

6th Edition

Essentials of **NURSING INFORMATICS**



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Virginia K. Saba
Kathleen A. McCormick

Essentials of Nursing Informatics

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Essentials of Nursing Informatics

SIXTH EDITION

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FOREWORD 1

A Turning Point in U.S. Healthcare

The last edition of this book heralded the recent enactment of the Patient Protection and Affordable Care Act (commonly called the Affordable Care Act or ACA), sweeping legislation intended to reduce the numbers of uninsured and make healthcare accessible to all Americans. As of 2014, over 7 million enrolled for coverage via the healthcare insurance exchange marketplace mandated in the ACA—surpassing all expectations.

Experts predict that these newly insured will increase the use of medical services, particularly prescription drugs and physician and clinical services. By 2022, the numbers of uninsured will drop by 30 million, signaling to healthcare providers that a transformation in healthcare delivery models must begin now if we are to care for the newly insured while making significant progress in improving care quality and reducing costs.

Adding to the challenges created by broader insurance coverage are simple and complex demographics: by 2040, the 65 and over population will double. This population is also the segment with the highest incidence of chronic diseases. Chronic diseases account for 80% of healthcare costs, not just in the United States but in Europe and developing countries—chronic diseases are no longer the particular scourges of the wealthier western nations. It is a global wave that threatens to overwhelm healthcare systems unless we find new ways to manage patients and deliver care over the long term.

In the United States, we have specific issues that may or may not be a product of the current healthcare system but that clearly further galvanize the case for change. In the United States, it is worth noting that 45% of healthcare costs are driven by 3% to 5% of the population—the sickest individuals. But, the next tier of patients, those considered to be at the 20% to 30% risk level consumes 35% of healthcare costs. And consider that one in three Medicare patients is re-admitted within 30 days of an initial hospitalization, largely due to not receiving or complying with recommended follow-up care—and that penalties for such re-admissions are now in effect. Most sobering is that 33% of care expenses do not contribute to improving the health of an individual.

Healthcare organizations have begun the transformation of care delivery already, taking on risk-sharing models

and forming Accountable Care Organizations, which now number over 600; patient-centered homes; and population health management functions. This necessitates a shift, not only in the physical care setting approach but also in how providers approach care delivery overall:

- As fee-for-service becomes less the norm, providers will move from a care volume to an outcomes orientation.
- Demographics and the costs of treating chronic diseases over time will necessitate a move from the acute-centric environment to multiple venues, including outpatient clinics and home-based care.
- Evidence-based medicine—and the ability to manage volumes of clinical evidence through sophisticated HIT systems—will mean that providers can tailor treatment for the individual and intervene earlier to keep patients well.
- New care delivery models require a transition from individual care providers to collaborative teams.
- We will move from a “sick care” system to one that focuses on keeping the individual and identified populations of patients (such as those with diabetes) healthy.
- Instead of avoiding care for the chronically ill until it becomes acute, provider organizations will seek out these populations. Population Health Management is intended to deliver specific care protocols aimed at managing these conditions and improving the health status of each individual through monitoring and early intervention. This will not only improve health status but also will reduce costs and reduce re-admissions.
- Patient—and family—engagement will become a critical component in the care process, particularly in population health management.

Such shifts require an equally dramatic shift in healthcare information systems, evolving Electronic Health Record, clinical, and administrative systems from those

that support the care “transaction” to those that provide intelligence-based support to:

- Guide clinical diagnostic and therapeutic decisions
- Ensure that the sequence of care activities conform to the evidence-based practices and performance contract requirements
- Monitor the execution of core clinical processes
- Capture, report, and integrate into EHRs quality and performance measures
- Support the interactions of the care team
- Identify, assess, stratify, and select target populations
- Provide care management interventions for individuals and populations
- Provide tools that support and promote patient and family engagement
- Guide the delivery of high-quality care across multiple care settings
- Monitor, predict, report, and improve on quality performance measures

From treating the individual to caring for communities or populations of patients to implementing pay-for-performance and quality measures, HIT systems will move

from support of clinical operations to sophisticated tools integral to the delivery of care and management of the health of individuals and populations. Population health management and care coordination systems will help bend the cost and outcomes curves, enabling more effective, efficient care management of an entire population and helping ensure that those individuals dealing with a chronic condition do not join the 3%–5% comprising the sickest patients.

Nursing professionals are at the center of the new care delivery models and care coordination and population health management strategies. Always the foundation of care delivery, the nursing community is the integrator of care and in this role will increasingly require advanced knowledge and expert use of healthcare information technology. To the authors, editors, and publishers of the Sixth Edition of *Essentials of Nursing Informatics*—and to all of the Nursing Informatics professionals, our appreciation for leading the way.

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FOREWORD 2

In the previous edition of *Essentials of Nursing Informatics*, we predicted that 2010 would be a watershed year for accelerating the implementation of electronic health records in the United States. The prediction that the “HITECH Act” would forever change health informatics in the United States has now been confirmed by multiple sources, including data from the Office of the National Coordinator for Health Information Technology showing that over 84% of eligible hospitals and 69% of eligible providers met Stage 1 of “meaningful use” as of October 2013.

