses who design, test, implement, and evaluate informatics solutions such as electronic health records (EHRs), is only one of many available roles for nurses to hold within the field of informatics.

Experienced informatics nurses will continue to be found in hospital and healthcare organizational settings. However, these specialty providers will also begin to further permeate additional areas of health care where digital technologies are of interest to the industry. Some areas where informatics nurses and informatics nurse specialists are and will be found as expert resources include state and federal government agencies (e.g., Centers for Medicare and Medicaid Services, Office of the National Coordinator), regulatory and accreditation entities (The Joint Commission), commercial vendors and entrepreneurial ventures, health agencies and foundations, special interest groups, academic educators, researchers, and even supporting the care of those returning from space! In all these roles nurses will have access to massive amounts of data, analytics, artificial intelligence and machine learning to translate science that is timely, relevant, and driven by outcomes.

Nurses will play central leadership, practitioner, researcher, and technology insertion roles as members of interprofessional and diverse healthcare teams. By participating in an inter-professional team, informatics nurses are using a shared set of knowledge, skills, and associated abilities of their respective profession and specialty to craft solutions that meet the needs of all stakeholder groups. Additionally, the “digital divide” remains, as significant numbers of people have little access to or experience with information technology. Informatics nurses must also take the lead in eliminating the digital divide for those with and without access to information. In all situations, informatics nurses and informatics nurse specialists can advocate and apply methods so that users can learn and use new technologies effectively and safely.

1. **Increasing Informatics Competency Requirements for the Nursing Profession**

Today, every nurse must have some knowledge, skills, and appreciative competency toward the use of informatics and information technology in the delivery of quality care. The number and complexity of informatics competencies will continue to evolve in order to meet the current and emerging informatics professional roles. Some of the core informatics competencies once ascribed to informatics nurses and informatics nurse specialists are now mandatory for all nurses (e.g., computer literacy and information literacy). However, today and in the future, these core informatics competencies will alone be insufficient for nurses to deliver care safely, efficiently, and effectively. Similarly, the current standard of nursing informatics competencies required for INs and INSs will be ever increasing to meet the expertise needed for these individuals to invent, design, develop, implement, and diffuse new innovative informatics solutions in healthcare settings across the world.

In the past several years, nursing specialties have incorporated informatics into their practice. Probably the clearest trend is ongoing change in the functional areas for informatics nurses and informatics nurse specialists, moving from a generic set of skills toward a shared set of competencies based on functional areas required to enact a particular position. These competencies now extend beyond baseline computer and information literacy to also include proficiency in informatics:

* knowledge surrounding topics such as data, education, privacy and security, usability and data mining (Sipes, McGonigle, Hunter, Hebda, Hill & Lamblin, 2016; Skiba, 2016)
* skills to address data analysis, data structures, fiscal management, programming, and systems development life cycles and communication across technologies (Sipes, McGonigle, Hunter, Hebda, Hill & Lamblin, 2016; Skiba, 2016)
* attitudes to lead and drive the future of informatics in the development of new innovations and conducting research to uncover new knowledge needed to delivery optimal care (Sipes, McGonigle, Hunter, Hebda, Hill & Lamblin, 2016)

Currently two validated instruments assess and measure nurses’ informatics competencies at the basic and advanced levels in a complimentary manner. The two instruments are the TIGER based Assessment of Nursing Informatics Competencies (TANIC©) for basic competencies and the Nursing Informatics Competency Assessment (NICA-L3/L4©) which includes Level 3, the informatics specialist and Level 4, the informatics innovator (Hebda, Hunter & Czar, 2019; Sipes, McGonigle, Hunter, Hebda, Hill, & Lamblin, 2016; Skiba, 2016). The TANIC© instrument differentiates between the basic and advanced nurse while the Nursing Informatics Competency Assessment L3/L4 (NICA-L3/L4©) is used to measure the competencies of an informatics specialist and the informatics innovator (Sipes, McGonigle, Hunter, Hebda, Hill, & Lamblin, 2016). Together, these two instruments allow for comprehensive assessment of informatics competencies and hold international recognition. The tool developers recommend future research to investigate how to reduce time to complete the tool by the nurse.

The four informatics nurse competencies from level 1 (L1) to level 4 (L4) are outlined briefly below.

* Entry Level Nurse (L1): Demonstrating basic computer literacy, information literacy, and information management.
* Experienced Nurse (Level 2): Proficiency in understanding the relationship between nursing and health IT for the delivery of optimal evidence-based practice and knowledge development.
* Informatics Nurse Specialist (Level 3): apply advanced information management skills and techniques to advance clinical practice and education while also demonstrating leadership capabilities.
* Informatics Innovator (Level 4): Design and execute on new research studies, analyze data for new insights, evaluate effectiveness of new informatics solutions, develop new competencies, and information technology solutions.

1. **Applying Rapidly Evolving Technological Advances to Nursing and Health Care**

Informatics nurses and informatics nurse specialists must be prepared to address the rapidly evolving technologies that are emerging incrementally, as well as those exponential technologies, to best support their clinicians. Incremental technological innovations enhance existing technologies while keeping the currently established framework. An example of this might be adding on a new feature to an in-use existing technology (e.g., wearable, electronic health record, smart pump). Exponential technologies disrupt the status quo and transform care in ways that current solutions cannot do through incremental changes. These technologies also are not often easy to predict or plan for but can transform healthcare delivery (Harrington, 2018).

Clinicians are using these existing incremental technologies and will be expected to use exponential technologies in the future to deliver care that results in decreased barriers, increased access, improved outcomes, and increased patient engagement in their own health. To best leverage these technological advances, INs and INSs must be aware and knowledgeable to address the system development life cycle within their healthcare organizations. Technological areas where informatics innovations will emerge include artificial intelligence, gaming and virtual reality technologies, hardware devices, educational technologies, knowledge representation, machine learning, nanotechnology, robotics, population health management, syndromic surveillance, and telehealth technologies.

*Gaming and Virtual Reality Technologies*

Gaming and virtual reality technologies hold great potential to support patient education and engagement while improving wellness in health care. Virtual reality worlds (e.g., Second Life©) allow consumers to interact with providers to seek care at a distance. Avatars are used by the Department of Defense to support patients with posttraumatic stress disorder (PTSD) (Rizzo & Shilling, 2017). Virtual realities also provide the potential for some patient anonymity (where appropriate) to seek care. Nursing informatics involvement is needed to bridge solutions that support virtual health worlds as well as complement face-to-face care with virtual care. Healthcare education and research can be conducted within a virtual world (Bauman, E., 2016).

*Hardware Devices*

Informatics nurses and informatics nurse specialists must understand the available hardware devices and associated applications to support access to data, information, knowledge, and wisdom for the appropriate user. In recent years, the introduction of many different types of hardware devices has supported healthcare delivery through technological platforms. The diffusion of mobile devices (e.g., smart phones, tablets, and wearables) across the globe over the last decade has changed the accessibility and availability of information to all. Additionally, such hardware devices introduced the opportunity to change existing health information technology solutions and lead to the development and deployment of new solutions.

Acceptance of hardware solutions among the public offers the opportunity to address data, information, and knowledge needs that could not be met through other devices, software application models, and/or payment models. Additionally, the call to action to address nurse burnout from the National Academy of Medicine’s report in 2019 through existing technologies requires evaluation of how to address ergonomics, human-computer interaction, and user experience to improve and enhance the experience of health IT on diverse workflow requirements.

