# An Introduction to Nursing Informatics

# Evolution & Innovation

2nd Edition

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Edited by





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# Dedication

I would like to dedicate this book to my family who continue to provide unwavering support for all my endeavors. To my husband, and partner in everything, you have always been by my side and keep me laughing. To my children, even though you are so far away, you are always there with a supportive call, text, or graphics design assistance. Love you all.

#### —Susan M. Houston

I dedicate this book to my family, peers, and friends who have helped by providing the time and support feedback to bring this publication to print. I hope that the history, stories, and vision will inspire a new generation of informatics professionals.

#### -Tina Dieckhaus

This book is dedicated to my family. Without their support and encouragement I would not be where I am today. Thank you all for standing behind me as I worked developing my nursing career.

#### -Bob Kirchner

This book is dedicated to my family. My family is the driver for everything I have accomplished, and they have supported me every step of the way. I am forever grateful for their love and motivation. More specifically, I thank my husband for being my rock, my parents for their inspiration, and my children for their patience.

#### -Michelle Chu Lardner



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# Foreword

### By Joyce Sensmeier

The second edition of this book represents an excellent summation of the current state of nursing informatics, while demonstrating the rapid trajectory of this specialty. Nursing informatics (NI) has evolved from a grass-roots activity supported primarily by nurses with on-the-job training to become a formalized and highly differentiated nursing practice built on a foundation of care coordination, effective communication, and strategic leadership. What we once thought of as the future has now represented itself in the present wherein technology and innovation are pervasive. Today, informatics nurses are leveraging data analytics, predictive modeling, telehealth, and even artificial intelligence to transform the healthcare environment into a value-based care model.

Nursing informatics roles are also evolving to accommodate these advancements and these new roles will help to relieve nurses' documentation burden by leveraging technologies such as mobile solutions, device interoperability, and secure texting. More than 300 job postings currently seek NI candidates, and the job responsibilities extend well beyond the traditional NI roles. One thing that remains constant, however, is the patient's place at the center of nursing's focus. Consumer engagement is gaining traction, and the authors describe how informatics nurses continue at the forefront of ensuring that systems and portals can support safe, patient-centric care.

The demand on nurses to understand the technological advances and tools that are being introduced into practice is constantly growing. The authors emphasize how informatics nurses are critical to supporting nurses' understanding and use of data. NI can reinforce the need for change and help nurses embrace emerging technologies while still maintaining the art and science of nursing practice. At the same time, NI must be diligent in monitoring for unintended consequences and evaluating the impact of technology on safe and high-quality clinical care.

This second edition outlines how NI is maturing and describes how advanced degrees and professional certification are becoming more prevalent among individuals who show the desire to demonstrate their expertise in this field. Leadership remains an essential competency as well as collaboration, communication, and large-scale project management skills. Concept representation and standards to support evidence-based practice, research, and education make up another core area of work for NI. Data and communication standards are also areas of focus to help us build an interoperable and secure national data infrastructure. And, as nurses increasingly have a seat at the table, NI can help define healthcare policy to advance the public's health.

While NI is embracing powerful new technologies and tools to advance our work, we are reminded by the authors that an understanding of clinical processes and workflow remains foundational. And serving as the conduit between clinicians and IT professionals to bridge nursing and technology is still an important aspect of our work. The case studies and day-in-thelife journals of informaticists included in this second edition bring to life the real-world activities of this specialty. I am sure you will enjoy reading these stories, and I hope this book will inspire you to consider the journey at hand—how we got to where we are today, and the exciting future that lies ahead.

# Acknowledgments

I would like to acknowledge all the nurses whose focus is on the health of patients and comfort of families, either directly or indirectly. Your title and role are irrelevant, as each of you has a part in improving health and providing comfort. This is a noble and heroic profession of which I am proud to be a member. Thank you to those who came before me and those who will follow.

#### -Susan M. Houston

I would like to thank all of the contributors to this book. It has been exciting to read their stories and learn from their experiences. It has been an honor to work with many of the contributors and develop professional relationships with these leaders in my chosen profession

#### —Tina Dieckhaus

I would like to thank all of the informatics nurses that blazed the path in creating this growing nursing discipline. Without all of their hard work and dedication, nursing informatics would not be where it is today

#### -Bob Kirchner

I thank all of the contributors to this book and those who have made this specialty what it is today and what it will be in the future.

I also want to especially thank Sue Houston for being a wonderful colleague and role model and for giving me the opportunity to work with this great group on this book.

#### -Michelle Chu Lardner



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# Introduction

"Unless we are making progress in our nursing every year, every month, every week, take my word for it, we are going back."

#### -Florence Nightingale

In 1992, the American Nurses Association's Congress of Nursing Practice established nursing informatics (NI) as a specialty practice. In the 25+ years since its recognition, NI has spread and flourished, influencing every aspect of the U.S. healthcare landscape. Today, nurse informaticists can be found at the bedside, in information technology (IT), within the C-suite, and in government at the local and federal levels.

The scope and standards of this profession, updated every five years, have also grown in order to meet the opportunities—and challenges—of a healthcare landscape continuously shifting and adjusting to the dizzying array of new technologies and regulations.

What is nursing informatics? Who are the people behind the specialty? What careers can be—have been—forged from its practice? How can I get started as an informatics nurse?

This book is meant to provide some answers.

An Introduction to Nursing Informatics: Evolution and Innovation, 2nd Edition provides a concise history of NI and an overview of the current state of the discipline, and serves as an introduction to the specialty's scope, influence, and growth within the healthcare industry.

**Chapter 1** defines healthcare and nursing informatics along with introducing the role of the informaticist. This chapter goes on to define the different professional roles and titles being used, as well as the various reporting structures in operation today. This lays the foundation for the rest of the book. **Chapter 2** builds a concise history of the profession, the pioneers, and the key moments that led to the development of NI over the decades.

**Chapter 3** provides a snapshot of NI today, which has expanded due to the increasing use of health IT and is impacting on the transformation of healthcare today. The chapter reviews the informatics leaders of today who are influencing policies and bridging the gap between IT and clinical as they describe the nurse informaticist's role in designing the electronic health record (EHR).

**Chapter 4** looks at the impact of emerging technologies on the role of the nurse informaticist in the future. This includes understanding "Big Data" and the role of analytics in the clinical setting. Advances in technology will bring challenges and new workflows that could influence the NI role, necessary competencies, and professional development.

**Chapter 5** provides insights into advanced analytical technologies that can be used by nurses in the healthcare environment. The chapter explains the modern healthcare data platform and the associated data sources that can be processed. Being able to visualize the output in a way that is understandable and actionable is an important component to analytics.

**Chapter 6** provides a brief look into the day in the life of a number of nurse informaticists. This chapter demonstrates diverse and expansive career opportunities for nurse informaticists through the description of a small sample of roles available today.

**Chapter 7** shares tips and advice for obtaining your first informatics job. This is beneficial no matter what path you have been on prior to deciding to move into an informatics role. Self-assessment is provided to help the reader understand his or her own situation and what role might be best.

To help you, the reader, reflect upon the information provided in each chapter, there is a section in the Appendix of case studies and questions. These present concepts discussed in each chapter and are intended to stimulate discussion within the classroom or by study groups on the topics covered. We suggest that you take the time to review these questions for a better insight into the scope of NI.

As many of you reading this book are new to nursing—even new to healthcare—this book can serve as a roadmap to get your journey off on the right foot. It is a great resource for students, those new to health IT, and can even serve as a reference guide for the many nurses currently working as informaticists.

# Chapter 1

# **A Discipline Defined**

### Susan K. Newbold and Carol A. Romano

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Technology surrounds us in our personal and professional lives. The "Internet of Things," first mentioned by Kevin Ashton in 1999, is described as a system in which the Internet is connected to the physical world by way of ubiquitous sensors. We are not yet at the point at which all data in healthcare is automated, but we are moving toward more automation in healthcare and other areas of our lives. Increasingly, our health records are being automated. Eventually, we will all have an electronic health record (EHR) that tracks our health, wellness, and illnesses from birth to death. Many factors are leading us to utilize more health information technology (IT). In the U.S. healthcare system there are issues with access to care, fragmentation of care, quality of care, and the cost of care. Driving the use of technology are federal incentive programs to adopt and meaningfully use and standardize IT in healthcare.

There are challenges to the adoption of health IT. Software products need to be more practical and have better connections to other software. For example, not all environments have the capability to pass data from one healthcare site to another. When a patient moves from the hospital to a rehabilitation unit to the home, the information needed for patient care must move as well. Often our electronic records do not tell the "patient story," but consist of drop-down menus and click boxes. Finding the money to pay for new systems and measuring the value of those systems are additional challenges. Employing the right personnel to select, implement, and maintain systems is an issue as there are not enough people skilled in both healthcare and IT in the workforce. In the midst of the explosion of technology in healthcare, the patient role is changing from one that is the recipient of care to one that is an engaged partner in his or her healthcare. Consumers of healthcare might use a personal health record (PHR), which is similar to an EHR, except that patients can control the data that goes into it. Through the PHR, one can make appointments, request prescription refills, communicate with a healthcare provider, and pay bills. With some PHRs in use today, patients can input healthy practices such as tracking food intake, blood pressure, weight, and exercise.

### **Definition of Healthcare; Nursing Informatics**

"Healthcare informatics" is defined by the Office of the National Coordinator for Health Information Technology (ONC) as "the application of information science and technology to acquire, process, organize, interpret, store, use, and communicate medical data in all of its forms in medical education, practice and research, patient care, and health management." (It is also known as "medical informatics.") There are many sub-areas of healthcare informatics, including nursing, dental, radiology, nutritional, veterinary, consumer, and health information management. A more in-depth definition provided by Stephen B. Johnson from Columbia University addresses the non-technical aspects of medical informatics: Medical Informatics studies the organization of medical information, the effective management of information using computer technology, and the impact of such technology on medical research, education, and patient care. The field explores techniques for assessing current information practices, determining the information needs of healthcare providers and patients, developing interventions using computer technology, and evaluating the impact of those interventions. This research seeks to optimize the use of information in order to improve the quality of healthcare, reduce cost, provide better education for providers and patients, and to conduct medical research more effectively.

### Available online at http://cci.drexel.edu/faculty/ssilverstein/ informaticsmd/infordef1.htm (accessed August 14, 2018)

Dr. Johnson puts a heavier burden on the informaticist, stating that medical informatics needs to provide scientific methods to study information needs—not simply focusing on a particular technology—and must show the impact of systems. He proposes that the field is more a social science than a technological one indicating that the informatician (or informaticist) needs to have a strong knowledge of ergonomics, organizational theory, a little economics, and some political and social skills. The American Medical Informatics Association (AMIA) suggests the development of a new information management paradigm will be required, proposing four cornerstones for this new paradigm. These AMIA cornerstones can serve as a functional "definition" of medical informatics. They are: "representing medical knowledge; acquiring and presenting clinical information; managing change; and integrating information." These are key functions well-suited for medical informatics leadership.

Nursing informatics (NI) is a specialty that integrates nursing science with multiple information management and analytical sciences to identify, define, manage, and communicate data, information, knowledge, and wisdom in nursing practice. NI supports nurses, consumers, patients, the interprofessional healthcare team, and other stakeholders in their decision-making in all roles and settings to achieve desired outcomes. This support is accomplished through the use of information structures, information processes, and information technology.

This is the most accepted definition of nursing informatics used in the United States, refined over time and published by the American Nurses Association. Although this definition may seem complex, when dissected, it makes sense. Let us look at the first sentence, "Nursing informatics (NI) is a specialty that integrates nursing science with multiple information management and analytical sciences to identify, define, manage, and communicate data, information, knowledge, and wisdom in nursing practice."

Nurses work in a discipline that must integrate concepts from other fields in order to accomplish the work of providing safe, efficient, and effective care. Informatics and other nurses do not work in isolation but need to partner in order to provide better care. In this definition, we see the continuum of data to information to knowledge to wisdom, which are concepts that increase in intricacy. To continue, nurses support all those who are associated with healthcare in all settings to make evidence-based decisions. In the final sentence, "information structures" refer to nursing and healthcare terminologies (CCC, NIC, NOC, NANDA, CPT, ICD-10, etc.). Information structures organize data, information, and knowledge for processing by computer systems. Information technology includes computer hardware, software, and communication and network technologies.

Not all nurses are informatics nurse specialists, but all nurses need to understand nursing informatics concepts. All nurses utilize data and put it together in meaningful ways to create information. The information then can contribute to the creation of new nursing knowledge. Health information systems are being integrated into every nursing role at the point of care and beyond. We are moving past the stage at which we merely input data to now understanding the information being created about the individual patient and patient populations. One goal of nursing informatics is to support the "triple aim" of healthcare, which is improving the experience of care, improving the health of populations, and reducing per capita costs of healthcare. Nurses who understand nursing and healthcare informatics are likely to help to improve the delivery and safety of patient care.

### **Evolving Roles for Nurses**

Some nurses think that informatics is a new field, but nurses have worked in this area for more than 40 years. In the early 1980s, a nurse who worked in the data-processing department was typically called the "computer nurse." At that time, nurses implemented order entry and results-reporting systems (nursing systems were not well developed and widespread) and they trained other users on these systems. Some nurses developed information systems while working for a vendor organization or in the data-processing department of a hospital. Florence Nightingale is credited with being a statistician, collecting and using data to alter the way patients were cared for in the Crimean War. Perhaps she could be called the first informatics nurse because she used analytical methods to manipulate data to understand how to care for patients. Nursing has come a long way as a profession and in using data and information to make informed decisions since the days of Ms. Nightingale.

### The Early Role of the Nurse in Medical Informatics

According to Hannah, Ball, and Edwards, the first MedInfo conference on medical informatics in Stockholm in 1974 included only five papers authored by nurses. One paper was written by Maureen Scholes, a registered nurse from England, who is credited with coining the term "nursing informatics" in the early 1980s. "Informatics" was derived from the French word "informatique," referring to computer science. Scholes was instrumental in the hosting of the First International Conference on Nursing and Computing in 1982, held in the United Kingdom. The involvement of nurses in health IT has increased significantly since the early 1980s. In June 2016, the 13th International Congress on Nursing Informatics was held in Geneva, Switzerland, with an estimated attendance of more than 1,000 nurses from many countries.

The American Medical Informatics Association (AMIA) has a very active Nursing Informatics Working Group. One of their key projects has been to capture the history of pioneers in NI. These are nurses who have made an early and sustained contribution to the field of NI. The overall purpose of AMIA's Nursing Informatics History Project is to document and preserve the history of NI. Nurses are invited to listen to the words of our nursing leaders to learn how the profession has evolved. The project encompassed three areas:

- NI pioneers and organizations were solicited to preserve their materials in an archive started by Dr. Virginia Saba at the National Library of Medicine in 1997.
- Stories of the pioneers in NI002 were videotaped and the recordings made available through AMIA's website.
- Historical research was inaugurated to document the evolution of informatics as a specialty in nursing.