A significant outcome of this widespread adoption and use of health information technology is an increasing focus on nursing informatics. There is a steadily growing recognition of the need for nurse informaticists in the transformation of healthcare delivery. Nurse informaticists are healthcare leaders for the twenty-first century, exemplars in the right place at the right time, masterfully employing education, nursing practice, experience, and leadership skills to help create effective partnerships. Their role is a key one in advancing value and science-driven healthcare—moving healthcare information technology from arduous implementation to ubiquitous practice, and healthcare informatics from data management to decision support.

The accelerating demands of gathering and using data for patient care has increased awareness of informatics as a core skill and intensified the need for all nurses and clinicians to better understand how they can utilize technology. This updated edition incorporates teaching aids to help educators show and teach others, developing more sophisticated users of technology who can collaborate to improve processes and workflow that result in safer, more effective, and efficient patient care.

For decades, primary communication among team members has been accomplished through notes written in the patient chart. Yet, this represented one of the major roadblocks to the most effective and efficient care, as the best patient care is dependent on up-to-date data and timely information sharing among the healthcare team members, including the patient. Access to the most accurate and complete information remains vital, and as we move from paper charts to mobile devices, nursing informaticists are at the center of much of the work

being done to improve the speed, accuracy, and utility of patient information. With nearly instant access to patient data and evidence-based decision support, nurses, physicians, and other clinicians will be able to make better decisions about a patient’s care. Health systems are already progressing toward this goal by embracing new technology that provides real-time notifications and provides clinical staff with intervention-level patient data to drive improvement in both patient experience and the interaction of caregivers.

The challenge for the informatics community is to ensure the new technologies are seamlessly integrated and that use by caregivers improves the patient experience. It is critical that the electronic health record is transformed into a system that provides output, rather than one primarily receiving input. The appropriate use of information structure, information processes, and information technology can support consumers, patients, nurses, and other providers in their decision-making in all roles and settings. While we have not yet built a nationwide network that supports exchange of both clinical and administrative health information, that vision is now coming into sharper focus and is increasingly achievable. When that network is complete, our ability to put it to good use will have been enhanced by decades of preparation by nurse informaticists.

Nurse informaticists have been and will continue to be leaders in the partnerships between information technology providers, clinicians, and health administrators. The crucial role of nurse informaticists in the development, implementation, and optimization of clinical applications, including nursing clinical documentation, computerized provider order entry (CPOE), and electronic medical/health records (EMR/EHR), seems to be confirmed by the results of the HIMSS 2014 Nursing Informatics Workforce Survey. The survey indicates the specialty is increasingly recognized as adding value, and it continues to thrive. Salaries are rising, more nurse informaticists are seeking accredited certification, and increasing demand is drawing some nurses from the bedside.

As the specialty that integrates nursing science, computer science, and information science to manage and communicate data, information, knowledge—and ultimately, wisdom—into nursing practice, nursing

informatics is uniquely positioned to help lead the building of inter-professional healthcare teams that will effectively support healthcare transformation. The vision for the future of technology in healthcare will rely heavily on these teams to use data to coordinate care and improve outcomes, from real-time data mining to recognizing population health patterns to using social media to drive awareness.

A decade has passed since the call for ubiquitous electronic health records was first made in the 2004 Presidential State of the Union message. These 10 years represent a very long time in the lifespan of health information technology, and one who has witnessed a rapid evolution of healthcare systems. During this time, nursing informatics has provided tremendous energy, insight and leadership, not only helping to establish the necessary infrastructure but also in driving gains in healthcare technology competency, information literacy, and better healthcare outcomes. On the basis of this history, we

believe even more strongly that our future and the future of nursing informatics hold even more promise.

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PREFACE

This sixth edition of *Essentials of Nursing Informatics* was initiated in response to requests by educators for a digital version of the publication, a guide for faculty to use in the development of their course work, and by nurse users of the fifth edition. Because of these requests we have expanded the content primarily in the areas: Nursing Informatics Technologies—(a) *Computer Hardware*, (b) *Advanced Hardware and mHealth*, (c) *Computer Software*, (d) *Data and Data Processing*, (e) *System Life Cycle*, (f) *System Life Cycle Tools*, (g) *System and Functional Testing*.

Seven section editors edited the sixth edition content: *Nursing Informatics Technologies*—Jacqueline Ann Moss; *System Life Cycle, Informatics Theory, Standards, Foundations of Nursing Informatics, and Research Applications*—Virginia K. Saba; *Nursing Informatics Leadership*—Kathleen Smith; *Advanced Nursing Informatics Practice*—Gail E. Latimer; *Nursing Informatics—Complex Applications, Big Data Initiatives*—Kathleen A. McCormick; *Educational Applications*—Diane Skiba; and *International Perspectives*—Susan K. Newbold.

In addition, this book includes new content that focuses on innovative expansions in Professional Practice using Nursing Informatics such as (a) *The Role of the Nurse Executive in Information Technology Decision-Making*, (b) *Care Delivery Across the Continuum: Hospital-Community-Home*, (c) *Foundations of a Nursing Plan of Care Standard*, (d) *Health Information Technology*, (e) *Striving to Improve Patient Safety*, (f) *Federal Health Care Sector Nursing Informatics*, (g) *Nurse Scheduling and Credentialing Systems*, (h) *Establishing Nursing Informatics in Public Policy*, (i) *Nursing Informatics in Retail Clinics, Safety, Global Initiatives*, and (j) *Big Data*. We welcomed new authors who have expanded the scope of this book and added unique expertise in Nursing Informatics.