Such mobile device solutions, paired with the complimentary software applications, are now ubiquitous in everyday life. They must also be incorporated into our healthcare delivery system in ways that meet the expectations of clinicians and patients on their interactions with technology. Examples of hardware device technologies that will impact INs, INSs, clinicians, patients, and healthcare consumers include:

* Wearable devices to track consumer health data from vital signs to blood sugars and arrythmias
* Devices with mobile and web-based cloud applications to support access to personal health information
* Devices with mobile and web-based cloud applications to support workflow information needs of healthcare professionals
* Sensors to support data monitoring and diagnostic tools for patients at home and in healthcare settings
* Proximity badges and RFID (radio-frequency identification) to track providers for workflow or allow logon to systems.

*Educational Technologies*

Evolving teaching technologies are changing the education techniques used in the classroom, the lab, and the clinical setting. Software programs have been developed to assist nursing and medical students to learn physical assessments via simulated practice with a digital patient, document in an electronic medical records system, and explore medical concepts in three dimensions in a virtual world (Shadow Health, 2020). Patient care simulation activities allow students to run programmed care scenarios in a safe environment and provide innovative options for teaching and fostering critical thinking skills (Sternberger, 2012). Group learning tools, such as electronic reminders, polls and scoring used in interactive teaching, can change how students engage with class content, as well as how they learn to function as members of a team (Michaelsen, n.d.).

Distance education technologies, web-based and cloud-based collaboration (such as web-based course management systems and the related student support services), are challenging basic education concepts such as what academic resources must be included in a library collection or how a university defines a credit hour of education. This automation is forcing institutions to review, and in many cases to revise, their educational policies and curriculum plans. Information is now generated and made available so quickly that baseline knowledge for students will evolve away from specific content to methods of finding accurate, current information and knowledge. The INS will be at the center of this union of informatics and new educational models because of the INS role’s focus on managing information. The innovative future of nursing informatics requires acceptance of a paradigm shift in knowledge delivery, which affects students, instructors, and course content, and creates significant opportunities for innovative informatics nurses.

*Interoperability*

Interoperability is the ability to seamlessly exchange data and information between two or more disparate information systems. While the vision for data interoperability from Health Level 7 dates back several decades (HL7.org, 2020), recent developments at the Centers for Medicare and Medicaid Services (CMS)’s and the Office of the National Coordinator (ONC) in the last few years have led to a focus on operationalizing interoperability across the healthcare information systems. *(More details of such federal initiatives are described in the next section).*

To reach data interoperability, INs and INSs must be knowledgeable of all three levels of interoperability. The three levels are technical, process, and semantic interoperability. Technical interoperability is the functional need of moving the data between systems (Kelley, 2016). The data may move unidirectionally or bi-directionally and in single data elements or in documents. HL7 has several interoperability standard versions (V2, V3, CDA and FHIR) that are currently in use or will soon be in use in healthcare organizations across the globe (HL7.org, 2020). Yet, before making data interoperable, INs and INSs must be prepared to advise on the process flows of the data needs between systems. Lastly, INs and INSs will need to ensure that the meaning of the data elements being exchanged are semantically equivalent in meaning and nature. For example, only a clinician will be able to know if a heart rate in one system is the equivalent of a pulse in another system or if the two fields differ in semantic meaning (Kelley, 2016). When considering any interoperability solution, cybersecurity of the data that resides within the systems and also exchanged between systems, must be considered and addressed. The National Institute of Standards and Technology (NIST) provides guidance on cybersecurity frameworks for healthcare (NIST.gov, 2020).

*Knowledge Representation*

Electronic data are now available for and about patients over their lifetime. Clinicians need tools to help locate and synthesize these data remotely and securely. Innovative technology is being used to allow the wireless display (via smartphones, tablets, laptops, etc.) of data to clinicians to optimize patient care and enhance patient and clinician efficiencies, while avoiding medical errors.

NI practice now requires that more nurses be educated about knowledge representation, semantic representation, and other knowledge areas, including use of standardized language that supports nursing practice and decision-making. This also has implications for knowledge discovery in databases, data quality, and a continued emphasis on data standards and data quality.

Nurses constantly make complex and diverse decisions in their daily practice. Decision-making must consider relevant evidence-based and patient-specific information. As nurse decision-making becomes more complex, the need for computerized clinical decision support will increase. In the absence of explicit evidence-based guidelines for nursing decisions, novel technologies will be necessary to synthesize evidence from the literature or induce models from clinical data. Knowledge discovery in databases could play an important role in the induction of clinical knowledge models. Informatics nurses must partner in the planning of and forward thinking about maintenance and evaluation of legacy data, mandates for interoperability, and data conversion and retention, as well as accessibility for future use.

*Machine Learning*

Machine learning is the most common form of artificial intelligence of increasing prevalence and importance in nursing and health care today. Machine learning uses data to develop models that can be used to anticipate the future trends of healthcare needs (Davenport and Kalakota, 2019). Such models may be used to anticipate or predict individual level outcomes or population level outcomes depending on the technology’s design and purpose. During the 2020 pandemic, data models were used by the Coronavirus Task Force and individual states to anticipate the surge of positive cases among the population, hospitalizations, and unfortunately also deaths. Such machine learning models were resources used to develop mitigation strategies for the public, anticipate bed space needs, staffing needs, PPE and ventilator needs and more. With exorbitant amounts of digital data and information technology professionals trained in writing machine learning algorithms, INs and INSs are essential to providing the insight needed to ensure the models answer the clinically and statistically significant questions which will inform strategic and operational decision making.

*Nanotechnology*

Nanotechnologies use microscopic materials from atomic and molecular structures to develop new devices. A common example of a nanotechology was the iPod Nano from Apple which used microscopic chips to store music files. The microscopic chips and materials allowed for the development of a significantly smaller product than that of the traditional iPod. In health care, nanotechnologies are developed for three primary areas: pharmaceutical drug delivery, monitoring devices for patients, and the regenerative technologies (Staggers, McCasky, Brazelton, and Kennedy, 2008). The application of this technology for healthcare delivery uses (nanomedicine) will have an impact on the diagnosis and treatment of many diseases and conditions (Huston, 2013). The implementation of this technology for patient care applications requires education in its safe use as well as ethical practices for nurses as well as for the consumer (Staggers, McCasky, Brazelton, and Kennedy, 2008).

*Population Health Management*

Never before has the healthcare industry been posited with such meta amounts of digital data available at the element level. With such data, a growing trend is emerging to find new ways to support the health of patient populations. Nursing informatics, paired with informatics nurses and informatics nurse specialists, will be able to provide tools that allow for efficient, effective, and accurate data collection, analysis, and reporting of population health specialty data by the use of standardized variables in interoperable electronic documentation systems (Kelley, 2016). Population health data becomes a useful tool to support research, inform policy, and identify best practices to enhance treatment of national population health concerns.

*Robotics*

The use of robotics in nursing and health care is another form of artificial intelligence that is transforming health care and will continue to do so. Robots are increasingly used to support nurses and healthcare professionals with upwards of 30 percent of daily activities (Schwab, 2019). These activities include delivering supplies to patient care areas, enabling remote surgeries, virtual reality based surgical procedure training, and serving as translators for patients. Hand-assist devices help patients regain strength after a stroke, and robotic technology is being used for immediate patient assessments (Leventhal, 2020). Robots also provide a remote presence by allowing clinicians to virtually examine patients by manipulating remote cameras.

Robotics are also being used in provision of patient care: for instance, to help lift morbidly obese patients, to assist patients who have had traumatic injuries, and in other innovative applications (Robotics-Technology-Healthcare Robotics, n. d.). A notable use is the research underway for using robotics to assist paralyzed patients to walk (Houlihan, n. d.). However, a recent study revealed that robots are being used globally in nursing care areas beyond typical day-to-day processes providing physical health. In many cases, robots are being used with aged patients for companionship, differing from the typical use of mechanical and repetitive-type motions (Carter-Templeton, et al., 2018). Furthermore, a recent patent analysis revealed that many areas of nursing may benefit from robotics and the field of robotics in nursing is emerging, yet to be determined is the appropriate place to integrate robotics in the delivery of nursing care (Frazier et al., 2019).