### **Nursing Specialty Practice**

Although nurses had been working with IT for many years, NI was formally recognized as a specialty by the American Nurses Association only in 1992. Nursing research regarding NI is increasing and there is now a cadre of nurses who identify themselves as informatics nurses. Nurses are employed as informatics specialists, speak at conferences, write books and papers, contribute to journals, participate in professional organizations, take courses at university level, seek certification, and conduct research.

The Healthcare Information and Management Systems Society (HIMSS) is a membership organization (and publisher of this book) that provides tremendous support for nurses interested in informatics. Surveys, webinars, the *HIMSS Online Journal of Nursing Informatics*, nursing informatics books, blogs, and the Annual HIMSS Conference and Exhibition are among the plethora of offerings. HIMSS student rate encourages membership for those new to the field or interested in healthcare informatics.

### Job Titles for Informatics Nurses

The American Nurses Association's *Nursing Informatics: Scope and Standards of Practice, 2nd edition* (2014) gives two titles for nurses working in informatics: "informatics nurse" and "informatics nurse specialist." The informatics nurse (IN) is a registered nurse with an interest or experience in an informatics field, such as nursing informatics. The informatics nurse specialist (INS) is a registered nurse with formal, graduate-level education in informatics or a related field. Although the American Nurses Association (ANA) recommends use of these two titles, there are actually a couple of thousand titles in use for nurses working within informatics. This makes it difficult to understand who is actually working in informatics and to make any comparison of job titles for purposes of evaluation and salary assessment.

In a study of the top titles used by nurses identifying with the informatics field in this author's database, there were 6,211 unique titles used out of 23,667 nurses. A selection of job titles and the numbers of instances of use can be found in Table 1.1. "Clinical Analyst" was the informatics title used most often in the database. The recommended title of Informatics Nurse Specialist was used by only 35 nurses and Informatics Nurse was not in the

Number of Nurses	Title
236	Registered Nurse (or title not specified)
220	Clinical Analyst
219	Informatics Nurse
154	Consultant
133	Clinical Informatics Specialist
132	Assistant Professor
130	Graduate Student Nursing Informatics
125	Clinical Systems Analyst
117	Associate Professor
90	Nursing Informatics Specialist
84	President
82	Clinical informatics Analyst
82	Project Manager
75	Director
73	Senior Consultant
70	Professor
67	Clinical Informatics Coordinator
62	Senior Clinical Analyst
59	Systems Analyst
58	Clinical Informaticist
58	Manager
52	Nursing Informatics Coordinator
51	Nurse Informaticist
50	Clinical Informatics
49	Nurse Manager
47	Clinical Informatics Nurse
46	Clinical Consultant
45	Director, Clinical Informatics
42	Senior Systems Analyst
35	Informatics Nurse Specialist
35	Chief Nursing Officer

Table 1.1Top Titles Used by Nurses in Informatics, 2013

list of the top 31 titles. Perhaps informatics nurses should think about moving to a smaller number of titles and perhaps use the recommended two titles to be able more clearly to define who they are and compare job duties and salaries, etc.

It is easy to confuse roles with titles. The list below presents the functional areas of NI described in *Nursing Informatics: Scope and Standards of Practice, 2nd edition.* Those working in informatics may not be serving in all areas but would focus on one or more functional areas combined within a particular NI position.

- administration, leadership, and management
- systems analysis and design
- compliance and integrity management
- consultation
- coordination, facilitation, and integration
- development
- educational and professional development
- genetics and genomics
- information management/operational architecture
- policy development and advocacy
- quality and performance improvement
- research and evaluation
- safety and security

## A Role for Every Nurse

Not all nurses desire to be informatics nurses or informatics nurse specialists. Yet every nurse does have a role in informatics. According to *Scope and Standards*, "Nurses are skilled in managing and communicating information and are always concerned with content quality" (p. 3). We can use health IT to help manage and communicate information. The typical nurse will have a specialty area such as perioperative nursing as a central focus and then use the concepts of data, information, knowledge, and wisdom to provide effective healthcare delivery regardless of where he or she works. All nurses can use their knowledge of workflow, skill sets, and clinical experience to identify where improvements are needed and what can be improved through the use of IT. Informatics is more entrenched in our educational programs and in practice and is included in the American Association of Colleges of Nursing's elements and framework ("Essentials") for building nursing curriculums for Baccalaureate, Master's, and Practice Doctoral Education Programs. The nurse may focus on using information applications and technology, whereas the informatics specialty nurse may focus on the design, development, implementation, and evaluation of applications and technologies, ensuring their safety, quality, effectiveness, efficiency, and usability.

### **Reporting Structures**

In 2017, HIMSS conducted a survey of 1,279 informatics nurses and found that 64 percent of respondents worked in a hospital or corporate offices of a healthcare system. (see Figure 1.1) Of those respondents, 49 percent stated they report to the information systems (IS) or IT department, slightly lower in the 2017 survey than in a previous survey. Thirty-two percent reported to the nursing department, which was slightly higher than two previous survey years. Twenty-eight percent reported to administration, perhaps related to the increase in nurses in Chief Nursing Informatics



**Department to Which You Report** 

Figure 1.1 HIMSS 2017 Nursing informatics workforce survey reporting structure for informatics nurses. (From the HIMSS 2017 Nursing Informatics Workforce Survey. Used with permission.)



Figure 1.2 HIMSS 2017 Nursing informatics workforce survey reporting structure for informatics nurses. (From the HIMSS 2017 Nursing Informatics Workforce Survey. Used with permission.)

Officer roles. As the figures total more than 100 percent, it is assumed that several of those surveyed reported to more than one department (see Figure 1.2). "Which department is the best for reporting?" is a common question. There is no easy answer, as there are pros and cons of reporting to IS/IT versus nursing. The culture of the organization may dictate which fit is best. For this author's entrance into informatics, it was best to report to IS/IT to learn the more technical side of informatics. In other organizations, a strong nursing executive officer may be able to offer solid leadership.

### **Standards of Nursing Informatics Practice**

*Nursing Informatics: Scope and Standards of Practice* was first published in 1995 and 1996 as two separate documents (now combined into one). It has been revised over the years and is a must-read resource for defining the breadth and depth of the profession of informatics nursing. Importantly, it defines the informatics competencies for all nurses—not just informatics nurses. The definition of NI was recently updated to include analytical sciences and stresses the interprofessional nature of the profession. This resource also addresses metastructures, concepts, and tools of NI, functional areas for NI, competencies, ethics, and the future of NI.

### Summary

This chapter provided an introduction to healthcare and NI. The purpose and goals of NI were defined. The different roles, available job titles, and reporting structures were described along with the impact and pros and cons of each. This chapter also discussed the evolving scope and standards of the practice of NI. Every nurse has a role related to informatics, and understanding how to apply IT appropriately can help provide better patient care.


### Chapter 2

# The Origins and Evolution of Nursing Informatics

# Sejal Patel, Grischa Metlay, Kathy Lesh, and Linda Fischetti

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Just as the study of man leads us to look back to our evolutionary ancestors and the study of flight leads us to explore history well before the Wright brothers' first success at Kitty Hawk, the study of nursing informatics (NI) appropriately begins decades before the discipline was created. In the 1940s, nurses were adopting classification, information management, and operations research methods to understand the science of nursing. Many of the nurses who were leading activities to quantify nursing outcomes, methods, resource models, and practices were the same nurses who quickly adopted computers to support this work. This early history of NI prior to its formalization as a specialty is important for fully appreciating the discipline's current accomplishments.

As this chapter shows, the early pioneers of NI applied their professional expertise toward patient needs, hospital management, and information flows to improve systems geared toward healthcare planning and management. In addition to applying their expertise toward the design of these systems, early NI pioneers also used these tools to further the scientific basis of nursing care and improve the profession itself.

This chapter introduces some NI pioneers and describes their early engagement with computers and information systems, their efforts to organize and educate nurses with interests and experience in informatics, and their endeavors to enhance nursing research and practice more generally through standardizing nursing information and terminology systems.

This chapter divides the recent history of NI into three key periods. First, beginning in the 1940s, nurses allied with operations researchers and industrial engineers to adapt computers and information management to health-care settings and practices. The next period, which began in the late 1970s, saw the development of standardized classification systems for nursing diagnoses, nursing interventions, and patient outcomes to advance the profession of nursing and improve patient care. The most recent period in the history of NI is characterized by the revolutionary use of technology in healthcare

environments and the formalization of NI as a speciality within the nursing profession. This period is characterized by what many equate with NI today—the incorporation of nursing concepts into machine-readable health terminologies, the collaborative development of interprofessional informatics, and the expansion of research on the impacts of nursing on patient outcomes across the continuum of care.

#### The Roots of a New Specialty: 1940–1980

Economic factors in the 1940s fundamentally changed care delivery environments. The increased availability of employer-based health insurance, the introduction of new inpatient technologies and services, and the influx of federal funding for hospitals following the Hospital Survey and Construction Act of 1946 had transformed hospitals from places for rest and convalescence into complex organizations with numerous departments, personnel categories, and payment streams.

This evolution led to an increased demand for managerial sense and logistical planning in healthcare settings, which in turn led to efforts across the country to identify approaches to rational health planning and hospital management that would help meet patient needs in a more efficient and effective manner (Shuman, Speas, and Young, 1975). These developments, in addition to concerns over healthcare worker shortages, particularly in nursing, and the rising cost of healthcare, popularized operations and systems thinking in the healthcare domain.

Beginning in the 1940s, nurses, along with operations researchers, industrial engineers, hospital administrators, and public health officials, among others, began embracing the notion that patient needs, although variable, could be identified quantitatively and that models based on patient classification schemes could be used to predict the resources required for patient care. Nurses began partnering with operations researchers and industrial engineers to adapt the approaches used in systems engineering to healthcare. During this period, public health officials began actively surveying community and regional health needs in an effort to adequately allocate public health personnel (Melhado, 2006). Together, these groups created and tested models for rational planning and management aimed at effectively distributing resources while maintaining healthcare quality.

#### Hospital Management Systems

From the start of these activities, nurses participated in interprofessional teams alongside operations researchers and industrial engineers to better understand and develop approaches to plan and manage healthcare resource use. As primary overseers of the flow of information about patients throughout the hospital setting, nurses became essential in efforts to capture and codify information flow within hospitals for modeling purposes.

For example, Rita Zielstorff, a NI pioneer, began her initial work in healthcare informatics when she responded to a posted newsletter soliciting nurses to help design an automated medication system in the Laboratory of Computer Science at the Massachusetts General Hospital. In that role, and in other subsequent positions involving the development of information systems, Zielstorff contributed her knowledge of nursing practice.

As she recalled, "It was because I was using my nursing expertise, my knowledge of how nurses particularly handled medications, and how they recorded medications, that I was hired to participate in the design of this automated medication system" (Zielstorff, 2008).

Through using their insights into the operation of hospitals and other healthcare delivery institutions, nurses embraced an interprofessional approach, partnering in particular with operations researchers to develop patient classification systems that would effectively predict the resources required to treat a given population. Hospitals found that such systems more accurately predicted the amount of care required by various departments and services and thus optimized overall patient care. Nurses also helped in these endeavors by dividing nursing procedures into a manageable number of tasks and by developing coefficients to represent cost in utility and salary for each. These early efforts resulted in staffing and time studies directed at improving the quality and quantity of nursing services. The interprofessional collaboration between nurses and operations researchers was critical to these early efforts. As one operations researcher remarked, "The nursing profession has taken commendable leadership in cooperating with efforts to analyze and improve patient care" (Levine and Kahn, 1975).

#### Health Resource Planning

The 1960s saw historic economic influences on healthcare, with new federal legislation including the Medical Assistance to the Aged Act of 1960, the Community Health Services and Facilities Act of 1961, the Nurse Training Act of 1964, and the Social Security Amendments of 1965 authorizing Medicare and Medicaid, injecting millions of dollars into the American healthcare system. Sanctioning these expenditures was the country's growing expertise in accurately assessing and distributing healthcare resources. In addition, this period saw increasing requirements for reporting as well as sophistication in the approaches used to assess and analyze health worker resources throughout the country.

Once again, nurses played an early and critical role in developing the models and approaches used in health labor resource models. Nurses in the United States Public Health Service (USPHS) had been producing nurse manpower analyses on community nursing since 1937. To produce these analyses, nurses not only surveyed the number of community nurses across the country but also sought information about the specific needs of the communities served.

As Virginia Saba, a NI pioneer, explained, the flow of information "starts with the nurse, who collects data as she provides service to the patient. The data are then transferred to the reporting system, where they can be translated into information of significant value to all components of the agency and all levels of personnel" (Saba, 1974).

By 1972, when Saba took the lead in preparing these surveys, the models had expanded from providing basic descriptive statistics on nurses working in community settings to relating nursing personnel and nursing programs to the total public health resources of the community. This expanded focus facilitated the measurement of relationships between services offered by public health agencies, personnel providing the services, and characteristics of the population serviced. It also provided a better statistical base for projecting nurse manpower needs in public health, out-of-institution, and community nursing services. As with hospital management systems, health resource planning required accurate predictions of the resources required to meet healthcare needs—activities toward which nurses, like Saba, contributed greatly.

#### Nurses and the Application of Computers

Nurses like Saba and Zielstorff, who had already been leading the study and quantification of nursing practices, were early adopters of computers in healthcare settings. For example, they influenced the early development of hospital management systems and became leaders in adopting information management systems in their respective institutions. At the USPHS, the use of computers became almost inevitable as its community nursing surveys grew more sophisticated. Assistant Surgeon General Rear Admiral Jessie Scott wrote in the foreword to *Management Information Systems for Public Health/Community Health Agencies: A Report of a Conference*, "With the increasing cost of health manpower and the multiplying complexities in the delivery of healthcare, it is no longer possible to plan and predict the manpower needs and staffing requirements of public health/ community nursing agencies without computer assistance" (Scott, 1974).

These needs prompted the USPHS, specifically its Division of Nursing, which was led by Scott, to fund early initiatives focused on the use of computers and information systems in nursing. As a result, key players with backgrounds in manpower analyses, like Saba, went on to develop management information systems for other public health/community health agencies.

Nurses also played central roles in overseeing the implementation of information and management systems in healthcare settings. For example, Carol Romano, who designed and implemented one of the first computerized medical information systems in 1976 and established the first graduate curriculum in nursing informatics, led the development of interfaces between the various management information systems used in different hospital departments. According to Romano:

As one looks at all of the different types of clinical systems that are used in a healthcare environment, it becomes important to understand how the interfaces of these systems need to work. For example, a nutrition system is important, but it needs to connect with the diet order, and then how the nurse communicates electronically to let the dietary system know when the patient is NPO, a medical term for "nothing by mouth," or when diet trays have to be served, and whether diet drug allergies are integrated into the clinical systems

#### Romano, 2008

Nurses detailed the clinical and operational needs for the proper flow of information from one department to another. Romano remarked, "Nurses have always been in a critical position to handle information and to integrate it across the discipline" (Romano, 2008). Like Romano, nurses across the country played similar roles in ensuring the proper integration of information systems in healthcare settings.