Updates of many other chapters include new references and new policies, new concepts, and skills required by nurses in informatics. All Six continents describing International Perspectives updated their unique chapters.

Because a gap still exists with students, faculty, and nurse users' understanding the meaning and scope of the content, a companion book (*Essentials of Nursing Informatics Study Guide*/ISBN: 978-0071845892, edited by Juliana and Jack Brixey, Virginia Saba, and Kathleen McCormick) is available that outlines the chapters and includes sample test questions for every chapter. A companion, online faculty resource has also been created to support both books (accessible at www.EssentialsofNursingInformatics.com), providing online PowerPoint slides for chapters, which include objectives, key words, outlines, and tables/figures.

With each new edition, we have responded to those who teach Nursing Informatics, and who have focused the content where they identified areas that they thought would be most helpful in the profession. Our goal in expanding this edition is to increase the number of professional nurses who are prepared in Nursing Informatics to work to improve Quality and Outcomes in Healthcare. There are 6,000 nurses who consider themselves Nurses in Informatics, and 3,000 credentialed in Nursing Informatics. We cannot achieve the goals in healthcare and HITECH without more nurses prepared in Informatics. It is also our goal to keep all nurses in Informatics up-to-date in the field, and to entice those nurses who are looking for first or second careers in nursing to consider the breadth of areas in Nursing Informatics.

Dr. Virginia K. Saba
Dr. Kathleen A. McCormick

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ACKNOWLEDGMENTS

This sixth edition book is dedicated to all of the section editors, chapter authors and their co-authors. Each of these prestigious contributors was extremely busy implementing policies, systems, and educational programs to support Nursing Informatics in the United States and abroad. The nurses who are credentialed by the American Nurses Association, Certification in Nursing Informatics, all 3,000 of them deserve recognition, as well as the 6,000 nurses in informatics in the United States. We acknowledge our international colleagues in nursing informatics. We also acknowledge the McGraw-Hill Education staff

who contributed to editing the book, completing the production of this book, and supporting the expansion of the book with new resources. The authors also acknowledge their families because without them encouraging this effort, the book would not be a reality. We thank the Lord in giving us the opportunity to embark on a sixth edition and for the help in completing it.

*Dr. Virginia K. Saba
Dr. Kathleen A. McCormick*

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The authors would like to sincerely thank the following for content in the fifth edition that has been updated in the sixth edition.

- 1** Historical Perspectives of Nursing Informatics
Patricia Wise
- 3** Advanced Hardware and mHealth
Thomasine D. Guberski
- 5** Open Source and Free Software
Peter Murray and E. Scott Erdley
- 8** Standardized Nursing Terminologies
Suzanne Bakken, Connie White Delaney, Bonnie Westra
- 11** System Life Cycle
M. Kathleen Smith and Denise D. Tyler
- 18** Establishing Nursing Informatics in Public Policy
Amy M. Walker
- 20** Assessing the Vendors
Ann Patricia Farrell and Sheryl L. Taylor
- 21** Nurse Scheduling and Credentialing Systems
Richard Robinson, Kathy Malloch, Lisa LaBau
- 23** Structuring Advanced Practice Knowledge: Curricular, Practice and Internet Resource Use
Laketa Entzminger
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Rita D. Zielstorff
- 44** Initiation and Management of Accessible, Effective Online Learning
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- APPENDIX A** Overview of Clinical Care Classification System
Jacqueline Ann Moss

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PART

1

Nursing Informatics Technologies

Jacqueline Ann Moss

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Historical Perspectives of Nursing Informatics

Virginia K. Saba / Bonnie L. Westra

• OBJECTIVES

1. Describe the historical perspective of nursing informatics.
2. Explore lessons learned from the pioneers in nursing informatics.
3. Describe the types of nursing standards initiatives.
4. Review the historical perspectives of electronic health records.
5. List the major landmark events and milestones of nursing informatics.

• KEY WORDS

Computers
Computer literacy
Computer systems
Data standards
Electronic Health Records (EHR)
Healthcare Information Technology (HIT)
Information systems
Internet
Nursing informatics

OVERVIEW

Nursing Informatics (NI) is a title that evolved from the French word “informatics” which referred to the field of applied computer science concerned with the processing of information such as nursing information (Nelson, 2013). The computer was seen as a tool that could be used in many environments. In the early 1960s, the computer was introduced into healthcare facilities for the processing of basic administrative tasks. Thus the computer revolution in healthcare began and led to today’s healthcare information technology (HIT) and/or electronic health record (EHR) systems.

The importance of the computer as an essential tool in HIT systems and in the delivery of contemporary

healthcare is indisputable. HIT is an all-encompassing term referring to technology that captures, processes, and generates healthcare information. Computerization and/or electronic processing affect all aspects of healthcare delivery including (a) provision and documentation of patient care, (b) education of healthcare providers, (c) scientific research for advancing healthcare delivery, (d) administration of healthcare delivery services, (e) reimbursement for patient care, (f) legal and ethical implications, as well as (d) safety and quality issues.