*Syndromic Surveillance*

Syndromic surveillance or monitoring of the burden of communicable disease in a geographical area can be performed in multiple ways. Historically, school absenteeism records (Rodriguez, et.al., 2009) and management of immunization data (Hinman & Ross, 2010) and public health record data at the state and federal levels (HealthIT.gov, 2020), all provide insights into the potential of population-level data. Another evolving source for surveillance of disease is that of the electronic health record (EHR). EHRs have the potential to assist in monitoring the health status of our populations in a cost-effective and timely way. A more comprehensive and precise assessment of population health can be gathered when EHRs are used in combination with other sources of data (Perlman, et al., 2017). School health and public health nurses are leading movements to standardize variables and data collection processes that will enhance this ability. This potential for research and analysis is exemplified in the data collected by school nurses on more than 95% of the school-aged population. Other examples of this potential will be driven by business globalization, the threat of bioterrorism, and addressing pandemic health concerns on a rapid basis such as 2020’s coronavirus pandemic. The desire for improved disease management across traditional boundaries will lead to a demand for new population health tools and solutions.

*Telehealth*

Telehealth tools and emerging technologies are positioned to change the face and practice of health care. Nurses using informatics, telehealth tools, and new, transformative technologies will be well positioned to interact with and virtually care for their patients. These services will vastly expand in areas such as primary care, mental health, and initial specialty service consultation visits where the patient and provider primarily require verbal discourse for the visit. Such expansion of services will likely increase the volume of patients seen who were otherwise unable to physically travel to the appointment. As a result, the number of brick-and-mortar practices will likely decrease and an increasing number of clinicians and specialists available to provide telehealth services for a fraction of traditional cost and at the click of a button, will increase.

The United States saw an immediate surge in adoption of telehealth services during the COVID19 pandemic. Nearly overnight, the technology became accepted as a model for care, with a payment structure that also met the federal and state expectations to better serve patients in need of non-urgent medical care services. Through telehealth services, patients in rural ICUs can be monitored remotely by intensivists and ICU nurses. Less experienced critical care nurses can be remotely mentored by experienced nurses. Pharmacists can provide remote pharmacologic assistance to rural areas. Radiologists can read images in real time from anywhere in the world.

*Transforming Health Care through a Connected Healthcare System*

While each of the presented technologies may address a specific healthcare opportunity, these solutions cannot exist in isolation from one another. Additionally, INs and INSs must be knowledgeable not just of how these solutions work and for what healthcare workflow needs but also how these solutions may or may not work together in the given healthcare environment. Thus, the interconnectedness of hardware devices, software solutions, middleware platforms, networks, data exchange models, cybersecurity principles and more require expertise and oversight that contributes to an ongoing learning health system. Such expertise must exist from the data element level to that of vision casting for the future through strategic and operational planning for the healthcare organization’s informatics and health information technology needs to deliver care.

1. **New and Emerging Federal Regulations and Foci to Support the Delivery of Quality Care**

The design and evolution of healthcare systems, organizations, and enterprises, as well as the regulatory environment and actual models of care delivery, must be integral and primary considerations for any new information technology solutions. The Health Information Technology for Economic and Clinical Health (HITECH) Act as part of the American Recovery and Reinvestment Act (ARRA) of 2009 stimulated the rapid adoption of electronic health records (EHRs) across the United States. The HITECH Act set forth the “Meaningful Use” program to provide incentives to eligible hospitals and providers who meet the established criteria. In 2018, the meaningful use program was renamed to Promoting Interoperability. The continuing federal requirements to meet set standards supports the increasing pace of adoption and advancement of our ability to use, access, and exchange clinical health data for optimal care delivery.

INs and INSs will be essential in supporting the strategic and operational expertise needed to meet the current and future requirements. History demonstrates that national adoption of new health information technologies is dependent upon a payment framework through either the federal, state or private level. As CMS is the largest payer of health care services, regulatory requirements have influenced the advancement of our digital health information technologies over the last several decades. Yet, at the start of 2020, the nation saw the clinical need for health care during the COVID-19 pandemic transform the use of telemedicine and licensure in a matter of weeks. The clinical need drove the regulation instead of the regulation driving the technological solution. Perhaps we are on the brink of seeing the driving force for new health care technologies shift to that of the user, a need that nurses, doctors and health care professionals have advocated for quite frequently in the last decade. Informatics nurses and informatics nurse specialists can help continuously advocate for this shift and strategically influence the next generation of health care information technologies.

*21st Century Cures Act*

At the end of 2016, the 21st Century Cures Act was enacted to accelerate the use, design, and development of new technologies needed to support care delivery. Healthcare innovation is more complex due to many barriers including regulatory requirements, reimbursement models, and a pervasive risk-averse nature of health care which collectively leads to slow adoption rates. The Cures Act included many provisions. Some of those provisions that directly relate to informatics and information technology include advancing the development of medical devices and digital health applications through the Food and Drug Administration (FDA).

In addition to medical device and app development, the Cures Act set the stage for a national focus on health data interoperability at healthcare systems levels and also improve patient access to their own health data through secure and standard frameworks. On March 9, 2020, two new rules were introduced to advance national interoperability of data using APIs, remove acts of information blocking, and ultimately advance consumers’ access to their own patient health data using reasonable effort. These rules mark a transformative move to provide a technical and clinical infrastructure to support the delivery of optimal care delivery while under the care of healthcare professionals and also set the stage for consumers to be active participants in their own health. These rulings will require informatics nurses and informatics nurse specialists to be competent in understanding data standards, interfaces, HL7, FHIR APIs, and workflow processes to optimize the design for our healthcare professionals, patients, consumers and families.

**Implications of the Innovative Future for Nursing Informatics**

Every nurse will have an informatics role in the future of health care. Informatics nurses and informatics nurse specialists will have a role in ensuring that the new technologies and approaches address the care needs while also meeting the needs of the users for safe, timely, patient-centered, equitable, efficient, and effective care. INs and INSs will need to devise the best methods of care and also design solutions that enable patients to monitor and maintain their own health. INs and INSs will play a key role in designing new tools for data capture and analyses to comply with regulatory guidelines. In partnership with these roles, nursing informatics professionals must be knowledgeable of rules, regulations, and responsibilities surrounding the use of these technologies.

The evolving roles of informatics, increasing informatics competency requirements, rapidly evolving technological innovations, and new trends in healthcare delivery regulations and foci will continue to influence the future of nursing informatics. Clinicians are now available in retail stores, work settings, and other nontraditional places. These new settings require new design, deployment, and support models that will challenge the informatics nurse specialist. New technologies will create wider access to information and the need for a new generation of data and information management skills, analytic tools, educational models, and cognitive skills. Traditional boundaries of institutions, care delivery, and education will continue to shift and evolve. New positions and functional areas are emerging. Increased collaboration among nursing informatics colleagues and a shared scope and standards of practice will continue to be a characteristic of the future.

**Essential concepts for current and future innovations in informatics and health IT include:**

■ Preparing for technology innovations through competencies in evidence-based practice, evidence-based innovation, and data quality evaluation.

■ Introducing and delivering new educational models to teach a workforce with diverse competency levels with computer and information literacy.

■ Designing, developing, implementing, and evaluating solutions for innovative incremental and exponential health information technologies across all areas of nursing and health settings.

■ Incorporating emerging technologies and methods to facilitate access and care provision, research, and administrative processes.