# Establishing a New Specialty of NI in the 1980s and 1990s

The nurses who took on the responsibility of managing these systems became self-taught users, often enrolling in computer and programming courses as needed to support their ability to better use and develop these systems and the information they produced. Nurse administrators quickly saw the need to promote the inclusion of nurse informaticists in decisions about which information systems to adopt, in large part to assist their own evaluation of staffing needs and workflows.

As a chief nurse at the NIH Clinical Center told Romano, "We're going to let the technology people worry about the technology, and we're going to worry about what it is about nursing care that the system can do for us, and what is the information piece for our nursing care process that we want to capitalize on" (Romano, 2008).

However, in the early 1980s, these nurses were often making such systems decisions independently—without leadership, without organization, without standards. Without realizing it, nurses were creating the basis of a new professional specialty they would later refer to as "nursing informatics." However, this transition required a great deal of collaboration, convening, and sharing of ideas to create a common foundation. Through conferences, educational programs, and leadership roles in major nursing organizations, NI pioneers like Zielstorff, Saba, and Romano communicated the role of nurses in information systems, the demand for this expertise, the need for further training, and how the nursing profession as a whole would benefit from the contributions of NI.

#### Conferences

Early conferences on computers and nursing played a critical role in bringing together nurses who had worked on hospital information and management systems and were eager to develop their skills in and knowledge of this area. Motivating NI pioneers like Saba and Romano to organize such conferences were the questions they and a handful of other nurses had about operating and maintaining these systems.

Saba, who convened a nursing session at the Symposium on Computer Applications in Medical Care (SCAMC) in 1977, found a large number of receptive attendees eager to build their knowledge and networks. In 1981, Romano sent out flyers for a conference titled *Computer Technology*  *and Nursing* at the NIH. The experience was eye-opening for Romano. For one, she received a far greater number of responses than she had originally expected.

As she explained, "We thought we would get maybe a hundred people...and we were shocked to get a thousand people come to the conference" (Romano, 2008). The event was also surprising because it brought to the fore the collective need for information sharing and collaboration in this area. For many attendees, this was their first interaction with other nurses working with computers and on classifying activities for health information, and many were eager for answers to questions and to acquire needed information.

The high turnout at these early conferences led to regular opportunities for nurses interested in computers and informatics to build their knowledge and networks. Saba's nursing sessions at SCAMC became an annual event; Romano went on to organize six more *Computer Technology and Nursing* conferences within the decade. Such forums were essential for building a network of nurses willing to collaborate on topics related to NI. Saba made a point of collecting contact information on all nurses who attended the SCAMC sessions and would send them regular updates on new initiatives, sessions, and conferences focusing on computers in nursing.

NI pioneers also used conferences to establish interest groups, like the Computers in Nursing interest group at SCAMC and working groups such as the International Medical Informatics Association's Working Group 8 on Nursing Informatics, which further served to build an emerging network of, and professional base for, nurse informaticists. Conferences also gave NI pioneers the opportunity to publish conference proceedings and special conference issues, as the journal *Computers in Nursing* began doing in 1984. Overall, conferences were instrumental in bringing to the attention of the nursing profession the growing interest, existing potential, and future contributions of the emerging speciality of NI.

#### **Educational Programs**

In the early 1980s, a spattering of workshops and seminars were available for providing nurses with a basic introduction to using computers in healthcare settings. For example, the University of Akron School of Nursing started holding an annual one-week workshop, beginning in 1980, called "Computer Usage in Healthcare" that introduced nurses to all aspects of computer applications in their field. Supporting these programs were the early books and textbooks published about nursing informatics during this period. Zielstorff's *Computers in Nursing*, published in 1980, was the first book on nursing informatics (Zielstorff, 1980). This was followed later in 1980 by *Nursing Information Systems*, edited by Harriet H. Werley and Margaret R. Grier (Werley and Grier, 1980).

Nursing programs soon began offering undergraduate courses in nursing informatics as well. For example, in 1985, Saba led Georgetown University School of Nursing's elective NI courses in both its undergraduate and graduate programs. Marion Ball, not a nurse herself but a longstanding nurse advocate, along with Romano and Barbara Heller, Dean of the School of Nursing, spearheaded the effort to establish the first graduate degree in Nursing Informatics at the University of Maryland in 1988—a program responsible for producing the vast majority of nurse informaticists that joined the workforce in the 1990s (Ball, 2008). These programs helped establish a NI workforce and enabled an even greater number of hospitals and other healthcare institutions to benefit from the work of nurse informaticists.

#### Nursing Organizations

Major nursing organizations supported the formalization of NI through providing platforms on which to build leadership and formalize classification systems, educational programs, and other aspects of NI. At the initiative of Saba and others, the American Nurses Association (ANA) launched the Council on Computer Applications in Nursing (CCAN), which allowed early NI pioneers to develop nursing information systems (NISs). The National League for Nursing (NLN) also formally supported NI through forming the National Forum of Computers in Healthcare in 1985, which became the Council on Nursing Informatics in 1989.

Through these councils, NI pioneers were able to pass national resolutions about the future of this emerging field. For example, the ANA and NLN approved resolutions urging nurse informaticists to assume leadership in the development of NISs and to include computer courses in educational programs, respectively. In 1982, the ANA created the Steering Committee on Classification of Nursing Practice (later named the Steering Committee on Databases to Support Clinical Nursing Practice and then the Committee for Nursing Practice Information Infrastructure) for the purpose of recognizing classification systems on ANA's behalf. This was an important function, because ANA-recognized classification systems later became part of the National Library of Medicine's Unified Medical Language System (UMLS®) (McCormick, et al., 1994). In 1984, the ANA created a Council on Computer Applications in Nursing to promote and oversee education on the topic.

#### NI as a Nursing Specialty

While the 1980s were notable for the growing recognition of NI through conferences, publications, educational programs, and formal and informal networks across the country, nurses engaged with computers, information processing, and analyses had little sense of belonging to a distinct specialty within nursing. Indeed, the definition of NI was limited to that of an activity based on skills and scope of practice for nurses in IT.

As one observer noted, during the 1980s, technology often defined the area of nursing informatics, with textbooks describing NI as any use of IT by nurses in relation to the care of their patients, the administration of health-care facilities, or the educational preparation of individuals to practice the discipline (Hannah, 1985).

In other words, the impact of NI on the nursing profession as a whole was less recognized and appreciated. What helped NI establish itself as a speciality within nursing was its ability to articulate its role in promoting the profession of nursing, establishing a well-defined research and educational agenda, and, eventually, building an accepted mechanism through which nurses could become credentialed in NI (Staggers and Bagley Thompson, 2002).

Helping NI assert its place within the nursing profession as a whole was the seminal 1989 article by Judith Graves and Sheila Corcoran titled, "The study of nursing informatics." Rather than describing NI as a set of skills, Graves and Corcoran described NI as a "combination of computer science, information science *and nursing science* [italics added] designed to assist in the management and processing of nursing data, information and knowledge to support the practice of nursing and the delivery of nursing care" (Graves and Corcoran, 1989). By emphasizing nursing science as a critical component of the work performed by nurse informaticists, they elevated the status of nursing informatics from a set of practices into a specialty in its own right. The article helped articulate a research and educational agenda for the new field as well—one in which NI enabled and supported improvements in the practice and delivery of nursing care.

With this clearly articulated role in the nursing profession, ANA recognized nursing informatics as a specialty practice in 1992. Steps towards certification began soon after, with ANA publishing the NI Scope of Practice statement and *Nursing Informatics: Scope and Standards of Practice* in 1994. Formal certification by the American Nurses Association Credentialing Center (ANCC) began in 1995 (Panniers and Gassert, 1996). Today there are more than 1,000 certified nurse informaticists, while thousands more have received graduate-level degrees and/or work in the practice of NI without certification (Bickford and Lewis, 2014).

#### Standardizing Nursing Information, 1980–1995

Expanding, refining, and standardizing nursing information became a major focus of NI during the 1980s and 1990s. For example, when the ANA originally explored the development and testing of a classification system for use in all areas of nursing practice in 1986, the system, known as the North American Nursing Diagnosis Association (NANDA) Taxonomy, grouped "human responses to actual or potential health problems" according to nine response patterns. By the time ANA officially recognized the NANDA Taxonomy in 1992, it contained more than 100 nursing diagnosis labels (McCormick, et al., 1994).

Driving the focus of NI on classification systems during this period were efforts to strengthen the nursing profession as a whole. With an established professional base united by educational programs and national organizations, first- and second-generation NI pioneers began asking how NI could elevate the status of nurses while improving patient care.

At the beginning of the 1980s, a small cohort of nurses coalesced around the idea that the nursing knowledge base could advance if nurses collected standardized information about their activities and their patients. Each of these pioneers had seen the status of the nursing profession improve during the 1970s. They also felt strongly that continued improvements could only be assured if nurses were able to document their contributions to patient care and develop a solid foundation of objective nursing knowledge that could drive future improvements in clinical practice and health policy. These pioneers dismissed as unscientific the nursing theories that guided the profession during the first half of the 20th century. In their view, nursing interventions should not be defined as a residual category of "things that doctors don't do" (Bowker and Star, 1999).

Interventions needed to be precisely delineated, and they needed to be associated with patient outcomes in order to generate scientific evidence of their efficacy. The key to accomplishing these goals was in refining the documentation of nursing diagnoses and practices, as well as their impact on patient outcomes. As Norma Lang famously quipped, "If you don't name nursing you can't practice it, you can't teach it, you can't pay for it, [and] you can't put it in public policy" (Lang, 2008).

Joined by a common vision for nursing, these pioneers came together at conferences and *ad hoc* workshops to discuss how to construct standardized terminologies. This effort was motivated by the recognition that, as Margaret Grier argued at a 1977 conference, "problems arise in making nursing decisions because of difficulty in acquiring and processing information" (unreferenced).

For Grier, nursing information was critical to proper clinical decisionmaking, not to mention nursing education and research. To further these ends, it was necessary to design and develop "systems of information for nursing practice" (Grier, 1981). At that same conference, Werley stressed recent improvements in computing; she also emphasized to her colleagues the importance of ensuring that nurses played an active role in the creation of nursing information systems (Werley, 1981).

External factors also contributed to the emphasis on expanding, refining, and standardizing nursing information during the 1980s. Early in that decade, Medicare introduced prospective payment systems and diagnosisrelated groups and Congress passed legislation that provided strong incentives to form health maintenance organizations—all of which were intended to curb spiraling healthcare costs. As the federal government and other insurers sought to rein in costs, healthcare administrators became more cognizant of resource utilization. In such an environment, focused as strongly as it was on costcutting efforts, the ability for nurses to document their contributions and account for their activities became more important.

For example, since nursing costs were (and still are) factored into the room costs for an inpatient hospital stay, the documentation of nursing activities helped ensure that hospital administrators would not inappropriately eliminate nursing shifts to reduce overhead. The imperative to cut healthcare costs highlighted the need to more systematically document nursing's unique contributions to patient care, which in turn provided the incentive to standardize nursing terminologies in the 1980s.

#### NANDA Taxonomy, Omaha System, Nursing Minimum Data Set

The first major effort to classify nursing information began in 1973, when Kristine Gebbie and Mary Ann Lavin convened what they called the First

Task Force to Name and Classify Nursing Diagnoses, which eventually led to the creation of the NANDA alphabetical list of nursing diagnoses. Nurse informaticists then worked to restructure NANDA's list of nursing diagnoses into a hierarchical taxonomy in preparation for submission to the World Health Organization for consideration for inclusion in the 10th revision of the International Classification of Diseases (ICD) (Fitzpatrick, 1991).

At roughly the same time, staff and administrators at the Omaha Visiting Nurse Association set to work on their own classification system for public health nursing. Led by Karen Martin, these nurses believed that such a system would expedite staffing and care delivery while promoting professional autonomy and accountability. More comprehensive than the NANDA Taxonomy, the Omaha System encompassed interventions and an outcome scale as well as the types of client problems that the NANDA Taxonomy covered.

Beginning with a list of 49 nursing conditions in 1976, the Omaha System was expanded in 1986 to include 44 client problems, 663 interventions, and an outcome scale denoting relative improvement and decline. In 1992, the system was further refined, and that same year ANA recognized it as an official classification system (Martin and Scheet, 1992).

Work on the Nursing Minimum Data Set (NMDS), another nursing classification system, can be traced back to conversations between Harriet Werley and other participants of the 1977 Nursing Information Systems Conference. In the early 1980s, while working at the University of Wisconsin-Milwaukee School of Nursing, Werley approached Norma Lang, Dean of the School of Nursing, about developing a minimum data set for nursing information.

At the time, the U.S. Department of Health & Human Services was promoting the notion of a minimum health data set for collecting essential information about certain aspects of a healthcare system. Lang discussed the subject with other faculty at the nursing school and in 1985 the school hosted a three-day invitational conference, the outcome of which was the NMDS.

In 1990, the ANA recommended that the NMDS be used as the essential minimum data set for nursing information in any electronic patient record system. By 1994, the NMDS included 16 items, which consisted of elements covering nursing care (i.e., nursing diagnosis, nursing intervention, nursing outcome, and intensity of nursing care) as well as other items encompassing patient characteristics and administrative information (Lang, et al., 1995).

#### Nursing Intervention Classification (NIC) and Nursing Outcomes Classification (NOC)

Joanne McCloskey and Gloria Bulechek from the University of Iowa conducted other important work in nursing terminology classification. McCloskey and Bulechek became interested in systematizing nursing interventions in 1982 when they were teaching a graduate course on adult health nursing. This collaboration led to the publication in 1985 of an awardwinning textbook, *Nursing Interventions: Treatments for Nursing Diagnoses* (Bulechek and McCloskey, 1985). Their work piqued the interest of other faculty at Iowa for offering a robust, integrated classification scheme for interventions and outcomes. After the 1986 NANDA conference, McCloskey and Bulechek decided to mount a substantial effort to promote their approach.

Guided in large measure by the idea that clinical decision-making required knowledge about nursing diagnoses, nursing interventions, and patient outcomes, McCloskey and Bulechek formed a research team in 1987, and in 1990 they received a three-year grant from the NIH to develop their system further. The Iowa research team completed the first version of the Nursing Intervention Classification (NIC) in 1992, which consisted of 433 interventions. Each intervention included a list of activities falling under the scope of that intervention.

The Iowa team developed a text, published in 1992, stating, "When nurses systematically use a common standardized language to document the diagnoses of their patients, the treatments performed, and the resulting patient outcomes, then we will be able to determine which nursing interventions work best for a given population" (McCloskey and Bulechek, 1992). In 1992, the Iowa team, led by Sue Moorhead, expanded their efforts to include an analogous classification scheme for patient outcomes: the Nursing Outcomes Classification (NOC). Like other classification initiatives, the motivation driving NIC and NOC revolved around demonstrating the impact of nursing practice on patient outcomes. Recognizing the sophistication of the NIC and NOC schemes, ANA officially recognized NIC in 1992 and NOC in 1997. The sixth edition of the NOC was published in 2018 and includes 540 outcomes (Moorhead, et al., 2018).