Since its inception there has been a shift from the use of mainframe, mini- or microcomputers (PCs) toward integrating multiple technologies and telecommunication devices such as wireless, handheld, mobile computers, and cell phones designed to support the continuity of

care across healthcare settings and HIT systems. There has also been a dramatic shift from visible to invisible storage devices such as cloud storage, and from developing instructions for old software programs to today's icon, user-friendly, menu-driven, touch-screen manipulation methods for activating software programs.

Today, computers in nursing are used to manage patient care information, monitor quality, and evaluate outcomes. Computers and networks are also being used for communicating (sending and receiving) data and messages via the Internet, accessing resources, and interacting with patients on the Web. Nurses are increasingly becoming involved with systems used for planning, budgeting, and policy-making for patient care services, as well as enhancing nursing education and distance learning with new media modalities. Computers are also used to document and process real-time plans of care, support nursing research, test new systems, design new knowledge databases, develop data warehouses, and advance the role of nursing in the healthcare industry and nursing science.

This chapter is an updated and revised version of the Chapter 2 “Historical Perspectives of Nursing Informatics” (Saba & Westra, 2011) published in the fifth edition of *Essentials of Nursing Informatics* (Saba & McCormick, 2011). In this chapter, the significant events influencing the growth of NI as a nursing specialty are analyzed according to (1) **Seven Time Periods**, (2) a synthesis of lessons learned from 33 videotaped interviews with **Nursing Informatics Pioneers**, (3) **Nursing Standards Initiatives** including nursing practice and education, nursing content standards, and confidentiality and security standards, (4) **Electronic Health Records from a Historical Perspective**, and (5) **Landmark Events in Nursing and Computers** with Table 1.2 listing those events that influenced the introduction of computers into the nursing profession including key “computer/informatics” nurse(s) that directed the activity.

MAJOR HISTORICAL PERSPECTIVES OF NURSING AND COMPUTERS

Seven Time Periods

Prior to 1960s. Computers were first developed in the late 1930s to early 1940s, but their use in the healthcare industry occurred in the 1950s and 1960s. During this time, there were only a few experts nationally and internationally who formed a cadre of pioneers that attempted to adapt computers to healthcare and nursing. At that time the nursing profession was also undergoing major changes. The image of nursing was evolving, the number of educational programs and nurses increasing, and nursing practices and services were expanding in scope, autonomy, and

complexity from physicians' handmaidens to professional status. These events provided the impetus for the profession to embrace computers—a new technological tool.

Computers were initially used in healthcare facilities for basic office administrative and financial accounting functions. These early computers used punch cards to store data and card readers to read computer programs, sort, and prepare data for processing. They were linked together and operated by paper tape using teletypewriters to print their output. As computer technology advanced, the healthcare technologies also advanced. The major advances are listed chronologically in Table 1.2.

1960s. During the 1960s, the uses of computer technology in healthcare settings began to be explored. Questions such as “Why use computers?” and “What should be computerized?” were discussed. Nursing practice standards were reviewed, and nursing resources were analyzed. Studies were conducted to determine how computer technology could be utilized effectively in the healthcare industry and what areas of nursing should be automated. The nurses' station in the hospital was viewed as the hub of information exchange, the most appropriate center for the development of computer applications.

By the mid-1960s, clinical practice presented nurses with new opportunities for computer use. Increasingly complex patient care requirements and the proliferation of intensive care units required that nurses become super users of computer technology as nurses monitored patients' status via cardiac monitors and instituted treatment regimens through ventilators and other computerized devices. A significant increase in time spent by nurses documenting patient care, in some cases estimated at 40% (Sherman, 1965; Wolkodoff, 1963), as well as a noted rise in medication administration errors prompted the need to investigate emerging hospital computer-based information systems.

1970s. During the late 1960s through the 1970s, hospitals began developing computer-based information systems which initially focused on physician order entry and results reporting, pharmacy, laboratory, and radiology reports, information for financial and managerial purposes, and physiologic monitoring systems in the intensive care units, and a few systems started to include care planning, decision support, and interdisciplinary problem lists. While the content contained in early hospital information systems frequently was not specific to nursing practice, a few systems did provide a few pioneer nurses with a foundation on which to base future nursing information systems (Blackmon et al., 1982; Collen, 1995; Ozbolt & Bakken, 2003; Romano, McCormick, & McNeely, 1982; Van Bommel & Munsen, 1997). Regardless of the focus,

which remained primarily on medical practice, nurses often were involved in implementing HIT systems.

Interest in computers and nursing began to emerge in public and home health services and education during the 1960s to 1970s. Automation in public health agencies began as a result of pressure to standardize data collection procedures and provide state-wide reports on the activities and health of the public (Parker, Ausman, & Overdovitz, 1965). In the 1970s, conferences sponsored by the Division of Nursing (DN), Public Health Service (PHS), and the National League for Nursing (NLN) helped public and home health nurses understand the importance of nursing data and their relationship to new Medicare and Medicaid legislation, passed in 1966, requirements. The conferences provided information on the usefulness of computers for capturing and aggregating home health and public health information. Additional government-sponsored conferences focused on educational uses of computers for nurses (Public Health Service, 1976). At the same time as hospitals and public health agencies embarked on investigating computers and nursing, the opportunity to improve education using computer technology also began. Bitzer (1966) reported on one of the first uses of a computerized teaching system called PLATO, which was implemented to teach classes in off-campus sites as an alternative to traditional classroom education.