■ Participating in global public and private initiatives to proactively and retroactively evaluate disease patterns and trends

■ Proactive risk mitigation through 24/7 operations, monitoring and high reliability testing

■ Developing and designing new technological solutions with minimal system implementation resource efforts and upgrades

■ Scalable cloud-based technologies requiring minimal downtime efforts to upgrade

Begin to think beyond today. This edition of *Nursing Informatics: Scope and Standards of Practice* presents the current and future state as a structural framework for the specialty practice of nursing informatics. However, where the specialty field advances to next will largely depend on the deliberate forward-thinking actions of informatics nurses and informatics nurse specialists. While individuals, families, communities, and populations will continue to need care across the lifespan, the digital software, hardware, and network solution innovations that emerge will offer new capabilities to use data and information for clinical care and decision making. Such solutions will require the specialty practice to frame how such solutions are designed, developed and built, implemented into workflows, and measured for patient health outcomes. Greater numbers of informatics nurses will lead in identifying and developing the next generation health information technologies.

Informatics nurses know firsthand from their own experiences and experiences working with other nurses and healthcare professionals where the data and information need gaps persist. The history of innovation reveals that the origins of new innovations to address unmet needs originate from the users at least 77% of the time (vonHippel, 1988). The nursing and healthcare professions are now well positioned to leverage this insight and emphasis on innovation in nursing at a national level to address pervasive needs affecting the profession and health care.

Beyond health information technology and informatics invention and innovation development, informatics nurses must also begin to look beyond the obvious more traditionally recognized roles within the field. Over the last ten to twenty years, the informatics roles for nurses have primarily resided within healthcare organizations (e.g., hospitals, health systems, provider practices) and vendors as analysts (e.g., clinical, application, business, workflow) working to select, design, build, test, implement, maintain and optimize electronic health records. With over 95% adoption rates in health systems and 75% in provider practices (National Academy of Medicine, 2018), those informatics roles will largely evolve into the next phase of digitalization in health care. Such opportunities will include efforts to support interoperability in alignment with the newly released rules from CMS and ONC in March 2020. In collaboration with interoperability will be the need to support a trusted network including advancements in privacy, security, and overall cybersecurity efforts in the healthcare industry. Additionally, the COVID-19 pandemic presented new needs for expertise in understanding how to access, use and evaluate data needed to understand population level health risks. Such expertise will be necessary to support public health initiatives such as epidemiological data modeling and contact tracing to provide recommendations at a population level as well as individual level of disease prevention and promotion. Such anticipated future roles are just a few of the many that will need the expertise and competence of informatics nurses and informatics nurse specialists. We as a collective specialty practice must embrace the forthcoming changes and proactively step into these roles through continued educational efforts, competency development, and leadership efforts to share such a vision for the future.

As we continue to advance the specialty practice of nursing informatics and invent new technologies to support optimal care delivery, the environment will be expected to continue to change and evolve over the next 5 years. INs and INSs are the nursing leaders who will need to foresee the innovative future of nursing informatics and identify the data, information, knowledge and wisdom needs of patients, families, and the healthcare team. As you continue to work within the field, consider the unmet needs of the target population and the technologies that could help meet those needs. INs and INSs hold the potential to drive the strategic vision for the nursing profession’s future.

**Standards of Nursing Informatics Practice**

The 2015 *Standards of Professional Nursing Practice*, on which the Standards of Nursing Informatics Practice are based, are authoritative statements of the actions that all registered nurses, regardless of role, population, or specialty, are expected to perform competently. The standards published herein may be utilized as evidence of the standard of practice, with the understanding that application of the standards is context dependent. The standards are subject to change with the dynamics of the nursing profession, as new patterns of professional practice are developed and accepted by the nursing profession and the public. In addition, specific conditions and clinical circumstances may affect the application of the standards at a given time (e.g., during a natural disaster). The standards are subject to formal, periodic review and revision. The competencies that accompany each standard may be evidence of compliance with the corresponding standard. The list of competencies is not exhaustive. Whether a particular standard or competency applies depends on the circumstances.

**Standards of Practice**

**Standard 1. Assessment**

The informatics nurse collects comprehensive data, information, and emerging evidence pertinent to the situation.

**Competencies**

The informatics nurse:

* Conducts a needs analysis to define the issue or problem when necessary.
* Involves the healthcare consumer, family, interprofessional team, and key stakeholders, as appropriate, in relevant data collection.
* Assesses the needs of the healthcare consumer, family, interprofessional team, and key stakeholders, as appropriate.
* Uses evidence-based assessment techniques, instruments, tools, and effective communication strategies in collecting pertinent data to define the issue or problem.
* Uses analytical models and tools to facilitate assessment.
* Assesses information literacy of stakeholders and sponsors.
* Applies workflow analyses to examine current practices.
* Identifies potential impacts of an informatics solution.
* Prioritizes data collection activities.
* Synthesizes available data, information, evidence, and knowledge relevant to the situation to identify patterns and variances.
* Identifies data collection activities when exploring technologies that may assist the user in capturing appropriate data for the situation.
* Assesses technologies that enhance the automatic synthesis of available data, information, evidence, and knowledge relevant to the situation.
* Supports the development of technology that enhances care providers’ ability to capture relevant data.
* Assesses technology’s capacity to capture relevant data in a retrievable, standardized, and approved format.
* Documents relevant data in a retrievable format.

**Additional Competencies for the Informatics Nurse Specialist**

In addition to the competencies of the informatics nurse, the informatics nurse specialist:

* Identifies technology (devices, instruments, and tools) designed to enhance evidence-based assessment techniques in the collection and display of pertinent data.
* Analyzes systems to determine the best technologies that support clinical decision support, analytical models, and algorithms that facilitate assessment.
* Reviews gap-analysis performed by the IN.
* Conducts feasibility study using SWOT to assess the practicality of proposed solution.
* Contrasts current workflow and information flow to the proposed redesign.
* Identifies improved workflow design based on user experience and responses.
* Determines the impacts of computer information management technologies on time allocation and tasks of care.

**Standard 2. Diagnosis, Problems, and Issues Identification**

The informatics nurse analyzes assessment data to identify diagnoses, problems, issues, and opportunities for improvement.

**Competencies**

The informatics nurse:

* Diagnoses basic computer problems, needs, issues, and opportunities for improvement based on assessment of data and information management systems.
* Validates the diagnoses, problems, needs, issues, and opportunities for improvement with the healthcare consumer, family, interprofessional team, and key stakeholders when possible and appropriate.
* Identifies actual or potential risks to consumer’s health and safety in healthcare, or barriers to health by using data and nursing expertise in assessment activities to improve interpersonal, systematic, or environmental circumstances.
* Uses standardized clinical languages and decision support tools, when available, to identify problems, needs, issues, and opportunities for improvement.
* Documents problems, needs, issues, and opportunities for improvement in a manner that facilitates the discovery of expected outcomes and the development of a plan.
* Identifies issues related to usability and user experience.

**Additional Competencies for the Informatics Nurse Specialist**

In addition to the competencies of the informatics nurse, the informatics nurse specialist:

* Develops methodologies to diagnose problems, needs, issues, and opportunities for improvement.
* Substantiates the diagnoses, problems, needs, issues, and opportunities for improvement.
* Identifies information solutions used to diagnose problems, needs, issues, and opportunities for improvement that emphasize evidence-based practices.
* Defines the identified problems, needs, issues, and opportunities for improvement regarding clinical languages.

**Standard 3. Outcomes Identification**

The informatics nurse identifies expected outcomes for a plan individualized to the healthcare consumer or the situation.