### Entrenching Classification Systems and Researching Nursing Impacts, 1995–Present

Once nurse informaticists had standardized nursing terminologies, they turned to the task of integrating nursing classification systems and concepts into larger standardized health terminologies. Prompting this shift were new federal initiatives beginning in the 1980s that promoted the computerization of such terminologies. For example, in 1986, Congress funded the National Library of Medicine (NLM) to build the Unified Medical Language System (UMLS®), which provided health professionals and researchers with a centralized system to "build or enhance systems that create, process, retrieve, and integrate biomedical and health data and information" (National Library of Medicine, 2009). Including nursing classification systems into these initatives was critical to ensuring nursing-relevant data were collected in new computer systems and available for nursing research and quality improvement needs.

#### Incorporating Nursing Concepts into Computerized Health Terminologies

Nurse informaticists worked to ensure that ANA-recognized systems were included in the UMLS<sup>®</sup> Metathesaurus, the first edition of which was released in 1990 and has since undergone several revisions. Starting in the mid-1990s, nurse informaticists at the ANA sent NLM the NANDA Taxonomy, Home Health Care Classification (HHC), an early version of NIC, and the Omaha System. As a result of these efforts, the NANDA Taxonomy, HHC, and NIC were incorporated into the UMLS<sup>®</sup> Metathesaurus in 1995, and the Omaha System was added in 1996 (Hoskins, 1995). Nurse informaticists also subsequently added and periodically updated other nursing terminologies for new versions of the UMLS<sup>®</sup> Metathesaurus.

Later in the 1990s, nurse informaticists also began integrating nursing concepts into the Systemized Nomenclature of Medicine Reference Terminology (SNOMED RT<sup>®</sup>), a comprehensive system of machine-readable clinical concepts. In 1998, nurse informaticists collaborated with the College of American Pathologists (CAP), the organization contracted to work with the United Kingdom's (UK) National Health Service to converge SNOMED RT and the UK's Clinical Terms Version 3 to create SNOMED CT (Clinical Terms), in large part to demonstrate that nursing concepts could be integrated into a machine-readable terminology system (International Health Terminology Standards Development Organization, 2014). For example, in a seminal article published in 1998, Suzanne Bakken and colleagues showed that nursing diagnoses contained in the NANDA Taxonomy and Omaha System could be disassociated into existing semantic linking systems. They further demonstrated that the resulting linked diagnoses were compatible with the semantic linking system in SNOMED CT (Bakken, et al., 2002). Having produced this proof of concept, Bakken's team undertook further work to construct the semantic linkages needed to fully integrate the NANDA Taxonomy and Omaha System into SNOMED CT.

At the end of the 1990s as part of the standardization of health concepts and the incorporation of nursing concepts into machine-readable terminologies, nurse informaticists also moved to standardize the definitions of and distinctions between different types of concept groupings. The ANA acknowledged that not all groupings of nursing concepts were classifications and that different recognition criteria were needed for different types of concept groupings. ANA adopted definitions from the International Organization for Standardization (ISO) for terms such as classification, taxonomy, and terminology and broadened the scope of ANA recognition from nursing classification systems to terminologies that support nursing practice.

As other nursing concepts were subsequently added to the UMLS<sup>®</sup> Metathesaurus, the process of integrating new concepts was simplified in the early 2000s when nursing terminologies incorporated in the UMLS<sup>®</sup> Metathesaurus were routinely extracted into new editions of SNOMED CT (Matney, et al., 2012). Currently, SNOMED CT's Nursing Problem List subset contains 417 concepts which are included in the UMLS<sup>®</sup> Metathesaurus. Full integration of nursing concepts within SNOMED CT was a critical accomplishment for nurse informaticists because EHR vendors must use SNOMED CT to become certified and meet certain EHR Incentive Program requirements. As a result, it is now possible to collect standardized nursing data from multiple sources, an achievement that will facilitate further research on the impact of nursing on clinical outcomes.

#### Using Nursing Informatics to Support Quality Improvement Efforts

Developments in the U.S. healthcare system provided further impetus to conduct research on how nursing impacts patient outcomes. Growing dissatisfaction with cost-cutting in the mid-1990s created a backlash against managed care. In the aftermath of the failed Clinton healthcare reform initiative, insurers and employers searched for ways to increase access without the costs associated with the traditional fee-for-service system, or the restrictions on patient access associated with managed care. In this context, the notion of paying providers on the basis of quality—as opposed to volume (fee-for-service) or numbers of patients (managed care)—began to capture the attention of health policymakers (Ginsburg, 2005). Groups of employers and insurers launched initiatives like the Leapfrog Group and Bridges to Excellence to demonstrate the viability of "pay-for-performance" programs in the late 1990s and early 2000s. Medicare soon followed suit, launching its first value-based purchasing program, the End-Stage Renal Disease Quality Incentive Program, in 2010.

The growing value of research in this new context and the need to structure nursing's informatics-focused research agenda led to efforts to establish a firmer theoretical basis for NI. To give a few examples, Patricia Schwirian introduced model-driven research, rather than problem-driven research, based on four elements: information, user, context, and technology (Schwirian, 1986). Carol Gassert, from the University of Maryland, added a fifth element—information processing (Gassert, 1990). Graves and Corcoran identified data, information, and knowledge as core to the definition of nursing informatics (Graves and Corcoran, 1989).

In 1996, James Turley described a conceptual framework for NI based on the interaction between nursing science and informatics science, which included the fields of cognitive science, information science, and computer science (Turley, 1996). Also in 1996, William Goossen, from the Netherlands, extended Graves and Corcoran's framework described earlier by including the processes of collecting, aggregating, representing, and using information and the nursing activities of decisions, actions, and evaluation (Goosen, 1996).

These models of nursing informatics have evolved from nursing and other sciences to provide the unique perspective in which nurse informaticists approach practice and research. A quick review of the published literature in NI over the past decade and a half reveals much activity across the different facets of these models, from the use of technologies, workforce competencies, education within specialty and traditional curriculums, information and terminologies, and efforts aimed at transforming the practice of nursing including work on evidence-based practice, quality, safety, and clinical decision support.

#### Horizons: Information to Knowledge

Nurse informaticists start their education with the introduction of the Data–Information–Knowledge continuum (Graves and Corcoran, 1989). The last

decade of EHR implementations has left the nursing informaticist in an ecosystem rich with clinical, administrative, operational, and patient-generated data. New tools and techniques are accelerating the speed and ease by which data can produce information and knowledge.

As this chapter illustrates, generations of nurses brought the tools of their time to pursue the goal of quantifying nursing outcomes, documenting methods, and compiling resource models and practices. In the 1940s, the techniques were information, operations research, and classification of nursing activities. Three decades later, the same goals were achieved with the first use of computers to create hospital information systems. Three decades after that, interoperable EHRs, consumer portals, population health management systems, and other computational tools are driving the acceleration of knowledge based on data generated by these systems. Viewing the history of nursing informatics in three-decade generations illuminates the environment in which the next generation of nursing informaticists will be practicing 30 years from now.

The spectrum of analytics, predictive analytics, machine learning, and artificial intelligence is primed to truly transform the nursing profession. Analytics, heavily utilized by nursing informaticists to help with retrospective studies, will feel increasingly unsatisfying, stimulating increasing appetite for predictive analytics. Predicting the future clinical status of an inpatient (Wellner, et al., 2017), the future trajectory of disease progression for chronic illnesses, or the progression of a cohort of the population will revolutionize when and how the healthcare delivery system intervenes (Anderson, et al., 2017).

One example of how predictive analytics are used in practice today is through Population Health Management Systems. These systems have been developed with known algorithms of disease progression and are constantly scanning patients' clinical and/or claims data to detect patients that have begun on the path towards illness. By identifying patients early and creating the clinical processes for proactive outreach before the patient identifies as ill, predictive analytics will better enable patients to maintain a state of wellness and improve quality of life (Hibbard, et al., 2016). If a patient is seen by four different providers who do not know of the results from the patient's other visits, the insurance company will be able to examine all four claims, diagnoses, and labs and detect a pattern that is consistent, for example, with pre-diabetes, thereby triggering a nurse navigator to reach out to the patient.

Beyond predictive analytics, artificial intelligence (AI) will introduce powerful tools that will raise new ethical questions for healthcare, just as it has in other industries with advanced use of AI. For example, the auto industry has posed ethical questions such as: Do you program the AI car to prioritize the life of the driver or the pedestrian? It can be programmed either way, but which is the right answer? (MIT's Moral Machine, [n.d.]). Similarly, the ethical practice of nursing will drive the nursing informaticist to constantly ask about bias in algorithms, fairness in resource distribution when determined by a computer and not a human, and the role of the clinician as the diagnostic power of the machine improves (May, et al., 2016).

#### **Changing Reimbursement Models**

As U.S. healthcare reimbursement continues to move from fee-for-service towards value-based payment, the ability to predict which patient will be a high utilizer of services, and the ability to intervene with the patient before their medical condition advances, has proven to help decrease utilization of acute care services (Hibbard, et al., 2016). Nursing, empowered by the data and tools provided by NI, has become critical to this move towards value-based payments, which can be divided into four different categories (i.e., the HCP-LAN Framework). Each advancing category of the LAN framework entails more potential value for the healthcare system, and additional risk on the part of provider organizations. Payments in the more advanced categories are made through multiple types of contracts, such as bundled payments (for particular procedures such as knee replacements) or payments by accountable care organizations (full management of patient cohort to increase quality and decrease medical spend for a large number of patients). Provider success in each of these contracts will require analysis of data, creation of clinical processes to change organizational behavior, measurement, and refinement. NI will have an increasingly important role in each of these areas as the healthcare system continues the transition to value-based payments.

#### Changing Consumer Preferences Driving Change

Tomorrow's healthcare consumer will spend more of their own money to purchase cover (Hancock and Luthra, 2016) and will expect healthcare to be as seamless as banking or investment platforms are today. The confluence of these two dynamics will completely redefine healthcare access, and virtual access platforms accessed through mobile devices will meet the demand for ease, cost, and convenience. For example, the nurse virtualist is an emerging practice that will rely on NI to create virtual platforms to effectively practice through new modalities and defer to traditional environments of care as appropriate (Nochomovitz and Sharma, 2018). This will disrupt the way in which patients traditionally access healthcare as well as the practice of traditional nursing (Asch, et al., 2017; Emanuel, 2018; Duffy and Lee, 2018). Reimagining access to care will be a critical area of innovation with early start-ups already entering the market.

#### Cyberattacks

Regrettably, an unintended consequence of the past decade of moving from paper to an electronic platform has been to create a new vulnerability for healthcare entities – the risk of cyberattacks. Hospitals and other delivery environments are experiencing a perfect storm wrought by the confluence of six forces: (1) the explosion of new and novel technologies throughout clinical, business, supply chain, and other business lines; (2) an industry that lacks experience in the management and communication of cyber threats; (3) a lack of standards for cyber compliance from a multitude of vendors; (4) the monetary value of illegally gained health information; (5) immature workforce development in the industry domain; and (6) healthcare's critical competing priorities for which time and resources must be provided (patient care, accreditation, regulatory compliance, etc.) (Jalali and Kaiser, 2018; Csulak and Meadows 2017; Duggan, 2017).

The good news is that there is growing awareness of the need to protect healthcare entities against cyber threats. The U.S. Government, recognizing the magnitude of the risk, included in the Cybersecurity Act of 2015 a provision to create the Health Care Industry Cybersecurity Task Force, which published its report on Improving Cybersecurity in the Health Care Industry in June 2017. Co-chaired by a nurse, Theresa Meadows MS, RN, CHCIO, FHIMSS, FACHE, who (at the time of publication) is the Senior Vice President and Chief Information Officer, Cook Children's Health Care System, the Commission's recommendations include six imperatives, associated recommendations, and actions that impact both Federal and private sector entities.

While the call to action of the Health Care Industry Cyber Security Task Force report has wide-ranging industry impacts, one action will require active engagement from the NI community of practice. For example, Recommendation 3.2 is: "Establish a model for adequately resourcing the cybersecurity workforce with qualified individuals," with the specific Action Item stating that "Industry should define mechanisms to educate and better leverage clinicians, in a tiered workforce model, capable of fundamental cybersecurity-related tasks." This specific action is relevant to the majority of the NI workforce who work directly with clinicians in a "wired" environment. Other Imperatives from the Task Force report have applicability to nurse researchers, nurse CIOs, and other nursing informaticists in expanded roles.

Nursing informaticists within the clinical environment will increasingly work with the Chief Information Security Officer (CISO) to lead activities to improve network safety and resilience to cyberattack. Leveraging the trusted role of the nursing informaticist as the 'computer nurse' in the clinical environment, nursing informaticists will be a strategic partner to the CISO for implementation of Cyber policies and educational awareness for clinical staff, intentionally decreasing endpoint complexity on clinical networks through their decisions of acquisition of clinical equipment and systems.

#### **Summary**

The next generation of nursing informaticists will smartly leverage predictive methods and Artificial Intelligence methods and tools to learn more about healthcare, populations, and patients than all prior generations and will face ethical considerations previous generations could not have imagined. Nursing informaticists will also experience a fast pace of change within the healthcare system, as the financial incentives for providing care drive an overhaul of the traditional fee-for-service environment. The consumer voice will move the industry to redefine access points, often defaulting to virtual care. Finally, the move to a cyber healthcare system will continue to attract cybercrime, the defense against which will be a common part of NI practice and policy. Taken together, these developments will change NI more rapidly than ever before, and in ways that previous generations could never have been imagined.

#### Conclusion

In 1863, Florence Nightingale noted the importance of information to improve healthcare. In *Notes on a Hospital*, she wrote, "I have applied everywhere for information, but in scarcely an instance have I been able to obtain hospital records fit for any purpose of comparison."

Her efforts to correct this oversight highlighted the value in systematically collecting information on healthcare practices and outcomes and served as a critical turning point in healthcare generally, and the professionalization of nursing in particular. Nightingale recognized that information, collected systematically, was necessary to "show the subscribers how their money was being spent, what good was really being done with it, or whether the money was not doing mischief rather than good" (Nightingale, 1863).

Nurse informaticists have played a critical role in advancing Nightingale's noble mission. Through standardizing data collection on nursing practices and patient needs and outcomes and ensuring these standards are integrated into health information systems, they have enabled the profession of nursing to advance its knowledge base and secure its place in contemporary healthcare.

Nursing informatics can trace its roots to the 1940s, when the specialty's early pioneers began collaborating with operations researchers and industrial engineers to improve health planning and hospital management. The work of these early pioneers, which included systematically tracking information flows through hospitals and building models to accurately predict health resource needs, fits well with the needs of the computer systems that became more prominent in healthcare institutions from the 1970s on.