The early nursing networks, which were conceived at health informatics organizational meetings, helped expand nursing awareness of computers and the impact HIT could have on practice. The state of technology initially limited opportunities for nurses to contribute to the HIT design, but as technology evolved toward the later part of the 1970s and as nurses provided workshops nationally, nurses gained confidence that they could use computers to improve practice. The national nursing organization's federal agencies (Public Health Service, Army Nurse Corps) and several university schools of nursing provided educational conferences and workshops on the state-of-the-art regarding computer technology and its influence on nursing. During this time, the Clinical Center at the National Institutes of Health implemented the TDS computer system; one of the earliest clinical information systems (called Eclipsys and now Allscripts) was the first system to include nursing practice protocols (Romano et al., 1982).

1980s. In the 1980s, the field of nursing informatics exploded and became visible in the healthcare industry and nursing. Technology challenged creative professionals in the use of computers in nursing, which became revolutionary. As computer systems were implemented, the needs of nursing took on a cause-and-effect modality; that is, as new computer technologies emerged and as computer architecture advanced, the need for nursing software evolved.

It became apparent that the nursing profession needed to update its practice standards and determine its data standards, vocabularies, and classification schemes that could be used for the computer-based patient record systems.

Starting in 1981, national and international conferences and workshops were conducted by a few nursing pioneers to help nurses understand and get involved in this new emerging nursing specialty. Also during the 1980s, invitational conferences were conducted to develop nursing data sets and vocabularies as well as numerous workshops were conducted at universities to introduce this new specialty into nursing education.

During this period, many mainframe healthcare information systems (HISs) emerged with nursing subsystems. These systems documented several aspects of the patient record, namely, provider order entry and results reporting, the Kardex reporting, vital signs, and other systems-documented narrative nursing notes using word-processing software packages. Discharge planning systems were developed and used as referrals to community, public, and home healthcare facilities for the continuum of care.

In the 1980s, the microcomputer or personal computer (PC) emerged. This revolutionary technology made computers more accessible, affordable, and usable by nurses and other healthcare providers. The PC brought computing power to the workplace and, more importantly, to the point of care. Also the PCs served as dumb terminals linked to the mainframe computers and as stand-alone systems (workstations). The PCs were user-friendly and allowed nurses to design and program their own applications.

Nurses began presenting at multidisciplinary conferences and formed their own working groups within HIT organizations, such as the first Nursing Special Interest Group on Computers which met for the first time during SCAMC (Symposium on Computer Applications in Medical Care) in 1981. As medical informatics evolved, nursing began focusing on what was unique about nursing within the context of informatics. Resolutions were passed by the American Nurses Association (ANA) regarding computer use in nursing and in 1985, the ANA approved the formation of the Council on Computer Applications in Nursing (CCAN). One of the first activities the CCAN executive board initiated was to solicit several early pioneers to develop monographs on the status of computers in nursing practice, education, research, and management. The CCAN board developed a yearly *Computer Nurse Directory* on the known nurses involved in the field, conducted computer applications demonstrations at the ANA Annual conferences, and shared information with their growing members in the first CCAN newsletter *Input-Output*. During this time, Nursing Informatics newsletters, journals were being introduced including several books, such as the first edition of this book

published in 1986. These were being used for educational courses introduced in the academic nursing programs, and workshops being conducted on computers and nursing. The CCAN became a very powerful force in integrating computer applications into the nursing profession.

1990s. By the 1990s, large integrated healthcare delivery systems evolved, further creating the need for information across healthcare facilities within these large systems to standardize processes, control costs, and assure quality of care (Shortliffe, Perreault, Wiederhold, & Pagan, 2003). Advances in relational databases, client-server architectures, and new programming methods created the opportunity for better application development at lower costs. Legislative activity in the mid-1990s paved the way for EHRs through the Health Insurance Portability and Accountability Act (HIPAA) of 1996 (public-law 104-191), emphasizing standardized transactions, and privacy and security of patient-identifiable information (Gallagher, 2010). The complexity of technology, workflow analysis, and regulations shaped new roles for nursing.

In 1992, the ANA recognized Nursing Informatics as a new nursing specialty with a separate *Scope of Nursing Informatics Practice Standards*, and also established a specific credentialing examination for it (ANA, 2010). Numerous local, national, and international organizations provided a forum for networking and continuing education for nurses involved with informatics (Sackett & Erdley, 2002). The demand for NI expertise increased in the healthcare industry and other settings where nurses functioned, and the technology revolution continued to impact the nursing profession.

The need for computer-based nursing practice standards, data standards, nursing minimum data sets, and national databases emerged concurrent with the need for a unified nursing language, including nomenclatures, vocabularies, taxonomies, and classification schemes (Westra, Delaney, Konicek, & Keenan, 2008). Nurse administrators started to demand that the HITs include nursing care protocols and nurse educators continued to require use of innovative technologies for all levels and types of nursing and patient education. Also, nurse researchers required knowledge representation, decision support, and expert systems based on standards that allowed for aggregated data (Bakken, 2006).