**Competencies**

The informatics nurse:

* Involves the key stakeholders in formulating expected outcomes when possible and appropriate.
* Identifies expected outcomes that incorporate evidence and are achievable through implementation of evidence-based practices.
* Defines expected outcomes in terms of the stakeholders’ perspectives.
* Designs outcomes and process measures that optimize the development and application of technology and data solutions.
* Identifies expected outcomes that maximize quality, efficiency, and effectiveness balanced with economy.
* Formulates expected outcomes after considering associated risks, benefits, costs, available expertise, evidence-based knowledge, and environmental factors.
* Develops expected outcomes that provide direction for team members, the healthcare team, and key stakeholders.
* Includes a time estimate for the attainment of expected outcomes.
* Modifies expected outcomes based on changes in the status or evaluation of the situation.
* Documents expected outcomes as measurable goals.

**Additional Competencies for the Informatics Nurse Specialist**

In addition to the competencies of the informatics nurse, the informatics nurse specialist:

* Differentiates outcomes requiring system-level interventions from those requiring care process interventions.
* Promotes the integration and use of clinical guidelines into practice, information management system solutions, and knowledge bases.

**Standard 4. Planning**

The informatics nurse develops a plan that prescribes strategies to attain expected, measurable outcomes.

**Competencies**

The informatics nurse:

* Develops a customized plan considering clinical and business characteristics of the environment and situation in collaboration with key stakeholders and others.
* Identifies ordering and dependencies of the plan’s steps, tasks, or activities.
* Establishes the plan priorities with key stakeholders and others as appropriate.
* Incorporates strategies in the plan to address each of the identified problems, needs, and issues.
* Incorporates an implementation pathway or timeline within the plan.
* Identifies cost and implications of the plan.
* Utilizes the plan to provide direction for the healthcare team and other stakeholders.
* Modifies the plan according to the ongoing assessment of the stakeholders’ response and other outcome indicators.
* Integrates evidence-based guidelines, standards, policies into informatics and technology principles for the design of interprofessional and organizational processes to address identified situations or issues.
* Documents the plan.

**Additional Competencies for the Informatics Nurse Specialist**

In addition to the competencies of the informatics nurse, the informatics nurse specialist:

* Identifies ordering and dependencies of the complex plan’s steps, tasks, activities.
* Integrates innovation, current evidence, emerging trends, and research considerations into the planning process.
* Considers the clinical, financial, social, and economic impact and ethical implications of the plan on stakeholders, organizations, and systems.
* Determines the budget necessary to complete the change/plan/project.
* Integrates current statutes, rules and regulations, and standards into the planning process, plan, and implementation and evaluation processes.
* Leads the design and development of informatics and technology solutions for interprofessional processes to address the identified diagnoses, problems, or issues.

**Standard 5. Implementation**

The informatics nurse implements the identified plan.

**Competencies**

The informatics nurse:

* Partners with the key stakeholders to implement the plan on time, within budget, and within scope.
* Integrates the nursing process within health information technology to measure, record, and retrieve healthcare data to inform stakeholders in the achievement of healthcare outcomes.
* Incorporates the collection of data to synthesize knowledge, inform decision support, analyze outcomes, and contribute to value-based care.
* Uses specific evidence-based information to resolve diagnoses, problems, or issues to achieve the defined outcomes.
* Promotes the healthcare consumer’s capacity for an optimal level of participation and problem-solving.
* Applies available healthcare technologies to maximize consumer engagement to enhance and optimize outcomes.
* Uses community and organizational resources systematically to implement the plan.
* Accommodates different styles of communication used by healthcare consumers, families, healthcare teams, and others.
* Implements the project plan using principles and concepts of enterprise management, project management, and change theory.
* Uses risk management and patient safety principles to mitigate risks.
* Fosters a high-reliability organizational culture that supports the implementation of the plan.
* Incorporates new information and strategies to initiate change if desired outcomes are not achieved.
* Identifies unintended issues and consequences that arise from the implementation of technologies.
* Advocates for systems conducive to staff workflow that promote best practices.
* Serves as a consultant for such activities as but not limited to:
  + Analysis and synthesis of data, information, knowledge, theoretical frameworks, and evidence.
  + Involvement of healthcare consumers, healthcare team members, and stakeholders in the design and decision-making processes.
  + Development of recommendations that inform the identified plan, facilitate understanding by stakeholders, compliment practice and business processes and promote change management principles to meet plan outcomes.
  + Expanding the influence of health information solutions in enhancing health of individuals, populations, and communities.
* Advocates for health care that is sensitive to the needs of healthcare consumers with emphasis on the needs of diverse populations.
* Documents implementation and any modifications, including changes or omissions, of the identified plan.

**Additional Competencies for the Informatics Nurse Specialist**

In addition to the competencies of the informatics nurse, the informatics nurse specialist:

* Leads the utilization of appropriate systems, organizational and/or community resources to implement the plan.
* Supports the collaboration of nurses and other colleagues to implement the plan.
* Uses advanced communication skills to foster relationships and understanding between healthcare teams and healthcare consumers
* Addresses unintended issues that arise from the implementation of technologies.
* Develops recommendations and strategies for leadership to address and resolve complex informatics issues and problems.
* Consults with thought leaders to expand the influence of health information solutions in enhancing population health at local, regional, national, and international levels.

**Standard 5a. Coordination of Activities**

The informatics nurse coordinates planned activities.

**Competencies**

The informatics nurse:

* Organizes the components of the plan.
* Directs the implementation of the plan, including activities and resources necessary to achieve desired outcomes.
* Synthesizes data and information to update sponsors and stakeholders of project status.
* Manages the project scope, risks, timelines, and deliverables within an interprofessional team to contribute to successful implementations.

**Additional Competencies for the Informatics Nurse Specialist**

In addition to the competencies of the informatics nurse, the informatics nurse specialist:

* Leads the management of project scope, risks, timelines, and deliverables within an interprofessional team to contribute to successful implementations.
* Provides leadership in the coordination of information technology and healthcare activities for the integrated delivery of efficient and cost-effective healthcare services.
* Coordinates appropriate systems, organizational, and/or community resources that enhance the delivery of health care across continuums.

**Standard 5b. Health Teaching and Health Promotion**

The informatics nurse employs informatics solutions and strategies for education and teaching to promote health and a safe environment.

**Competencies**

The informatics nurse:

* Integrates informatics solutions, resources, ergonomics, disability adaptations and compliance into clinical practice workflow and patient care routines.
* Applies technology to support the dissemination of evidence-based information to promote healthy lifestyle choices, risk reduction behaviors, disability and developmental adaptations, and preventive self-care.
* Introduces technology tools to facilitate healthcare consumer, staff, community, and population learning.
* Seeks opportunities for feedback and evaluation of the effectiveness of the educational strategies used.
* Assesses health information resources for accuracy, readability, and comprehensibility to help healthcare consumers, families, clinicians, staff, and others needing access to quality health information.
* Assists consumer alliances and advocacy groups in the proper utilization of technology to perform health promotion and health management activities.
* Assists in the development and/or the evaluation of technology that supports clinical decision support.

**Additional Competencies for the Informatics Nurse Specialist**

In addition to the competencies of the informatics nurse, the informatics nurse specialist:

* Provides leadership in the development and/or the evaluation of technology that supports:
  + clinical decision support
  + the dissemination of evidence-based information to promote healthy lifestyle choices, risk reduction behaviors, disability and developmental adaptations, and preventive self-care.
* Provides leadership in the development and/or the evaluation of existing and evolving technology tools that facilitate healthcare consumer, staff, community, population learning, and health management.
* Identifies appropriate opportunities for providing feedback and evaluation of the effectiveness of the educational strategies used.
* Creates solutions for feedback and evaluation of the effectiveness of the educational content and teaching strategies used for health teaching and health promotion.

**Standard 6. Evaluation**

The informatics nurse evaluates progress toward the attainment of desired outcomes.