Recognizing the demand for more training and research in this area, NI pioneers began offering courses, writing textbooks, and organizing conferences that enabled the fledging area to become a bona fide nursing specialty. In the 1980s, nurse informaticists began more concerted initiatives to standardize classification systems and terminologies—efforts that helped ensure that nursing concepts, practices, and approaches were included in broader health information initiatives and that they were acknowledged for their role in improving health outcomes more generally. Through entrenching classification systems and terminologies into initiatives like the UMLS® Metathesaurus, nurse informaticists ensured that technologies like electronic health records were standardized to capture information on nursing practices and patient outcomes—achievements that will ensure nursing's continued role in informing best practice and improving quality in healthcare.

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### Chapter 3

# Nursing, Informatics, and Technology Today

#### Kimberly Ellis Krakowski and Patricia Mook

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Nursing informatics (NI) is the driving force for the evolution of healthcare today in the United States. This is propelled by the increasing use of information technology (IT) in health. The Institute of Medicine's (IOM) 2010 report, *The Future of Nursing: Leading Change, Advancing Health*, acknowledged technology as a major contributor to increased patient safety and efficient and cost-effective care, and made profound recommendations for nurses to take a leadership role in transforming healthcare (Institute of Medicine, 2010). Clinical transformation will be based on technological advances that will require nurse informaticists to possess knowledge that was hitherto uncommon.

The nurse's role in the care of the patient has evolved, and with that has come a change in the way nurses think about and use technology to improve healthcare delivery. Every nurse today needs to be proficient in collecting and reviewing data and information related to their patients. The clinical practice requirements for nursing promote the development of skill sets important for informatics practice. The nursing process of assessment, problem identification, and care planning, combined with how nurses set priorities and always evaluate, prepare nurses to be early adopters and to employ and adapt the "systems life cycle" approach for delivering informatics projects.

Project management—a vital skill in managing IT projects by establishing timelines, milestones, task dependencies, and resources—is more easily grasped by clinicians who have worked in areas of care requiring constant priority setting and evaluation, such as emergency or critical care (Hassett, 2006).

A nurse professionally trained in informatics is part of a greater discipline of healthcare informatics. These nurses know how to apply IT to enhance their clinical skills and work with nurses across the healthcare continuum to integrate nursing science, computer technology, and information science resulting in improved communication, documentation, and efficiency. Possessing knowledge in these three areas positions nurse informaticists to lead the development of an emerging concept in healthcare—"clinical intelligence" (CI).

CI has risen out of the expansion of electronic data and is fueled by the prolific use of health IT. CI is defined as the electronic aggregate of accurate, relevant, and timely data into meaningful information and actionable knowledge in order to achieve optimal healthcare structures, processes, and outcomes (Harrington, 2011). The rapid rate of change in medical knowledge is what is driving clinicians, particularly nurses, to use high-quality, well-aggregated, electronic clinical data to make sound decisions that will improve the quality, safety, and efficiency of the care delivered.

#### **Today's Informatics Nurses**

Nurses who practice informatics today still need to be grounded in utilizing the nursing process. Being experts in the practice of analytical and critical thinking makes informatics nurses ideal candidates to produce aggregated clinical data. In addition, their skills in understanding patient care delivery models and integration points for automated documentation give them a context to use this high-quality data to affect clinical outcomes. The 2017 HIMSS Nursing Informatics Workforce Survey continues to suggest that the nurse informaticist plays a crucial role in the development, implementation, and optimization of information systems and applications, including clinical documentation, computerized provider order entry (CPOE), and electronic health records (EHR). Five times since 2004, HIMSS has surveyed members of the NI specialty to gain an understanding of the roles and responsibilities of the informatics nurse professional.

The 2017 survey findings help us understand many aspects about this field, but, most importantly, the increasing significance of this specialty in a variety of settings (see Figure 3.1). The majority of the 1,279 nurse informaticists who participated in this research (up from the 1,047 useable responses in 2017) continue to work in a hospital setting—42 percent (a decrease from the 58 percent in the 2014 survey). A new option of "multi-facility health system" was added to this survey, which could account for the decrease of the response. This option accounted for 16 percent of the respondents. A further 7 percent were working in the corporate offices of a healthcare system, decreasing from 13 percent in 2014. The survey also noted a slight increase in respondents working in academic and government settings.

While examining the nursing background of the nurse informaticist today, HIMSS found that 71 percent of respondents (up from 60 percent in 2014) had a postgraduate degree, which included a Master's degree in Nursing Informatics, Master's degree in Nursing, Master's in other disciplines, Doctor of Nursing Practice, PhD in Nursing, PhD in Nursing Informatics, and PhD in related fields (see Figure 3.2).

Looking at the clinical experience of the respondents, 42 percent indicated more than 16 years' experience (up from 41 percent in 2014). Of note,



Figure 3.1 Nursing informatics within the healthcare industry (From the HIMSS 2017 Nursing Informatics Workforce Survey. Used with permission.)



Figure 3.2 Nursing education—2011–2017 results. (From the HIMSS 2017 Nursing Informatics Workforce Survey. Used with permission.)

the number of respondents reporting one to five years of clinical bedside experience decreased from 20 percent in 2014 to 16 percent in 2017 (see Figure 3.3). This may be an indication that the increase in need for technology at the bedside is shifting nurses to the informatics field earlier in their nursing careers (National Council State Boards of Nursing, 2017).

#### Today's Informatics Leader

The leadership roles in the informatics area are evolving. Increasingly, the Chief Nursing Informatics Officer (CNIO) plays a dual role in improving



Figure 3.3 Years of clinical experience (From the HIMSS 2017 Nursing Informatics Workforce Survey. Used with permission.)

outcomes. The CNIO combines traditional frontline leadership responsibilities with innovative evidence-based processes and practices that are applicable to nurses and, by extension, all caregivers. As the primary liaison between IT and Nursing, the CNIO can help prepare strategically for the increasing technology needs for the healthcare challenges of tomorrow.

Wierz, Krakowski, and Mook (2016) conducted a survey with Witt/Kiefer, where the role of the CNIO showed trends over time that indicated an increasing presence and expanding responsibilities. One hundred leaders, primarily from academic medical centers, integrated delivery systems, and system hospitals, shared their responses and comments (see Figure 3.4).

The results of the survey provided data indicating the number of respondents with a CNIO or equivalent in place, hiring plans, top responsibilities and skills, and top challenges for individuals in this role. The prevalence of the title CNIO saw the highest growth along with the title of Director of Clinical Informatics. The informatics role is gaining recognition while making its way into the C-suite (see Figure 3.5).

The number of respondents who stated they had a CNIO in place increased by 82 percent. In 2016, 51 percent of the respondents said they had a CNIO in place compared with 28 percent in 2011. As the position of the CNIO has increased in number, the responsibilities noted in the survey are not surprising. The role is considered strategic in both the nursing and technology sides. The CNIO is seen as a bridge for the organizational interests of nursing and technologies.

The responses of this 2016 survey indicated that organizations with the position in place expect CNIOs to handle nursing strategy as it relates to IT, with some organizations emphasizing nursing and other emphasizing technology. The respondents of the survey indicated that the primary responsibilities for CNIOs today include implementation and optimization of the



Figure 3.4 A growing presence (From the 2016 Witt/Kiefer/Survey Report. Used with permission.)



Figure 3.5 Witt/Kiefer Survey—respondents' titles, 2011–2016. (From the 2016 Witt/ Kiefer/Survey Report. Used with permission.)

EHR and clinical systems (78 percent) and technology training (68 percent) (see Figure 3.6).

The CNIO role seems to be establishing credibility and gaining a seat at the table alongside Chief Medical Information Officers (CMIOs) and Chief Information Officers (CIOs). CNIOs are reported to be participating in technology value analysis committees, strategic planning and growth committees, executive councils, and clinical governance councils. They are also taking leadership roles at a number of task forces at HIMSS and other professional organizations such as the American Organization of Nurse Executives. The profile of this position is considered on the rise (Wierz, et al. 2016).

78%EMR and clinical IT system implementation and optimization
78% Nursing strategy as it relates to ITVP of Nursing
76%IT strategy as it relates to nursing
69% Direct day-to-day collaboration with CMIO on clinical IT matters
<b>48%</b> Education of organization regarding technology-related nursing
59% Oversight and training of nurses & nursing informatics team
37 % Day to day project management
36% Budgeting and resource allocation for clinical IT systems



#### Technology—Transforming Workflow and Outcomes

Many nurses are already savvy with technology despite the fact that, according to a 2015 survey conducted by the National Council of State Boards of Nursing and the Forum of State Nursing Workforce Centers, 50 percent of the RN workforce is aged 50 or older (American Association of Colleges of Nursing, 2014).

Nurses, it is said, do not want to be passive consumers of technology (Cipriano, 2011). Technology is what is driving transformational change and innovation in nursing care delivery models, and nurses are central to this transformation. With technology advances, we have the ability to accomplish regulatory work with standard practice, to provide efficiencies of space, and to provide access-to-care resources resulting in improved safety and efficiency.

The Patient Safety and Quality Improvement Act of 2005 was implemented in response to growing concern about patient safety in the United States (HHS.gov, 2005). The goal of the act was to improve patient safety by encouraging voluntary and confidential reporting of events that adversely affect patients. The act highlights a focus on how patient safety event information is collected, developed, analyzed, and maintained.

This has driven the nurse informaticist to be a key contributor to the efforts of creating clinical documentation systems that will enable accurate collection of information. They are frequently leading clinical governance models in the role of a Chief Nursing Information Officer (CNIO), leading and guiding the work of design teams, analyst build teams, and testing teams as new EHRs are implemented.

The nurse informaticist's role clearly encompasses designing, building, and testing clinical systems. As we develop systems that are designed and built by clinical end users like nurse informaticists, we will be better able to collect the patient safety event information that will assist healthcare organizations in identifying patterns of failures and proposing measures to eliminate patient safety risks and hazards.

Informatics nurses today work to assist in the development and training of technologies that enable us better to identify patients, which supports much of the "meaningful use" (MU) requirements that are guiding many initiatives being implemented in hospitals. Examples of this include bar-code medication administration, bar-code specimen collection, and the evolution and use of smart IV pumps.

Ultimately, one goal of NI leaders is to return more time at the bedside to nurses in order to provide safer care. Nurses are removed from tasks that are unnecessary with the development of lean process-transforming technologies. The development of systems that track time, awareness, supplies, and people by the mere ability to visualize improvements as a result of change assists in reducing delays in care.

Nurse informaticists are leading value-stream analysis efforts to look for defects in workflow and clinical documentation to support organizational efforts to provide safer care. The ability to have clinical decision support at the point of care is also seen as improving safety. These efforts would include best practice alerts (BPAs) used to guide clinical practice. The nurse informaticist has knowledge of the technology and logic used to build these, and at the same time is able to understand the key areas in which clinical decision support will make a difference in the outcome of the patient's care.

Advances in communication technologies that direct and prioritize messages to facilitate quicker responses to patients and caregivers will also improve safety. Nurse informaticists are key in the assessment of workflows which are the core components needed in looking at process as EHRs are developed.

The Situation, Background, Assessment, and Recommendation (SBAR) technique is one that is frequently used in healthcare as a communication technique:

- Situation: Describe the situation, patient, or question.
- Background: Highlight the important information, precautions, and issues.
- Assessment: Outline your reading of the situation, problems, and precautions.
- Recommendation: State your recommendation, request, or plan.

Originally developed by the United States Navy as a communication technique that could be used on nuclear submarines, SBAR was introduced into healthcare in the late 1990s by Safer Healthcare as part of its crew resource management (CRM) training curriculum. Since that time, SBAR has been adopted by hospitals and care facilities around the world as a simple yet effective way to standardize communication between caregivers (Rivier University, 2016).

This tool is one that many nurse informaticists use in an expanded way, as a model to outline problems as they are identified in their work day. Using SBAR can help staff to problem-solve, learn to respect each other's opinions by understanding why and how recommendations are drawn, and set a proactive approach that individualizes the corrective action that an organization may take to resolve a problem. The continued enhancement of technology tools will exponentially change how nurses plan, deliver, document, evaluate, and gather the evidence to provide safe, efficient care, and direct quality outcomes.

Healthcare environments frequently incorporate virtual office visits, online appointment scheduling and payment, mobile laboratories, and electronic medication prescribing. New technologies offer access and opportunities to provide quality care to patients in remote settings. Nurse informaticists become key in the role not of only developing these technologies but also in the implementation of them in all settings, and in the creative work that goes into the marketing and communication developed to present to patients in our communities.

Training becomes an essential skill for many nurse informaticists. The development of mobile health technologies has grown tremendously and the need to teach patients how to use them has become a focus. The challenge for these technologies in healthcare is ensuring that the automated solutions completely interact with one another, as well as with the healthcare professionals and patients using them (Health Information and Management Systems Society, 2017).

While we still wait for conclusive research in the field of mobile health technologies for care provision, Shapiro-Mathews, a clinical nurse informatics specialist, and Barton (2013) encourage engaging patients and their families in mobile technologies using a modified patient engagement framework for the adoption of mobile health applications. This modified "Patient Engagement Framework" offers steps to the adoption of mobile health applications. Their work clearly speaks to clinical nurse specialists as informaticists developing ways to improve patient engagement with mobile technologies.

Mobile and remote technology is an area in which nursing informaticists have just scratched the surface. The possibilities of how these technologies will impact care both for providers and patients are just beginning to be explored. The emergence of a unified mobile device strategy combining point-of-care documentation and multimodal communication is just now being realized. These solutions can support nursing practice in addition to assisting with the cognitive workload of nurses.

Advances in technology have enabled vendors to design products, based on smartphone technology, which allow flowsheet documentation into the EHR with bidirectional interfaces. In addition, data is enabled to flow back and forth between two software applications, bar-code medication administration,
communication using voice over Internet protocol (VoIP), and secure text messaging. All this exists on a single device that can fit into a provider's pocket.

Many nurse informaticists are driving changes in practice based on their nursing research in these areas. Redding and Robinson (2009) saw that 31 percent of nursing interruptions occurred when another employee asked a nurse a question while both were face to face. The Pew Research Center reported (2014) that as of January 2014, 90 percent of the adult population in the United States owns a cell phone and, given that texting has become a standard form of communication, 81 percent of cell and smartphone users send and receive text messages; allowing nurses access to secure texting methods might reduce the number of face-to-face interruptions.

Nurse informaticists provide the vision of a truly mobile clinical solution that enables practitioners to document their patient rounds as they are being carried out, see all assigned team members, place a call easily, and securely text other members of the care team. These are all possibilities, plus being able to choose the right mobile device that supports the cognitive workload of nurses by providing alerts—notifications that they see because they have the device at their fingertips in the moment. In addition, they allow access to the latest vital signs, medications, and pain scores with only a few taps of the finger.

Today's telecommunication choices have clinical ramifications beyond the purchase of a phone. Nurse informaticists need to be at the table during the evaluation and selection process. Utilizing technology to support the bedside clinician rather than causing barriers to safe practice is a goal that we all want to attain. Mobile technology is just one challenging area to which NI is contributing. The interoperability of devices is increasingly seen as some of the most important work that still needs to be done, and the voice of nursing leaders in the informatics arena can facilitate the escalation of this need.