In 1997, the ANA developed the *Nursing Information and Data Set Evaluation Standards* (NIDSEC) to evaluate and recognize nursing information systems (ANA, 1997). The purpose was to guide the development and selection of nursing systems that included standardized nursing terminologies integrated throughout the system whenever it was appropriate. There were four high-level standards: (a) inclusion of ANA-recognized terminologies;

(b) linkages among concepts represented by the terminologies were retained in a logical and reusable manner; (c) data were included in a clinical data repository; and (d) general system characteristics. The Certification Commission for Health Information Technology (CCHIT) had similar criteria for the EHR certification, which was later adopted by the Office of the National Coordinator (ONC); however, nursing data was no longer included. ANA was ahead of its time in their thinking and development. The criteria are now under revision by the ANA to support nurses to advocate their requirements for the emerging HIT systems.

Technology rapidly changed in the 1990s, increasing its use within and across nursing units, as well as across healthcare facilities. Computer hardware—PCs—continued to get smaller and computer notebooks were becoming affordable, increasing the types of computer technology available for nurses to use. Linking computers through networks both within hospitals and health systems as well as across systems facilitated the flow of patient information to provide better care. By 1995, the Internet began providing access to information and knowledge databases to be integrated into bedside systems. The Internet moved into the mainstream social milieu with electronic mail (e-mail), file transfer protocol (FTP), Gopher, Telnet, and World Wide Web (WWW) protocols greatly enhanced its usability and user-friendliness (Saba, 1996; Sparks, 1996). The Internet was used for High-Performance Computing and Communication (HPCC) or the “Information Superhighway” and facilitated data exchange between computerized patient record systems across facilities and settings over time. The Internet led to improvements in networks and a browser, World Wide Web (WWW), allowed organizations to communicate more effectively and increased access to information that supported nursing practice. The World Wide Web (WWW) also became integral part of the HIT systems and the means for nurses to browse the Internet and search worldwide resources (Nicoll, 1998; Saba, 1995).

2000s. A change occurred in the new millennium as more and more healthcare information became digitalized and newer technologies emerged. In 2004, an Executive Order 13335 established the Office of the National Coordinator for Healthcare Information Technology (ONC) and issued a recommendation calling for all healthcare providers to adopt interoperable EHRs by 2014–2015. This challenged nurses to get involved in the design of systems to support their workflow as well as in the integration of information from multiple sources to support nurses’ knowledge of technology. In late 2000s, as hospitals became “paperless,” they began employing new nurses who had never charted on paper.

Technological developments that influenced healthcare and nursing included data capture and data sharing technological tools. Wireless, point-of-care, regional database

projects, and increased IT solutions proliferated in healthcare environments, but predominately in hospitals and large healthcare systems. The use of bar coding and radio-frequency identification (RFID) emerged as a useful technology to match “right patient with the right medication” to improve patient safety. The RFID also emerged to help nurses find equipment or scan patients to assure all surgical equipment is removed from inside patients before surgical sites are closed (Westra, 2009). Smaller mobile devices with wireless or Internet access such as notebooks, tablet PCs, personal digital assistants (PDAs), and smart cellular telephones increased access to information for nurses within hospitals and in the community. The development and subsequent refinement of voice over Internet protocol (VoIP) provided voice cost-effective communication for healthcare organizations.

The Internet provided a means for development of clinical applications. Databases for EHRs could be hosted remotely on the Internet, decreasing costs of implementing EHRs. Remote monitoring of multiple critical care units from a single site increased access for safe and effective cardiac care (Rajecki, 2008). Home healthcare increasingly partnered with information technology for the provision of patient care. Telehealth applications, a recognized specialty for nursing since the late 1990s, provided a means for nurses to monitor patients at home and support specialty consultation in rural and underserved areas. The NI research agenda promoted the integration of nursing care data in HIT systems that would also generate data for analysis, reuse, and aggregation.

2010s. A historical analysis of the impact of the Nursing Minimum Data Set (NMDS) demonstrated that continued consensus and effort was needed to bring to fruition the vision and implementation of minimum nursing data into clinical practice (Hobbs, 2011). The NMDS continues to be the underlining focus in the newer HIT systems.

A new NI research agenda for 2008–2018 (Bakken, Stone, & Larson, 2012) emerged as critical for this specialty. The new agenda is built on the one originally developed and published by the National Institute for Nursing Research (NINR) in 1993 (NINR, 1993). The authors focused on the new NI research agenda on “3 aspects of context—genomic health care, shifting research paradigms, and social (Web2.0) technologies” (p. 280).

A combination of the economic recession along with the escalating cost of healthcare resulted in the American Recovery and Reinvestment Act of 2009 (ARRA) and the Healthcare Information Technology for Economic and Clinical Health (HITECH) Act of 2009 with funding to implement HIT and/or EHR systems, support healthcare information exchange, enhance community and university-based informatics education, and support leading edge research to improve the use of HIT (Gallagher, 2010). During 2010, the ONC convened two national committees, (a) National

Committee on Health Policy and (b) National Committee on Health Standards, which outlined and designed the focus for the “Meaningful Use” (MU) legislation. Meaningful Use was designed to be implemented in at least three stages, each consisting of regulations which built onto each other with the ultimate goal of implementing a complete and interoperable EHR and/or HIT system in all US hospitals. For each stage, regulations were proposed by the national committees, and developed and reviewed by the public before they were finalized by the Centers for Medicaid and Medicare (CMS) and submitted to the healthcare facilities for implementation.