**Competencies**

The informatics nurse:

* Conducts a systematic, ongoing, and criterion-based evaluation of the outcomes in relation to the structures and processes prescribed by the project plan and indicated timeline.
* Collaborates with the healthcare consumer, healthcare team members, and other key stakeholders involved in the plan or situation in the evaluation process.
* Uses ongoing assessment data to revise the diagnoses, outcomes, plan, and implementation strategies.
* Documents the results of the evaluation.
* Disseminates the results to key stakeholders and others involved in accordance with organizational requirements and federal and state regulations.

**Additional Competencies for the Informatics Nurse Specialist**

In addition to the competencies of the informatics nurse, the informatics nurse specialist:

* Examines the effectiveness of the planned strategies in relation to the attainment of the expected outcomes in partnership with the key stakeholders.
* identifies the link between outcomes and evidence-based methods, tools, and guidelines.
* Synthesizes the results of the evaluation analyses to determine the impact of the plan on healthcare consumers, families, communities, resources, networks, and healthcare organizations.
* Uses the results of the evaluation analyses to make or recommend process or structural changes, including policy, procedure, or protocol development, as appropriate.

**Standards of Professional Performance for Nursing Informatics**

**Standard 7. Ethics**

The informatics nurse practices ethically.

**Competencies**

The informatics nurse:

* Uses Code of Ethics for Nurses with Interpretive Statements (ANA, 2015a) to guide practice.
* Recognizes the centrality of the healthcare consumer and family as core members of any healthcare team.
* Uses nursing and informatics principles, standards, and methodologies in a manner that preserves and protects healthcare consumer autonomy, dignity, and rights.
* Employs informatics and ethical principles, standards, and methodologies to establish and maintain healthcare consumer confidentiality within legal, ethical, and regulatory parameters.
* Uses knowledge of informatics and ethics to evaluate factors related to privacy, security, and confidentiality in the use and handling of data and information.
* Escalates Identified ethical issues that arise from the implementation of technologies.
* Advocates for healthcare consumer access to electronic healthcare records and health technologies for the reduction of associated disparities.
* Seeks available resources as needed when formulating ethical decisions.

**Additional Competencies for the Informatics Nurse Specialist**

In addition to the competencies of the informatics nurse, the informatics nurse specialist:

* Participates in interprofessional teams that address ethical and outcomes.
* Informs appropriate individuals or groups of the risks, benefits, and outcomes of programs and decisions that affect healthcare delivery.
* Addresses ethical issues that arise from the implementation of new technologies.
* Promotes engagement of stakeholders in the oversight and management of the exchange of data and information, according to the highest ethical standards.
* Advocates for the application of ethical, legal, and privacy regulations and policies.

# **Standard 8. Culturally Congruent Practice**

The informatics nurse practices in a manner that is congruent with cultural diversity, equity, and inclusion principles.

## Competencies

The informatics nurse:

* Demonstrates respect, equity, and empathy in actions and interactions with all healthcare consumers, interprofessional colleagues, and other stakeholders.
* Participates in life-long learning to understand cultural norms, customs, worldview, and decision-making processes of diverse consumer groups.
* Creates an inventory of one’s own values, beliefs, cultural heritage, and implicit biases.
* Focuses on eliminating implicit biases and mitigating the negative impact of those biases in practice.
* Leads interprofessional teams to identify the cultural and language needs of the consumer.
* Applies knowledge of variations in health beliefs, practices, and communication patterns in all nursing practice activities, especially in the development and implementation efforts related to informatics solutions.
* Reduces the risk of population-based disparities in care and outcomes that result from discrimination towards vulnerable and marginalized groups.
* Takes responsibility for confirming that informatics solutions and tools are appropriately vetted for the culture, literacy, and language of the population served.
* Communicates using appropriate and non-discriminatory language and behaviors, including the use of medical interpreters and translators if needed.
* Incorporates standardized culturally sensitive terminology and language specific to various cultural groups.
* Advocates for policies and informatics solutions that promote health and prevent harm among culturally diverse, vulnerable, under-served, or under-represented consumers and groups.
* Promotes equitable and population-appropriate access to services, tests, interventions, health promotion programs, education, enrollment in research, and other opportunities that support the delivery of safe, quality care
* Acts a resource to nurse colleagues and other professionals about cultural similarities and differences of healthcare consumers, families, groups, communities, and populations and the requisite accommodations necessary in informatics solutions.

## Additional competencies for the informatics nurse specialist

In addition to the competencies of the informatics nurse, the informatics nurse specialist:

* Evaluates tools, instruments, systems, and services provided to culturally diverse populations to ensure cultural and language needs are met and appropriate options for choice are available.
* Facilitates the collection and analysis of culturally relevant and population-specific data to inform the design of informatics-based solutions and support the reduction of healthcare disparities
* Engages experts in health equity during the design and development of systems and informatics-based solutions.
* Advances organizational policies, programs, services, and practice that reflect respect, promote equity, and support diversity and inclusion.
* Engages consumers, key stakeholders, and others in designing and establishing internal and external cross-cultural partnerships in work and community settings.
* Contributes to research to improve health care and healthcare outcomes for culturally diverse and marginalized consumers.
* Promotes shared decision-making solutions in planning, prescribing, and evaluating processes when the healthcare consumer’s cultural preferences and norms are inconsistent with evidence-based practice.
* Develops recruitment and retention strategies to achieve a multicultural and inclusive workforce.

**Standard 9. Communication**

The informatics nurse communicates effectively in all areas of practice.

**Competencies**

The informatics nurse:

* Applies skills of communication to the needs of healthcare stakeholders regarding the role of information technology in their care.
* Collaborates with individuals, groups, and populations to moves projects forward.
* Works with healthcare consumers to increase their participation in the delivery of their care.
* Empowers consumers to take ownership of their own healthcare outcomes and safety.
* Partners with others to produce positive outcomes through the sharing of data, information, and knowledge.
* Participates in building consensus and resolving conflict with the application of technology to support care delivery.
* Applies group process and negotiation techniques to interact with colleagues.
* Adheres to standards and applicable codes of conduct that govern behavior among peers and colleagues to create a work environment that promotes cooperation, respect, and trust.
* Promotes the development and use of electronic health records that are focused on patient-centered outcomes and interprofessional decision-making.
* Engages in teamwork and team-building processes.

**Additional Competencies for the Informatics Nurse Specialist**

In addition to the competencies of the informatics nurse, the informatics nurse specialist:

* Partners with others through interprofessional activities to create technologies that support consumer engagement.
* Solicits the contribution of the healthcare stakeholders in order to achieve optimal health outcomes.
* Strategizes to increase healthcare consumers’ adoption of personal health records (PHRs) and similar health information technology (IT) tools to engage them in their health and health care.
* Leads collaborative relationships to design and implement technologies to achieve safe, quality health care.

**Standard 10. Collaboration**

The informatics nurse collaborates with the healthcare consumer and other key stakeholders in the conduct of nursing practice.

**Competencies**

The informatics nurse:

* Applies skills of communication to the needs of healthcare stakeholders regarding the role of information technology in their care.
* Collaborates with individuals, groups, and populations to moves projects forward.
* Works with healthcare consumers to increase their participation in the delivery of their care.
* Empowers consumers to take ownership of their own healthcare outcomes and safety.
* Partners with others to produce positive outcomes through the sharing of data, information, and knowledge.
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* Leads collaborative relationships to design and implement technologies to achieve safe, quality health care.

**Standard 11. Leadership**

The informatics nurse demonstrates leadership in the professional practice setting and the profession.