Much of this work is frequently conducted with a fast Plan-Do-Check-Act (PDCA) process that we are constantly trying to learn from and to create evidence to propel a flywheel to drive clinical transformation. As healthcare technology continues its rapid integration into so many aspects of care delivery, NI is at the forefront of providing the knowledge that nursing needs to lead change and advance health.

#### The Legislative Impact on Nursing Informatics

Legislation has greatly contributed to the growth of NI. It will continue with the American Recovery and Reinvestment Act (ARRA) signed into law by President Barack Obama in 2009. The primary purpose was to provision funding to promote health reform through IT adoption and implementation and included unemployment benefits, federal tax relief, education, healthcare, and infrastructure spending. This provided the allocation of \$19 billion for meaningful use of EHRs in both ambulatory and hospital settings. Within the ARRA was the Health Information Technology for Economic and Clinical Health (HITECH) Act which created criteria for standards used to incentivize eligible professionals, facilities, and critical access hospitals to use EHRS in a meaningful way (Centers of Medicare & Medicaid Services, 2014).

The Meaningful Use (MU) Incentive Program was created by the Centers for Medicare & Medicaid (CMS). The goal of MU is to improve quality, safety, efficiency, reduce health disparities, engage patients, improve health coordination and population health, and to maintain privacy and security of patient health information (PHI). The hope over the long term is that MU compliance will result in better clinical outcomes, improved population health outcomes, increased transparency and efficiency, empowered patients/families, and more robust research data. MU sets specific objective and quality measures that eligible professionals (EPs) and eligible hospitals (EHs) must meet to receive incentive payments and eventually avoid penalty payments (HealthIT.gov, 2014).

MU is divided into five objectives and three stages (HealthIT.gov, 2014). It is innovative thought leaders such as nurse informaticists, designers, implementers, and analytics experts that have led to the successful meeting of MU. The five objectives of the meaningful use program are:

- 1. To improve quality, safety and efficiency, and reduce health disparities.
- 2. To engage patients and families.
- 3. To improve care coordination.
- 4. To improve population and public health.
- 5. To ensure adequate privacy and security protections for personal health information.

The Meaningful Use Stages are as follows:

- Stage 1: Focus on capturing healthcare information electronically in a coded format to monitor key clinical conditions and communicate information that supports overall care coordination.
- Stage 2: Focus on using healthcare IT to impact and support continuous quality improvement at the point of care which includes the exchange of electronic health information.

Stage 3: Focus on improvements in quality, safety, and efficiency; decision support; patient self-management tools; and improving population health.

The next large piece of legislation that has greatly impacted the United States is the Patient Protection and Affordable Care Act (ACA), also signed into law by President Obama, in 2010. This piece of legislation is commonly referred to as Obamacare. The ACA was intended to set the groundwork for providing access to healthcare for everyone while promoting continuous improvement in healthcare so that patients may receive quality care. This law has been politically polarizing with threats of it being overturned because, while all will agree with its principles, the financial implications on businesses, patients, and hospitals have been increasing challenging.

The 21st Century Cures Act was signed into law in December 2016. This act was signed by President Obama with overwhelming bipartisan support. This legislation provides funding to battle the country's opioid epidemic, funding to accelerate cancer research and make therapies more readily available, funding for mental health research and treatment, and expedited drug approval. The legislation also included the following provisions:

- Healthcare Information Technology (HIT)
- information blocking
- EHR transparency and certification
- interoperability and patient matching
- HIPPA guidance and training.

Hefty penalties, such as decertification and fines up to \$1 million per violation for information blocking were instituted. Adler-Milstein and Pfeifer of the University of Michigan Schools of Information and Public Health concluded that half of their respondents reported that 25 percent of EHR vendors routinely engage in information blocking and that 25 percent of hospitals and health systems also do so. The most common form of information blocking by technology companies is deploying products with limited interoperability. The most common form of information blocking by hospitals or health system is by tying providers to a specific EHR to increase referrals and controlling patient flow (Elkins, 2017).

The Cures Act also required the Office of the National Coordinator for Health Information Technology (ONC) to create a patient matching policy to come from the Government Accountability Office (GAO). The outcomes of this very important legislation are still showing themselves, but currently include the creation of The Sequoia Project and The Center for Medical Interoperability. These organizations are focused on a commitment to connectivity of health data and healthcare equipment. Also, the ONC and CMS have enforced standard certification criteria for EHRs which included greater transparency of the certification process. In fact, beginning January 1, 2019, EHRs that have not met interoperability requirements will be decertified. The facilities using these EHRs will receive a one-year hardship exemption from meaningful use penalties. The identified overarching theme of the Cures Act is interoperability. The College of Health Information Management Executives (CHIME), after a two-year competition, presented Hero<sup>x</sup> with a \$1 million award for their patient identification solution (Elkins, 2017).

In 2017, reporting meaningful use measures for EPs was eliminated and replaced by MACRA/MIPS. The Medicare Access and CHIP Reauthorization Act of 2015 (MACRA) is a bipartisan legislation signed into law on April 16, 2015. MACRA created the Quality Payment Program (QPP) that repeals the Sustainable Growth Rate formula, changes the way that Medicare rewards clinicians for value over volume, streamlines multiple Quality programs under the new Merit Based Incentive Payments System (MIPS), and provides bonus payments for participation in eligible alternative payment models (APMs) (CMS.gov, 2014).

In March 2018, at the HIMSS annual conference, CMS presented a new approach to MU outcomes that focuses on a new era of state flexibility and local leadership, improvements in CMS customer experience, empowering patients and doctors to make decisions about healthcare, and support for innovative approaches to improve quality, accessibility, and affordability (CMS.gov, 2017).

With the emphasis on healthcare in the United States and continuous changes to legislation, there is more need than ever for NI. Nurses should be both proactive and reactive to legislation by actively participating in organizations like the Healthcare Information Management Society, American Nursing Informatics Association, American Medical Informatics Association, American Organization of Nurse Executives, and the American Nursing Association. Nurses should also feel empowered to call upon them.

An area for nursing to continue its work is in creating an official data framework for documenting. In 2011, the Alliance for Nursing Informatics (ANI) stated that the use of standardized nursing and other terminologies "is necessary and a prerequisite for decision support, discovery of disparities, outcomes reporting, improving performance, maintaining accurate lists of problems and medications, and the general use and reuse of information needed for quality, safety, and efficiency" (Sensmeier, 2010). Meeting the regulatory requirements organizations such as CMS without such a standardized format is increasingly difficult in addition to making the sharing of data across information systems more challenging. Currently, there is documentation that is required for payment and documentation that serves care. Nurses should support a movement from fee-for-service documentation to qualitybased care documentation. This, along with excessive use of copy and paste functionality, could eliminate excessive and duplicative text that can contribute to "note bloat". Another area where nurses could promote reform is with the requirement of automated data integration from medical monitoring devices which could decrease the documentation burden on all clinicians but also decrease risk of transcription error and promote greater data integrity (National Academy of Medicine Perspectives, 2018).

#### The Role of Nursing Informaticists in Technology Selection, Design, and Implementation

As mentioned previously, MU requires the implementation of a certified EHR in the hospital and ambulatory settings, which is quite complex. Nurse informaticists play a significant role throughout the entire process, which starts with the executive leadership and board approving the capital investment in an EHR system. Nurse informaticists also participate in the selection, design, and implementation of other software solutions and technology hardware.

The subsequent steps are typically inclusive of the request-for-proposal (RFP) process, vendor demonstration, end user review or vendor fair, contract agreement, build-team creation, build-team training and certification, model system validation, design team identification, design, build, testing, training curriculum development, subject-matter expert identification, end user training, cut-over activities, implementation, optimization, and upgrade installation.

The vendor evaluation stage is when many nurses first enter the realm of informatics. As they review the selected vendors, they are learning about features, modules, applications, and functionality. The input of nurses in selecting technology solutions is extremely valuable because end user buyin is essential in the success of the subsequent steps. And nurses typically make up 80 percent of the clinical workforce in any given hospital. Once the executive team has reviewed the top vendor candidates and selected a solution for purchase, the team that will manage its implementation is identified. Bedside nurses, nurse clinical specialists, and nursing leaders are recruited for these positions because of their clinical expertise and relationships with the multi-disciplinary end users.

Nurse Managers and their staff are uniquely positioned to lead or join the effort to make a difference with workflow design. Scherb, et al. (2013) believe it is the responsibility and obligation of nurses to ensure that clinical information systems are designed for the meaningful use of nursing clinical data. Additional roles for nursing expose them to the informatics specialty, such as training. Initially the training will be on how to understand the new solutions, but later training will focus more carefully on workflow.

Considering technology impacts the practice of nursing, every effort should be made to understand, implement, and optimize the technology available. Examples include electronic health records, communication tools (smartphones, tablets), artificial intelligence and machine learning, patient engagement software, decision support tools, patient outreach software, and patient portals.

Today's healthcare consumers demand a paradigm shift for how their care is communicated and provided to them. The patient is always at the center of what nurses do every day, in every moment, and with every touch. Nurses communicate through smartphone apps, video chat, and by monitoring electronic data via wearable devices. Nurses continuously strive to improve patient care and outcomes through the continuous analysis data now provided in the EHR. Nurses explore the newest technology, push for the interoperability of that technology, and advocate that it be incorporated into their care of the patient to increase efficiencies of documenting and increase time spent directly with the patient. Nurses continually seek opportunities to learn so that they may be thought leaders.

In the evolution of healthcare, nurse informaticists will continue to remain at the forefront.

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## Chapter 4

# Nursing, Informatics, and Technology: A Look Forward

#### Mary Beth Mitchell

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#### **Rise of Nursing Informatics**

From the time of Florence Nightingale there has been nursing informatics. Nightingale used data to support her theories and beliefs regarding the impact of cleanliness on health and outcomes. In fact, some reference her as the first nurse informaticist, a views supported by Wikipedia, which describes Nightingale as a statistician.<sup>1</sup> Now, more than 100 years later, we have the tools at our disposal to truly use the data of health and healthcare to drive clinical outcomes, define best practices, support the use of

technology and practice, and more fully understand health and wellness in society today and in the future.

Nursing informatics (NI) has become a critical factor for the success of how nurses use and adopt not only electronic health records (EHRs) but all technology impacting clinicians and patients within the hospital and other healthcare settings. Nursing informatics is now a professional domain within nursing and has its own body of work and knowledge and is certainly on the rise. The Health Information Management Systems Society (HIMSS) and the HIMSS nursing informatics community support NI across the globe, from both the individual and organizational perspectives. Every two years they conduct a NI Workforce Survey, which provides information on the type of work nurse informaticists are doing, where they are working, pay scales, and satisfaction with work. This survey was last undertaken in 2017, and its findings can be accessed in full on the HIMSS website (https://www.himss.org).<sup>2</sup> Figure 4.1 provides an infographic of the 2017 NI Workforce Survey. There are now more than 8,000 nurse informaticists working in all settings of healthcare, so we are well positioned to look to the future and discuss nursing informatics in the future.

#### Considerations for the Nurse Informaticist of the Future

As we discuss the future role of nursing informatics, and how technologies are beginning to inform our clinicians and patients, it is important to understand how the nurse informaticist's role will adapt to support this. Within every aspect of the nurse informaticist's work, they will need certain competencies to be successful. More effort put into leadership, research, and analytics will be critical, but there are some basic features that define the skill set of the nurse informaticist of the future, as we move into advanced technological development and implementations.

**Clinical Liaison:** With the introduction of new technologies into the healthcare setting, it is critical that the nurse informaticist understands these technologies and the impact they might have on the clinician and the patient, or healthcare consumer. The demand on nurses to understand the technological advances and tools that are introduced into their practice is constantly growing. All nurses have a responsibility to keep informed of emerging technologies as they affect their area of practice, but, given the flood of electronic applications and tools, this can be challenging.<sup>3</sup> From smart beds, to "patient wearables," to integration of basically every source



Figure 4.1 Nursing Informatics Workforce Survey Infographic

of data that nurses use for clinical decision-making, nurse informaticists can provide the support and education to help clinicians understand not only the use and function of the technology, but the rationale and purpose of the technology. They can also help design improved workflows and clinical efficiencies around the technology. As clinical liaisons, nurse informaticists are in the unique position to understand the clinical aspects, the technology impact, and the rationale for adoption.

**Clinical Facilitator:** Nurse informaticists will be challenged with new, emerging, and disruptive technologies and will be expected to support and embrace the changes that impact patients, consumers, and clinicians. It will be critical that nurse informaticists can facilitate the transition to these new technologies, their application to practice, and their relevance to our future. It will be increasingly important that nurse informaticists understand change theory and the factors that support change, as well as those that impede change. As Marilynn Bozak states, "Change evokes many responses, but rarely indifference."<sup>4</sup> Through implementation of the EHR, we are already aware of the impact of change on nurses. Now, more than ever, these changes are occurring at a rapid pace, and the technology impact often surpasses the ability to manage the change. Nurse informaticists, will not only be drivers of change, but also the translators of the change, while supporting and understanding the clinician's concerns to their practice and patient safety.

Use of Analytics-Big Data: As nursing informatics moves into the future, an understanding of "Big Data" and how data is used in analytics will be critical. There are now mammoth amounts of data that provide information we can use in analyzing everything from workflows and compliance with procedures to clinical outcomes and the ability to conduct research. Data is now more available and in the future will become more accessible and translatable by all clinicians. Nurse informaticists will need to understand the various types of analytics, how analytics are defined and presented, and what the data is revealing. Whether it is a simple dashboard or complex analysis using cognitive analytics, nurse informaticists will impact not only how data is being used but also how clinicians are interpreting the data. Nursing informatics will also be needed to help educate and inform clinicians and clinical leaders on how to use the data. The abundance of data being presented by organizations can be overwhelming and data is often in different locations, comes from various tools, and is presented in multiple forms. Clinicians have so much information available to them and nursing informatics will be critical to support their understanding and use of this data.

**Demonstrating Value:** In addition to nurse informaticists supporting use of analytics and advanced analytics in clinical practice, they also need to be using the data themselves to demonstrate the value of the technology being implemented, and the work they are doing. Nurse informaticists can support the advancement not only of nursing informatics but the impact of technology on practice, through defining metrics that demonstrate the value of the technologies used and the value nursing informatics is providing within a clinical setting. The tools are now becoming more available and there is a growing need to use data to demonstrate value. This will be critical for the continued advancement of nursing informatics within healthcare organizations.

**Patient Safety, High Reliability:** It is more important than ever that all clinicians and nurses be focused on patient safety and reliability. The move to high reliability principles is becoming common within healthcare organizations.<sup>5</sup> Figure 4.2 reviews the five principles of high reliability that can be used to support patient safety.