In 2011–2012 MU Stage 1 was initiated focusing primarily on the Computerized Physician Order Entry (CPOE) initiative for physicians. Hospitals that implemented this MU regulation successfully received federal funds for their HIT systems. In 2012–2013 MU Stage 2 was introduced focusing primarily on the implementation of Quality Indicators that required electronic data to be collected, measured, and used to demonstrate that a specific quality indicator was an integral component in the HIT systems. The Quality Indicators are used to guide hospitals in patient safety and if not implemented used as indicators subject to financial penalties. It is anticipated that MU Stage 3 will begin to be implemented in 2015–2016 and will primarily focus on care Outcome Measures and tentatively proposed Care Plans that encompass clinical specialty Plans of Care such as Nursing and Treatment Plans (see Chapter 16 “Nursing Informatics and Healthcare Policy” for MU details).

The billions of dollars invested are intended to move the health industry forward toward complete digitalization of healthcare information. Meanwhile the Center for Medicare & Medicaid Services (CMS) plans to increase reimbursement for the implementation of “MU” regulations in their HIT and/or EHR systems through 2015, and may even penalize eligible providers and facilities who do not meet the proposed MU criteria.

Nurses are involved with all phases of MU, from implementation of systems to assuring usage and adaptation to the evolving health policy affecting the HIT and/or EHR systems. Thus, the field of Nursing Informatics continues to grow due to the MU regulations which continue to impact on every inpatient hospital in the country. As a result, to date the majority of hospitals in the country has established HIT departments and has employed at least one nurse to serve as a NI Expert to assist with the implementation of MU requirements. As the MU requirements increase they will impact on the role of the NI experts in hospitals and ultimately on the roles of all nurses in the inpatient facilities, making NI an integral component of all professional nursing services.

Consumer-Centric Healthcare System. Another impact of the escalating cost of healthcare is a shift toward a Consumer-Centric Healthcare System. Consumers are encouraged to

be active partners in managing their own health. A variety of technologies have evolved to enable consumers to have access to their health information and choose whether to share this across healthcare providers and settings. Personal health records multiplied as either stand-alone systems or those tethered to EHRs. Consumers are increasing in healthcare information literacy as they demand to become more involved in managing their own health.

NURSING INFORMATICS PIONEERS

History Project

In 1995, Saba initiated a history of NI at the National Library of Medicine that consisted of the collection of archival documents from the NI pioneers. The History Project was initiated based on a recommendation by Dr. Morris Collen who published the *History of Medical Informatics* in 1995 (Collen, 1995). However, it was not until 2001 that the Nursing Informatics Working Group (NIWG) of the American Medical Informatics Association (AMIA) became involved and the NI History Committee was established to take on this project. The committee solicited archival material from the known NI pioneers for a History of Nursing Informatics to be housed in the NLM as part of its History Collection (Newbold, Berg, McCormick, Saba, & Skiba, 2012).

Beginning in 2004, the rich stories of pioneers in NI were captured through a project sponsored by the American Medical Informatics Association Nursing Informatics Working Group (AMIA-NIWG). The AMIA-NIWG History Committee developed an evolving list of pioneers and contributors to the history of NI. Pioneers were defined as those who “opened up” a new area in NI and provided a sustained contribution to the specialty (Newbold & Westra, 2009; Westra & Newbold, 2006). Through multiple contacts and review of the literature, the list grew to 145 pioneers and contributors who shaped NI since the 1950s. Initially, each identified pioneer was contacted to submit their nonpublished documents and/or historical materials to the National Library of Medicine (NLM) to be indexed and archived for the Nursing Informatics History Collection. Approximately, 25 pioneers submitted historical materials that were cataloged with a brief description.

Currently, the cataloged document descriptions can be searched online: www.nlm.nih.gov/hmd/manuscripts/accessions.html. The documents can also be viewed by visiting the NLM. Eventually each archived document will be indexed and available online in the NI History Collection. Also from the original list, a convenience sample of pioneers was interviewed over a 4-year period at various NI meetings. Videotaped stories from 33 pioneers were recorded and are now available on the AMIA Web site: www.amia.org/niwg-history-page.

Videotaped Interviews. The AMIA Nursing Informatics History page contains a wealth of information. The 33 videotaped interviews are divided into two libraries. The full interviews are available in Library 1: Nursing Informatics Pioneers. For each pioneer, a picture, short biographical sketch, transcript of the interview, and MP3 audio file are included in addition to the videotaped interview. In Library 2: Themes from Interviews, selected segments from the interviews are shared for easy comparison across the pioneers. The themes include the following:

- Nursing Informatics—what it is, present, future, what nursing brings to the table
- Significant events that have shaped the field of nursing informatics
- Pioneers’ paths—careers that lead up to involvement in (nursing) informatics
- When they first considered themselves informatics nurses
- Pioneers’ first involvement—earliest events they recall
- Informatics—its value, pioneers’ realizations of the value of informatics, how they came to understand the value of informatics
- Demography of pioneers including names, educational backgrounds, and current positions
- Personal aspirations and accomplishments, overall vision that guided the pioneers’ work, people the pioneer collaborated with to accomplish their visions, and goals
- Pioneers’ lessons learned that they would like to pass on

The Web site also provides “use cases” for ideas about how to use the information for teaching and learning more about the pioneers. These resources are particularly useful for courses in informatics, leadership, and research. They also are useful for nurses in the workforce who want to learn more about NI history.