**Competencies**

The informatics nurse:

* Promotes the organization’s vision, the associated goals, and the strategic plan.
* Demonstrates a commitment to continuous education and lifelong learning for self and others, especially related to informatics content.
* Mentors colleagues for the advancement of nursing informatics practice, the profession, and quality health care.
* Maintains professionalism with colleagues by practicing mutual respect, trust, and dignity.
* Demonstrates advanced conflict resolution skills.
* Seeks ways to advance nursing autonomy and accountability.
* Influences the development and implementation of healthcare policy involving healthcare consumers and the profession.
* Participates in professional and informatics organizations.

**Additional Competencies for the Informatics Nurse Specialist**

In addition to the competencies of the informatics nurse, the informatics nurse specialist:

* Influences decision-making bodies to improve the professional practice environment.
* Provides leadership to improve healthcare consumer outcomes.
* Provides direction to enhance the effectiveness of the interprofessional team.
* Interprets the nursing informatics role for others.
* Models expert nursing informatics practice to interprofessional team members and healthcare consumers.
* Mentors colleagues in the acquisition of clinical knowledge, skills, abilities, and judgment.
* Promotes the use of data, information, knowledge, and wisdom to improve healthcare delivery and support effective nursing practice.
* Shares innovative practice with healthcare stakeholders.

**Standard 12. Education**

The informatics nurse attains knowledge and competence that reflect current nursing and informatics practice.

**Competencies**

The informatics nurse:

* Identifies individual learning needs based on nursing knowledge, nursing roles, and the changing needs of target populations.
* Participates in ongoing informatics education to advance his or her knowledge base and professional practice.
* Demonstrates a commitment to lifelong learning through self-reflection and inquiry to address learning and personal growth needs.
* Seeks experiences that reflect current practice to maintain knowledge, skills, abilities, and judgment in informatics practice and role performance.
* Acquires knowledge and skills appropriate to the role, population, specialty area, setting, or situation.
* Seeks formal and independent learning experiences to maintain and develop professional skills and knowledge.
* Participates in knowledge acquisition to support the system development life cycle and project management methodologies.
* Continues to examine and review clinical care issues and new practice modalities for implications related to informatics ~~solutions and~~ practice.
* Shares educational findings, experiences, and ideas with peers and others.
* Facilitates a work environment conducive to the education of healthcare professionals.
* Develops and promotes educational opportunities and programs related to informatics.
* Maintains professional records that provide evidence of competence and lifelong learning.
* Uses current research findings and other evidence to expand knowledge, skills, abilities, and judgment

**Additional Competencies for the Informatics Nurse Specialist**

In addition to the competencies of the informatics nurse, the informatics nurse specialist:

* Creates educational opportunities and programs related to informatics.
* Conducts environmental scanning to help determine future direction and identify opportunities for innovation and best solutions.
* Maintains appropriate certifications.

**Standard 13. Evidence-based Practice and Research**

The informatics nurse communicates effectively in a variety of formats in all areas of practice.

**Competencies**

The informatics nurse:

* Assesses communication preferences of healthcare stakeholders with focus on the use of technology to facilitate communication.
* Supports communication preferences of healthcare consumers, families, and colleagues.
* Assesses her or his own communication skills in encounters with healthcare consumers, families, and colleagues to identify gaps, areas for improvement, and opportunities for education.
* Seeks continuous improvement of communication skills and technologies.
* Seeks continuous improvement of conflict resolution skills.
* Conveys information to healthcare stakeholders using communication formats to promote accuracy and accessibility.
* Communicates strategies to improve and enhance the value of nursing and patient documentation.

**Additional Competencies for the Informatics Nurse Specialist**

In addition to the competencies of the informatics nurse, the informatics nurse specialist:

* Problem-solves to report, address, and resolve hazards and errors in care or the practice environment.
* Identifies strategies and technologies to enhance communication among healthcare clinicians and consumers to minimize risks, especially those associated with transitions in care.
* Develops a communication plan to effectively manage the diverse communication needs associated with a project, plan, initiative, or other activity.
* Contributes the informatics professional perspective in discussions with the interprofessional team.
* Advocates for innovation in the development of communication technology.

**Standard 14. Quality of Practice**

The informatics nurse contributes to the quality and effectiveness of nursing and informatics practice.

**Competencies**

The informatics nurse:

* Demonstrates quality by documenting the application of the nursing process in a responsible, accountable, and ethical manner.
* Facilitates a unified or defined level of documentation by nurses in clinical practice.
* Uses the results of quality improvement activities to initiate changes in nursing and informatics practice and in the healthcare delivery system.
* Contributes to the development and continuous improvement of organizational systems that support the planning process.
* Uses creativity and innovation to enhance nursing and informatics practice to improve care delivery, workflow, client satisfaction, and reduce risks and healthcare costs.
* Uses data management techniques to optimize data for analysis.
* Applies analytic methods to convert data to actionable information.
* Incorporates new knowledge to initiate changes in nursing and informatics practice.
* Uses informatics principles to support quality improvement initiatives.
* Supports collaborative development of nursing policies, procedures, and guidelines.

**Additional Competencies for the Informatics Nurse Specialist**

In addition to the competencies of the informatics nurse, the informatics nurse specialist:

* Uses advanced data management methods.
* Generates new knowledge using new and advanced analytic methods to develop recommendations for quality improvement and effective practice.
* Provides leadership in the collaborative design and implementation of quality improvement efforts.
* Leads collaborative interprofessional teams to evaluate clinical care or health services.
* Leads collaborative efforts to minimize costs and unnecessary duplication.
* Develops policies, procedures, and guidelines to improve the quality of nursing informatics practice.
* Collaborates in identification and development of appropriate indicators to monitor the quality and effectiveness of healthcare delivery and outcomes.
* Determines appropriate indicators to monitor the quality and effectiveness of nursing informatics practice.
* Designs innovations in data capture and management to effect change in practice and improve health outcomes.

**Standard 15. Professional Practice Evaluation**

The informatics nurse evaluates personal nursing practice in relation to professional practice standards and guidelines, relevant statutes, rules, and regulations.

**Competencies**

The informatics nurse:

* Engages in self-evaluation of practice on a regular basis, identifying areas of strength as well as areas in which professional growth would be beneficial.
* Obtains feedback regarding one’s own practice from healthcare consumers, peers, professional colleagues, and others.
* Develops a self-improvement plan to enhance practice that is based on self and peer evaluations.
* Provides feedback to others regarding their practice or role performance.

**Additional Competencies for the Informatics Nurse Specialist**

In addition to the competencies of the informatics nurse, the informatics nurse specialist:

* Models effective self-evaluative processes seeking professional practice feedback from healthcare consumers, peers, professional colleagues, and others.
* Contributes to the development and implementation of professional practice standards and guidelines, relevant statutes, rules, and regulations.
* Mentors informatics nurses and those studying to become informatics nurses.

**Standard 16. Resource Utilization**

The informatics nurse employs appropriate resources to plan and implement informatics and associated services that are safe, effective, and fiscally responsible.

**Competencies**

The informatics nurse:

* Employs appropriate resources to plan and implement information management solutions which enhance the recipient's ability to interpret data.
* Monitors the healthcare information needs of individual consumers, organizations, and communities, as well as the available resources to achieve desired outcomes.
* Identifies opportunities, potential for harm/risk, complexity of the task, and desired outcomes when considering resource allocation.
* Modifies practice as technologies and resources emerge and evolve.
* Supports the integration of clinical, human, financial, and technical resources to enhance and facilitate the healthcare decision-making process.
* Advocates for resources, including technology, that enhance nursing practice.
* Assists the healthcare consumer and family in researching and securing appropriate and affordable information and technology resources to address care needs across the healthcare continuum.