It is especially critical that nurse informaticists understand reliability and manage within a framework of high reliability practice, as the potential for harm may increase as new technologies are introduced and implemented. The nurse informaticist is uniquely positioned both to evaluate the technology, clinical workflows, and impact of technology on patients and to support high reliability principles to assess, manage, and evaluate this constant influx of information.

**Unintended Consequences:** With advances in technology come the problems and challenges with the new workflows these technologies bring, or even with the technology itself. Changes to practice, clinical workflows and increasing demands, along with over-reliance on technology and a

Preoccupied with failure	
Reluctance to simplify	
Sensitivity to operations	
Commitment to resilience	
Defer to the experts	

Figure 4.2 Principles of High Reliability

lack of traditional communication, can lead to safety issues and unintended consequences.<sup>6</sup> Nursing informaticists must be diligent in monitoring for and evaluating unintended consequences and any impact on safe and quality clinical care. Figure 4.3 shows how unintended consequence are present with any change, and can either be desirable or undesirable. The types of outcomes we experience with any new technology or workflow will produce unintended consequences, but the concern is where there is a result that is neither expected nor desirable.<sup>7</sup>

As technology becomes more complex, and virtually every medical device, personal device, and clinical workflow is dependent on the use of technology, there will be unintended consequences. The clinical environment is so complex, with multiple medical devices that are all integrated, and each with their own points of failure. The nurse informaticist will help identify, understand, and respond to these challenges and develop programs and action plans to manage and control their impact. The Office of the National Coordinator (ONC) has developed a set of Safer Guides that can guide organizations to assess and develop safe practices for the development, implementation, and adoption of technology.<sup>8</sup> The SAFER Guides are available without charge on the ONC website, and are an excellent source of information for the nurse informaticist to help manage and support



Figure 4.3 Framework of Unintended Consequences

avoidance of safety concerns with clinical use of technology. To date, there has not been a great adoption of the SAFER Guides, but as we look forward there will be more applicability for the use of these guides and for nursing informatics, which can lead the effort to initiate these safety practices.

**Other NI Competencies:** Nursing informatics leaders have an array of competencies and activities that can support the next ten years in health-care as we advance our profession and expand our role. The AMIA Nurse Working Group<sup>9</sup> has identified the following core areas of work that nursing informatics will engage with:

- 1. Concept representation and standards to support evidence-based practice, research, and education.
- 2. Data and communication standards to build an interoperable national data infrastructure.
- 3. Research methodologies to disseminate new knowledge into practice.
- 4. Information presentation and retrieval approaches to support safe patient-centered care.
- 5. Information and communication technologies to address interprofessional work flow needs across all care venues.
- 6. Vision and management for the development, design, and implementation of communication and information technology.
- 7. Definition of healthcare policy to advance the public's health.

#### Healthcare Trends of the Future

Looking ahead at how nursing informatics roles will evolve, and how they will impact healthcare of the future, it is important to understand the trends that are impacting healthcare today. These trends will be discussed in the context of people, process, and technology, as the factors that impact the implementation of technology and the impact on our nurses, patients, and consumers. The role of nursing informatics will continue to evolve to support the advent of these tools and workflows to better support the delivery of healthcare.

When exploring where healthcare is going in terms of technology, it is important to realize that all new and emerging technologies have what Gartner defines as a "hype cycle." Figure 4.4 is a depiction of the hype cycle and how this represents the impact of the development and adoption of various types of technology.<sup>10</sup>



Figure 4.4 Gartner Hype Cycle for Technology<sup>10</sup>

When a new disruptive technology is introduced, there is an "Innovation Trigger," that stimulates the need for the new technology and drives its subsequent development. During this time there is a lot of hype around the emerging technology and its perceived impact, as we imagine the possibilities of its use. As defined by Gartner, "a potential technology breakthrough kicks things off. Early proof-of-concept stories and media interest trigger significant publicity. Often no usable products exist and commercial viability is unproven."Out of this comes the "Peak of Inflated Expectations" and during this time, the product fails to live up to the expectation, "early publicity produces a number of success stories-often accompanied by scores of failures. Some companies take action; many do not," and there follows a dramatic decline in use and adoption, as the "Trough of Disillusionment" descends and provides the negative impact, the resulting resistance to change, due to identified problems and concerns. "Interest wanes as experiments and implementations fail to deliver. Producers of the technology shake out or fail. Investments continue only if the surviving providers improve their products to the satisfaction of early adopters." After this, however, there is a period of stability where a more realistic understanding and use of the technology is realized. This "Slope of Enlightenment" provides the realistic understanding of the technology and the true value is identified. "More instances of how the technology can benefit the enterprise start to crystallize and become more widely understood. Second- and third-generation products appear from technology providers. More enterprises fund pilots; conservative companies

remain cautious." There may continue to be a gradual increase in use and adoption during the "Plateau of Productivity," where the technology gains general adoption and acceptance and the specific uses and best practices become generalized to the population. "Mainstream adoption starts to take off. Criteria for assessing provider viability are more clearly defined. The technology's broad market applicability and relevance are clearly paying off." Nurse informaticists' knowledge and awareness of the hype cycle is important in understanding how the introduction of technologies impacts our clinicians and patients. There is much we can do to provide guidance, direction, help define workflows, and develop best practices based on the prevalence and general adoption of the various technologies. We will now explore some of the technologies that are currently in the early stages of the hype cycle and will continue to impact healthcare in the next several years.

#### People

**Consumer Engagement:** Consumer engagement is identified and defined in a multitude of ways, but in this context we will consider customer engagement as anything within the framework of Health IT that impacts patients, families, or other consumers of healthcare goods and services. As we look at how consumers view their healthcare choices, we can get a glimpse of how technology will develop to support these needs and desires. According to Deloitte,<sup>11</sup> three things that will drive personal healthcare choices are:

- 1. Consumers want more interaction with providers and to be a partner with the provider instead of being a passive participant in their care.
- 2. An increasing number of consumers rely on online resources and trust those resources to provide reliable information. This will continue to grow and accelerate in number and scope.
- 3. More consumers are relying on technology to monitor and measure their health. Even treatment options may be supported through technology and use of "apps."
- 4. As consumers become more informed, taking more responsibility for their health, relying on technology for their health choices, the nurse informaticist needs to be an informed and reliable source of information, as well as to advocate and support the development of technologies to promote health and wellness of consumers, patients, and families.

#### Portals and Personal Health Records

Patient portals have been in use for more than ten years. Adoption has been variable and there is still a lack of interoperability between patient records, personal health information, and alignment with all a patient experiences across a full continuum of care. In the past, portals were primarily aligned with the provider's EHR, and while there are good results reported with portals, there are often challenges with language, the ability to access portals, and ongoing access of the portal.<sup>12</sup> Patients and consumers want seamless access to their health information, and they want to engage with it directly-i.e., input information, manage the information, communicate directly with caregivers, pay bills, make appointments-all seamlessly and from a single mobile device. They also want immediate access to healthcare services, often virtually. Ongoing development of patient portals will need to provide greater interoperability between all providers and EHR vendors, as well as the enhanced ability to interact more fully with the portal, such as the ability to enter personal health data, explore chronic conditions and treatment options, and manage all their healthcare needs in one mobile app. There has been some effort by technology vendors to commercialize portals and personal health records, including Microsoft, Apple, and Google, although adoption has been low. There is likely to be more movement from external sources as the demand for mobile and interactive healthcare access increases.

Another growing area is consumers entering and managing their own health information in their medical record. Susan Hull describes several factors influencing the rise of personal health information technology (PHIT), including:<sup>13</sup>

- 1. A growing dependency on digital and mobile technologies in everyday live.
- 2. Expectations for real-time access to traditional place-based and virtual health services.
- 3. Increased clinical and financial responsibilities for patients.
- 4. Pressure on providers to transition from episodic to value-based and population health focus.
- 5. Significant regulatory and legislative mandates.

At some point in the next few years we will see patients actively contributing their own patient information, whether it is history, data brought in from personal devices, or data entered to better manage chronic conditions and inform caregivers of their health status. Nursing informaticists are uniquely positioned to understand and support patients in their desire to manage their own health information, and the providers and clinicians need to support, trust, and even respond to the information.

Another area where consumers are managing their health is through websites and online resources to connect with other patients and consumers with similar healthcare needs. Patients can seek information, view realtime research, understand treatment options, and participate in a community of people who can provide support and information. More of these "wiki" type sites are becoming available for broader access to healthcare information. However, there is a plethora of resources that are readily accessible that provide no value, and in fact can be harmful if taken literally or seriously. There will continue to be trends to engage patients and consumers through online and mobile resources. Nurse informaticists can help inform patients and families on credible resources may be used to support consumer health. They also can help inform other clinicians and providers on how consumers and patients are using these types of resources.

#### Processes

Much of healthcare is driven by regulatory requirements and governmental regulation. The HITECH Act and Meaningful Use have driven the advancement of EHRs and technology through the second decade of the 21st century. There are also a lot of unknowns about how these and newer mandates will contribute to future healthcare management, advancement, and reimbursement. Liz Johnson describes the main themes around public policy that align with nursing informatics:

- 1. Federal policy is driving healthcare information technology initiatives; however, it does not lend itself to promoting innovative thinking, which is up to us.
- 2. It is innovative thinking, making sense of the federal policy, that moves us toward our goal of improved patient care.<sup>14</sup>

Other areas of public policy and healthcare resolutions will continue to impact the nurse informaticist and their expanding role into sustaining a greater and more holistic support of patients across a full continuum of care. Hospital-based care is transitioning to population health. The care of patients is moving to the home, and hospital care is driven by quality outcomes, incentives, and penalties. Nurse informaticists will need to transition to manage and support clinicians in all areas of practice, from schools to ambulatory centers, to hospitals and long-term care facilities. In addition, nursing informatics is well poised to address the changing social climate and to respond to public policy and government mandates that affect delivery of healthcare. Health records are expanding to include longitudinal plans of care, dealing with areas of gender, race, and social determinants of health in accordance with public policy and governmental programs. In addition, patients will have access to all their records-including notes, impressions, problem lists, and essentially everything that is entered, by anyone, as well as data that is integrated from other sources. As the world expands and healthcare is available from any location and access to healthcare is sought through web-based services, hosted sites, telemedicine, and apps, nurse informaticists will need to rely on their core competencies to assure safe, competent, and compassionate care to all. No longer will care be limited to a location, or a segment of society. What we have "assumed" about people and their healthcare needs and responses to care will now be fact-based, part of an extensive data set, and cover the entire lifespan of a person. This information can be used in many ways, and nursing informatics should help develop the organizational policies and requirements on how personal health data is monitored and used.

In addition, technology will support advanced care over the next ten years, especially around genomics and "precision medicine." The management of a person's health through genomic testing and identification of markers that respond to specific therapies will continue to advance. The amount of resources will be mammoth, and care givers and providers will rely on machine learning, artificial intelligence, and cognitive analytics to refine treatment plans to each person's unique needs and genetic make-up. Nurse informaticists will be part of the healthcare movement that guides these advances and provides availability of resources and workflows and defines standards of care around these advanced technologies.

#### Technology

Advances in technology are developing rapidly and new technology is constantly thrust upon us. The "Internet of Things" is an indicator of the expansion of technology increasing the availability of devices accessible through the Internet and the transfer of information and data between "things." Figure 4.5 shows the exponential development of technology over the past 18 years.<sup>15</sup>

With so many connected devices, healthcare will have to define ways to best manage the use of these devices and the policies and procedures that will guide their use. While much of this technology is already in use, it will become more expansive, robust, and easier to use over the next ten years. Nurse informaticists will be critical in evaluating the use of these products and defining and quantifying the value they provide in the healthcare setting. Let's look at some examples of how these technologies will impact the future of healthcare and the role of nursing informatics:

- 1. Developments in mobility that will provide clinicians with the ability to manage everything—from access to patient records, to connecting various technologies such as integration of vital signs from a "patientwearable" into the record, to managing outcomes for a patient or population—from a mobile device or smartphone. Enhanced communication through video, voice, or text will increase to connect caregivers and patients.
- 2. The ability to collect information directly from wearable devices seems routine today. However, we will continue to see data communicated instantly, from data-sensing devices for lab values, identification of conditions threatening harm to the body, pending emergencies, or



Figure 4.5 The Internet of Things<sup>15</sup>

subtle changes in health status. Data-sensing devices will provide a wealth of information that then can be synthesized immediately to provide real-time continuous status updates of an entire population of people. In addition, voice-controlled smart devices (such as Siri or Alexa) currently in use in homes and on smartphones will be a valuable tool in healthcare settings, to help coordinate and sift through data and present options, guiding and directing various interventions and outcomes.

- 3. Predictive and prescriptive analytics—the ability to take information input from multiple data sources and predetermine where patients are at risk of a variety of conditions and care concerns. These algorithmic tools, embedded in EHRs and other technologies, provide efficiencies and streamline workflows while providing data immediately when a change or condition is detected. Coupled with advances in genomics and precision medicine, we will be able to treat and manage health concerns prior to them being recognized or identified through standard diagnostic and testing measures.
- 4. Telemedicine, which is beginning to show real value in healthcare, and the requirements to govern and support its use are becoming better defined. There are now payment models around telemedicine, and organizations are starting to implement telehealth opportunities to serve their communities. The State of Mississippi and University of Mississippi Medical Center have developed a robust telemedicine program that provides telemedicine services to residents of Mississippi through two distinct services.<sup>16</sup>
  - Tele-emergency provides emergency department telemedicine visits from small, rural, critical access hospitals to physicians and providers at UMMC. It allows patients to stay close to home and keeps healthcare services in the community where the patient resides. This has resulted in a 25 percent cost reduction in rural emergency services and a 20 percent reduction in unnecessary transfers to the metropolitan medical center.
  - Remote patient monitoring, such as chronic disease management in the patient's home for diabetes management. Computer tablets are provided so that the patient communicates with the program directors. Data such as hemoglobin A1c, weight, medication compliance, and compliance with the program are monitored and patients receive calls and coaching if targets are not met. During

the pilot of the first 100 patients there were no emergency room visits and the cost savings were estimated to be \$339,000 in only six months.

Since 2003, over 500,00 patients have been helped via telehealth services from more than 200 locations across the State of Mississippi. They are expanding their telehealth services to cover more disease management and telemedicine options beyond the emergency department.

#### **Professional Development**

As nursing informatics continues to evolve and meet the needs of the future, it is important that we stay connected and provide for the ongoing professional development of individual nurse informaticists as well as supporting the advancement of nursing informatics as an essential domain within nursing. Several professional organizations within nursing and healthcare are committed to the advancement of nursing informatics and NI initiatives for professional practice. The four key nursing informatics professional organizations are outlined in Table 4.1 and can be accessed via the web.