Backgrounds. The early pioneers came from a variety of backgrounds as nursing education in NI did not exist in the 1960s. Almost all of the pioneers were educated as nurses, though a few were not. A limited number of pioneers had additional education in computer science, engineering, epidemiology, and biostatistics. Others were involved with anthropology, philosophy, physiology, and public health. Their career paths varied considerably (Branchini, 2012). Some nursing faculty saw technology as a way to improve education. Others worked in clinical settings and were involved in “roll-outs” of information systems. Often these systems were not designed to improve nursing work,

but the pioneers had a vision that technology could make nursing practice better. Other pioneers gained experience through research projects or working for software vendors. The commonality for all the pioneers is they saw various problems and inefficiencies in nursing and they had a burning desire to use technology to “make things better.”

Lessons Learned. What are some of the lessons learned from the pioneers? Pioneers by definition are nurses who forged into the unknown and had a vision of what was possible, even if they did not know how to get there. One of the pioneers advised, “Don’t be afraid to take on something that you’ve never done before. You can learn how to do it. The trick is in finding out who knows it and picking their brain and if necessary, cornering them and making them teach you!” Another said, “Just do it, rise above it [barriers], and go for it...you are a professional, and...you have to be an advocate for yourself and the patient.” Many of the pioneers described the importance of mentors, someone who would teach them about informatics or computer technology, but it was still up to them to apply their new knowledge to improve nursing. Mentors were invaluable by listening, exchanging ideas, connecting to others, and supporting new directions. Networking was another strong theme for pioneers. Belonging to professional organizations, especially interprofessional organizations, was key for success. At meetings, the pioneers networked and exchanged ideas, learning from others what worked and, more importantly, what did not work. They emphasized the importance of attending social functions at organizational meetings to develop solid relationships so they could call on colleagues later to further network and exchange ideas.

Nursing informatics did not occur in a vacuum; a major effort was made to promote the inclusion of nurses in organizations affecting health policy decisions such as the ONC’s Technology Policy and Standards Committees. The nursing pioneers influenced the evolution of informatics as a specialty from granular-level data through health policy and funding to shape this evolving and highly visible specialty in nursing.

NURSING STANDARDS INITIATIVES

The third significant historic perspective concerns standards initiatives focusing on nursing practice, education, nursing content, and confidentiality and security, as well as federal legislation that impacts the use of computers for nursing. These standards have influenced the nursing profession and its need for computer systems with appropriate nursing content or terminologies. Legislative acts during the early stages significantly influenced the use of computers to collect federally required data, carry out reimbursement,

measure quality, and evaluate outcomes. This section only highlights briefly the critical initiatives “to set the stage” for more information in other chapters of this book.

Nursing Practice Standards

Nursing Practice Standards have been developed and recommended by the ANA, the official professional nursing organization. The ANA published *Nursing: Scope and Standards of Practice* (ANA, 2008) that focused not only on the organizing principles of clinical nursing practice but also on the standards of professional performance. The six standards/phases of the nursing process serve as the conceptual framework for the documentation of nursing practice. The updated *Nursing Informatics: Scope and Standards of Practice* (ANA, 2010) builds on clinical practice standards, outlining further the importance of implementing standardized content to support nursing practice by specialists in NL.

Nursing Education Standards

The NLN has been the primary professional organization that accredits undergraduate nursing programs. Since the NLN’s Nursing Forum on Computers in Healthcare and Nursing (NFCHN) was formed in 1985, it has supported the integration of computer technology in the nursing curriculum. The American Association of Colleges of Nursing (AACN), which also accredits nursing education programs, revised *The Essentials for Doctoral Education for Advanced Nursing Practice* (AACN, 2006) and *The Essentials of Baccalaureate Education for Professional Nursing Practice* (AACN, 2011) to require the use of computers and informatics for both baccalaureate and graduate education. These new requirements for informatics competencies prepare nurses to use HITs successfully and to contribute to the ongoing design of technologies that support the cognitive work of nurses (AACN, 2011).

Nursing Content Standards

The nursing process data elements in EHRs are essential for the exchange of nursing information across information systems and settings. The original data elements and the historic details of nursing data standards are described in Chapter 7 of this book. Standardization of healthcare data began in 1893 with the *List of International Causes of Death* (World Health Organization, 1992) for the reporting of morbidity cases worldwide, whereas the standardization of nursing began with Florence Nightingale’s six Cannons in her “Notes on Nursing” (1959). However, it was not until 1955 that Virginia Henderson published her 14 Daily Patterns of Living as the list of activities and conditions that became the beginning of nursing practice standards in this country. But it was not until 1970 when the American