**Additional Competencies for the Informatics Nurse Specialist**

In addition to the competencies of the informatics nurse, the informatics nurse specialist:

* Selects appropriate resources to plan and implement information management solutions which enhance the ability to interpret health-related data.
* Coordinates the organizational and community resources and information technologies to empower the interprofessional team and enhance planning initiatives.
* Identifies best practices and evidence for safety and care outcomes when evaluating the allocation of resources.
* Formulates solutions that address the requirements and specifications of informatics projects.
* Designs evaluation strategies that measure fiscal outcomes, user satisfaction, and project effectiveness.

**Standard 17. Environmental Health**

The informatics nurse supports practice in a safe and healthy environment.

**Competencies**

The informatics nurse:

* Attains knowledge of environmental health concepts, such as implementation of environmental health strategies.
* Promotes a practice environment that reduces ergonomic and environmental health risks for workers and healthcare consumers.
* Assesses the practice environment for technology factors that threaten health, such as sound, odor, noise, electromagnetic forces, and light.
* Advocates for the judicious and appropriate use of ergonomic and environmentally safe technology products in health care.
* Communicates environmental health risks and exposure reduction and mitigation strategies to healthcare consumers, families, colleagues, and communities.
* Employs scientific evidence to determine if a product or treatment is an environmental or ergonomic risk.
* Participates in strategies to promote healthy communities.
* Assists in the development of health and safety alerts within the clinical documentation and technology solutions.
* Advocates for convenient electronic resources that allow quick and easy access to data and information.
* Reports near misses, safety breaches, defects, and deficiencies to the appropriate entity.

**Additional Competencies for the Informatics Nurse Specialist**

In addition to the competencies of the informatics nurse, the informatics nurse specialist:

* Creates partnerships that promote development of risk mitigation plans and sustainable environmental health policies, procedures, and conditions.
* Analyzes the impact of social, political, and economic influences on the environment and human health exposures.
* Critically evaluates the way environmental health issues are presented by the popular media.
* Advocates for implementation of environmental principles in nursing informatics practice.
* Supports nurses in advocating for and implementing environmental principles in nursing practice.

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**Appendix**

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| --- | --- | --- |
| **ONC Hit standards Committee recommended Clinical Vocabulary Standards** | | |
| **Vocabulary** | **Setting/ Application** | **Content** |
| CVX Codes for Vaccines Administered | Nursing and other | Vaccines (administered) |
| **CPT**  Current Procedural Terminology | Other | Medical, surgical, and diagnostic services rendered for claims |
| **CDC-PHIN/VADs**  CDC-Public Health Information Network/Vocabulary Access and Distribution System | Nursing and other | Patient characteristic (administrative gender, date of birth) |
| **HCPCs**  Healthcare Common Procedure Coding System | Other | Medical, surgical, and diagnostic services rendered for claims |
| **iCD-9 CM**  International Statistical Classification of Diseases and Related Health Problems—Clinical Modification (9th ed.) | Nursing and other | Diagnoses and assessments |
| **ICD-9 PCs**  International Statistical Classification of Diseases and Related Health Problems— Procedural Coding System (9th ed.) | Nursing and other | Diagnoses and assessments |
| **ICD-10 CM**  International Statistical Classification of Diseases and Related Health Problems—Clinical Modification (10th ed.) | Nursing and other | Diagnoses and assessments |
| **ICD-10 PCs**  International Statistical Classification of Diseases and Related Health Problems—Procedural Coding System (10th ed.) | Nursing and other | Diagnoses and assessments |
| **ICF**  International Classification of Functioning, Disability, and Health | Nursing and other | Functional status |
| **ISO-639**  International Organization for Standardization Standard 639 | Nursing and other | Representation of languages and language groups |
| **LOINC®**  Logical Observation Identifiers, Names, and Codes | Nursing and other | Outcomes and assessments |
| **RXNORM** | Nursing and other | Normalized clinical drug names |
| **SNOMED CT®**  Systematic Nomenclature of Medicine Clinical Terms | Nursing and other | Diagnoses, interventions, and outcomes |
| **UCUM**  Unified Code for Units of Measure | Nursing and other | Units of measure for results |

*Adapted from* CMS Measures Management System Blueprint v. 11.0, July 2014 [(http://www.cms.gov/Medicare/Quality-Initiatives-P](http://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/)a[tient-Assessment-Instruments/](http://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/) MMS/MeasuresManagementSystemBlueprint.html).

**GLOSSARY**

**Cloud based – cloud computing** – Cloud computing means storing and accessing data and programs over the internet instead of on the computer's hard drive. (The PCMag Encyclopedia defines it succinctly as "hardware and software services from a provider on the internet.")

**Data mart** – A subject-oriented subset of a data warehouse using a structured access pattern to retrieve client-facing data.

**Data lake** – A centralized repository that accepts and retains all forms of structured and unstructured data.

**Data warehouse** – A data repository of aggregated structured data from multiple diverse sources supporting business decisions of an organization.

**Data scientist** – An individual with a foundation in computer science, data modeling, statistics, and analytics with the responsibility to interpret and manage data to solve complex problems using machine learning applications.

**Evidence-based guidelines** – Systematically developed statements to assist practitioner and patient decisions about appropriate health care for specific clinical circumstances.

**Healthcare consumer** – The patients, persons, clients, families, groups, communities, or populations who are the focus of nurses’ attention. Healthcare consumers receive nursing services as sanctioned by the state regulatory bodies.

**Healthcare ecosystem** – The symbiotic environment and constituent relationships of persons, consumers, populations; providers, clinicians, other specialists; and organizations and networks focused on the delivery of health care.

**Human–computer interaction** **(HCI)** – The study of how people design, implement, and evaluate interactive computer systems in the context of users’ tasks and work (Nelson & Staggers, 2014, pp. 511–512).

**Information management** – An elemental process by which one files, stores, manipulates, and reports data for various uses.

**Information communication** – Enables systems to send data and to present information in formats that improve understanding.

**Informatics nurse (IN)** – A registered nurse with an interest or experience in an informatics field, most often nursing informatics.

**Informatics nurse specialist** (INS) – A registered nurse with formal graduate education in informatics. The INS is expected to have experience in informatics projects or processes and achieved and maintains applicable certifications.

**Information structures** – Organized data, information, and knowledge for processing by computers.

**Information technology** – Includes computer hardware, software, communication, and network technologies, derived primarily from computer science. Its use distinguishes informatics from more traditional methods of information management.

**Nursing informatics** - *Nursing informatics* is the specialty that supports nurses, patients, healthcare consumers, and other stakeholders in their decision-making to achieve desired outcomes through the identification, management, and communication of data, information, knowledge, and wisdom via the use of information structures, processes, and technologies.

**Sociotechnical framework** – An approach to complex organizational work design that recognizes the interaction between people and technology in workplaces. The term also refers to the interaction between society's complex infrastructures and human behavior. In this sense, society itself, and most of its substructures, are complex sociotechnical systems.

**Technology principles** – Apply to any technology that impacts a company’s direct employees, contract and temporary workers, and workers throughout their supply chain. These include but are not limited to:

1. Workers are at the frontline of technology transformation,

2. Companies must consider the impact to workers’ rights, wellbeing, and future when

implementing technology,

3. In the face of rapid tech evolution, impacts on the workforce should not be underestimated or overlooked; therefore prudence and engagement is necessary

to succeed with adoption of technology by the workforce.

**Usability** - Extent to which a product can be used by specific users in a specific context to achieve specific goals with effectiveness, efficiency, and satisfaction.

**User experience** – “User’s perceptions and responses that result from the use and/or anticipated use of a system, product or service.” (International Organization for Standardization. (2018). *Terms and definitions* (9241-210:2018, 3.2.3). Retrieved <https://www.iso.org/obp/ui/#iso:std:iso:9241:-210:ed-2:v1:en>

**Wisdom** – The appropriate use of knowledge to manage and solve human problems (ANA, 2015b).