Formal education in the form of advanced degree programs in nursing informatics have increased since the late 2000s. Many universities as well as private online education organizations now offer nursing informatics degree programs at the graduate, postgraduate, and doctoral levels. These programs will continue to develop and evolve to support the ongoing career advancement of nurse informaticists, and provide for more Master's and Doctoral Prepared Nursing Informatics Specialists. Over the next several years, coupled with the drive of meeting the Future of Nursing's Campaign for Action,<sup>17</sup> there will continue to be a growth in nursing informatics job and education opportunities. It is important that nursing informatics offers a strong framework for career advancement and provides definitions of job responsibilities and competencies. The top-ranked NI graduate programs demonstrate the growing emphasis for continued education in preparing nursing informatics leaders and executives. These programs support the evolution of the need for nursing informatics to respond to changes in the healthcare environment. The Top 10 Nursing Informatics Education Programs can be found at https://www.usnews.com/best-graduate-schools/top-nursing-schools/ nursing-informatics-rankings.

Organization Name	URL	Description	Comments
HIMSS (Health Information Management Systems Society)	www.himss.org	Cause-based, not-for-profit, global organization focused on better health through information and technology.	Nursing Informatics Community within HIMSS has over 8,000 nursing informaticists that provides networking, events, education, and resources.
AMIA (American Medical Information Association)	www.amia.org	AMIA aims to lead the way in transforming healthcare through trusted science, education, and the practice of informatics.	AMIA has a Nursing Informatics Working Group dedicated to advancing nursing informatics.
ANIA (American Nursing Informatics Association)	www.ania.org	ANIA seeks to advance nursing informatics through education, research, and practice in all roles and settings.	Very focused on connecting nurse informaticists through education and sense of community. Has a very active online presence.
ANI (Alliance for Nursing Informatics)	www.allianceni.org	To advance nursing informatics practice, education, policy, research, and leadership through a unified voice of nursing informatics organizations.	ANI has over 60 member organizations that support and promote the advancement of nursing informatics. ANI is co-sponsored by HIMSS and AMIA.

 Table 4.1
 Nursing Informatics National Organizations

#### Summary

In summary, healthcare initiatives, public policy, and the transition in payer practices from fee-for-service to population health and value-based care, coupled with advancement of technologies impacting consumers, patients, clinicians, and healthcare providers, create an environment rich for the advancement of nursing informatics to support these clinicians and initiatives. Nurse informaticists, through their willingness to embrace change and understand the impact of emerging technologies on the art and practice of nursing practice, and their ability to translate technology into practice, will continue to lead the way for nursing to adapt and embrace the next several years of practice. Nurse informaticists, and nursing informatics leaders, will participate in all sectors of healthcare, government agencies, and community areas to ensure the integration of nursing practice and technology to support clinical outcomes and overall health, wellness, and well-being.

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## Chapter 5

## **Advanced Analytics**

#### Charles M. Boicey

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Healthcare has passed the tipping point and we are now amidst a cycle of rapid and complex change (Gladwell, 2000). The Accountable Care Organization, Medical Home, Health Home, Population Management, and the expanding Centers for Medicare and Medicaid Services (CMS) Delivery System Reform Incentive Program (DSRIP) are but a few of the many new care delivery models and drivers demanding value for quality in the delivery of healthcare. The list below shows that as of June 14, 2014 the United States falls last for healthcare quality, access, efficiency, equity, and healthy lives (Davis, et al., 2014). As of May 2017, the gap has increased between the United States and the other countries listed (Sawyer and Gonzales, 2017). There is much work to be done in a very short time and advanced analytics holds the promise to help us meet the challenge.

Overall Healthcare Ranking:

- 1. United Kingdom
- 2. Switzerland
- 3. Sweden
- 4. Australia
- 5. Germany and Netherlands (tied)
- 7. New Zealand and Norway (tied)
- 9. France
- 10. Canada
- 11. United States

The purpose of this chapter is to expose you to those advanced analytic technologies that if leveraged appropriately will serve as the analytic accelerators for healthcare transformation. As you very well know, the transformation has already begun and is picking up speed. Your goal, then, is to understand not only the promise of these analytic technologies but also to understand their limitations so that they can be applied appropriately in the healthcare environment. Our clinical peers and our patients are counting on us as nurse informaticists to successfully implement and assist in the effective adoption of these new healthcare analytic technologies. To do this you will have to be creative and innovative, you will have to maintain a deep understanding of analytics capabilities available now, analytics capabilities on the near horizon, and analytics capabilities a few years out. These are exciting times to jump in and learn more about some of those emerging analytics technologies.

### **Advanced Analytics: Impact on Nursing**

Data lakes, machine learning, and event stream processing are just a few emerging analytics technologies that nurse informaticists must become familiar with. In looking at Figure 5.1, we see not only emerging analytics technologies, but we see a projected trajectory of those technologies. Every year in the summer, Gartner (2017) publishes a report describing emerging analytics technologies and places each on a "hype curve" that follows the pathway of a technology from innovation to mainstream productivity. Once a new technology emerges, it reaches a peak of inflated expectations where



Figure 5.1 Gartner's hype cycle for data science and machine learning (2017)

the expectation of a technology exceeds the practical application of that technology. We have all had an experience in which, before we had complete knowledge of a technology, we mentally applied it to a problem, only to find out later when we did have a more complete understanding of the technology, that it was not a fit for the problem we were trying to solve. This is why it is so important to fully understand technology before we apply it.

This leads to the next phase of the hype cycle: The "Trough of Disillusionment," where our perceptions did not meet reality. Again, we can all think back to a technology implementation where we thought that this was the ultimate technology solution only to learn of unintended consequences reported back to us by users that forced us to go back to the drawing board to rethink our approach. Once a technology has made it past the "Trough of Disillusionment," it begins a steady rise up the "Slope of Enlightenment" to the "Plateau of Productivity" where the technology gains wide acceptance and is mainstreamed into practice.

Let us take a look at three of these advanced analytics technologies that are in the "Innovation Trigger"/"Peak of Inflated Expectation" phases and explore some of the ways they may be applied to healthcare. Remember, many of these will not be matured for several years but it is important for us to be aware of them, follow them, and start to think of how we may apply them. We will not be able to cover all of the analytics technologies listed, so make a list of your own and start to follow them as they mature. Make a note to check back with Gartner each summer to see how the various analytics technologies are evolving and what innovations have been triggered.

#### **Data Lakes**

A data lake is a centralized repository that allows you to store all your structured and unstructured data in its natural state and in its entirety. You can store your data "as-is," without having to first structure it. You can also run different types of analytics, inclusive of machine learning, event stream processing, and predictive analytics.

#### **Machine Learning**

Machine learning is an application of artificial intelligence (AI) that provides systems with the ability to automatically learn and improve from experience without being explicitly programmed. Machine learning focuses on the development of computer programs that can access data and use it to learn for themselves (Varone, 2018).

The process of learning begins with observations or data, such as direct experience or instruction, in order to look for patterns in data and make better decisions in the future based on the examples that we provide. The primary aim is to allow the computers to learn automatically without human intervention or assistance and adjust actions accordingly (Varone, 2018).

#### **Event Stream Processing**

An *event* is anything that happens at a clearly defined time and that can be specifically recorded. Event objects usually include data about the type of activity, when the activity occurred, as well as its location and cause (Watts, 2018). A *stream* is a constant and continuous flow of event objects that navigate into and around companies from thousands of connected devices, Medical Internet of Things, and any other sensors. *Processing* is the final act of analyzing all of this data.

Let us weave data lakes, machine learning, and event processing together in a practical use case that we will see in the not too distant future. A large Integrated Delivery Network (IDN) charged with caring for 250,000 type I diabetics collects streaming dietary data, activity data, blood sugar data, as well as insulin dosing data from all 250,000 patients, in real time, as it occurs. This data is placed into the data lake of the IDN. Machine learning is applied based on previous encounters with a patient and data on similar patients and algorithms are developed to be used as objects in the event stream processing. As the data streams in and the algorithms are applied the results are transmitted back to the patient suggesting insulin dose, dietary choices, and activity recommendations.

#### A Modern Healthcare Data Platform

With the advent of data science and machine learning, the data types listed below, and the three analytics technologies previously highlighted, there is a need for a platform to collect various data types and to process and make sense of them all.

The EMR, Enterprise Data Warehouse, and existing analytics platforms are not ideally suited for the coming tsunami of healthcare-related data and the ever-increasing need to run analytics on that data. Figure 5.2 details a modern healthcare data platform (Hurff, 2018) that is capable of ingesting the data types listed above and future data types that are generated as outputs of advanced analytics capabilities. Please reference Table 5.1 for definitions of terms that we will use in this discussion.



Figure 5.2 A modern healthcare data platform (Hurff, 2018)

Term	Description
Algorithm	A step-by-step set of instructions for carrying out a process for problem-solving.
Anomaly detection	Data in a data set that does not match an expected or projected pattern.
Artificial Intelligence	The theory and development of computer systems able to perform tasks that normally require human intelligence, such as visual perception, speech recognition, decision- making, and translation between languages.
Clustering analysis	Identifying data in a data set that is similar and grouping it together to understand the similarities as well as the differences within a data set.
Correlation analysis	An analysis of data to determine a positive or negative relationship.
Deep learning	A subset of machine learning, utilizing a hierarchical level of artificial neural networks to carry out the process of machine learning.
Extract, transform, and load	A process in which data is extracted from a source, then transformed and loaded into a data warehouse.
Hadoop	An open source framework for the storage and processing of Big Data across a distributed file system.
HBase	A column-oriented data store allowing for fast access to data stored in HDFS. See HDFS.
HDFS	Hadoop Distributed File System. A file system for the storage of data across many computers.
High Performance Computing (HPC)	The use of super computers to rapidly solve complex problems.
Hive	A Hadoop data system that facilitates the interrogation of data stored in HDFS using Structured Query Language (SQL).
In-memory	A database management system that stores data in memory not on a disk, resulting in fast processing.
Medical Internet of Things	Medical devices connected to the Internet via sensors.
Machine learning	A process in which software learns during data processing and becomes more accurate over time.

 Table 5.1
 Modern Healthcare Data Platform Terminology

(Continued)

Term	Description
MapReduce	The processes of breaking up problems into pieces that are then distributed across multiple computers on the same network or cluster.
Metadata	Data about data. Information about stored data elements.
MongoDB	An open source, reliable, high performance, scalable document database.
Natural language processing	Extracting information from text.
Neo4j	An open source graph database.
NiFi	Data flow management application.
NoSQL	Databases that do not use the relational model, such as databases that store documents, tweets, and so on.
Ontology	A representation of a body of knowledge as a set of domain- specific concepts.
Open data	A data movement in which data sets are made available to the public for use without charge.
Open source	Applications in which the source code is available to the general public for use or modification.
Pattern recognition	Identification of patterns in data via algorithms.
Pig	A programing language used in the Hadoop framework.
Predictive analytics	The use of existing data sets and algorithms to predict the probability that a future event will occur.
Quantified self	A movement to incorporate data acquisition about self into all aspects of a person's daily living.
R	An open source programing language used for statistical computation. Most commonly used to develop statistical software.
Recommender systems	A system in which treatments, therapies, and medications are recommended based on patient data.
Sentiment analysis	The use of algorithms to understand human feelings.
Structured data	Data that is organized in a predetermined structure.
Unstructured data	Data that does not prescribe to a predetermined structure, such as free text.

 Table 5.1 (Continued)
 Modern Healthcare Data Platform Terminology

The EMR is not up to the task of complex pattern recognition, anomaly detection, machine learning, deep learning, real time analytics, advanced algorithm development, and natural language processing. At this point you may be asking yourself, do I really need to know this? The answer is, Yes, you do! The architects and developers of these systems as well as the data scientists that use them will require subject matter experts such as you to get this right. Nurse informaticists were on the frontlines of the configuration and implementation of the EMR and now we need to be right in the thick of things during the build-out of these advanced platforms. We know the data elements, their ontologies and their relationships, which data sources are authoritative and which ones are not. Data Science is our new frontier and will be a requirement to manage operations, patient care, and populations in real time.

The core of a modern healthcare data platform uses the same technologies that power Facebook, LinkedIn, Twitter, and Yahoo. These technologies are capable of ingesting large amounts of disparate data, storing that data, applying data science, and serving up processed data for various use cases. This architecture does not replace the EMR, data repositories, or existing analytic tools; it is an adjunct and serves to supplement them.

Use cases for a modern data platform include monitoring patients in real time for decompensation and mining social media for sentiment analysis to better understand the population's perception of our organizations. Marketing and communications can monitor and act accordingly. On the clinical side, an analytics platform is capable of monitoring our patients both in the hospital and at home in real time allowing for much earlier interventions. This platform will also support research and personalized medicine as it has the capacity for storing and analyzing "omics" data. For a deeper dive on the technology, check out the references listed below.

- Big Data Tutorial for Beginners https://www.youtube.com/watch?v=zez2Tv-bcXY
- Hadoop Explained in 30 mins http://www.plottingsuccess.com/hadoop-101-important-terms-explained-0314/
- Getting Started with R Studio https://www.youtube.com/watch?v=lVKMsaWju8w.

#### Data Visualization

Effective visualization of data from advanced analytic applications as well as existing and emerging data platforms is often overlooked, leading to misrepresentation and misunderstanding. Looking to the future, it is these very visualizations that will inform, alert, and educate clinicians and patients. Therefore, we need to understand the basic concepts to better prepare us to build not only our own data visualizations but to assist in the development of customer-facing data visualizations. Data visualization technology is continually evolving. Several references are posted in the suggested reading section at the end of the chapter.

Understanding how our sense of sight works is an essential first step in the data visualization process. Vision is our dominant sense and is tightly coupled with the process of thought. In his book *Thinking, Fast and Slow*, Daniel Kahneman (2011) presents two distinct processes of the brain:

- System 1 represents the automatic and intuitive thinking process.
- System 2 represents the thinking process that requires effort and attention.

For the purpose of visualizing healthcare data, you want to ensure that your visualizations invoke System 1 processes. You do not want viewers spending time trying to figure out what the data is representing. You want them to understand immediately. Figure 5.3 represents the presentation of data that requires a System 2 response. Tabular data and data poorly represented in a pie chart causes the viewer to rely heavily on thinking and very little on intuition, thus causing confusion and an out-of-balance state. Conversely, in Figure 5.4, the data is represented to evoke a System 1



#### Data Visualization and Human Perception

Figure 5.3 Kahneman's out of balance state


#### Data Visualization and Human Perception

Figure 5.4 Kahneman's balanced state

response so that the viewer can understand the patient waiting-time data at a glance.

When developing data visualizations, there are a few more points to consider. For example, consider a colorblind palate to ensure your visualizations take into consideration the colorblind population. Ensure your visualizations are reactive and can render regardless of the platform. We have all seen visualizations that worked well on a PC but rendered poorly on tablets and smartphones. The infographic is emerging as a visualization modality that takes advantage of our System I response. Infographics convey an exceptional amount of data that is easily understandable at a glance. Our very own Florence Nightingale used infographics to visualize data. Figure 5.5



Figure 5.5 Florence Nightingale's diagram of the causes of mortality in the army in the east

is the infographic Florence created to help with the understanding of the causes of mortality during the Crimean War. The Rose Diagram is the precursor to what we now call a circular histogram.

Websites with exceptional collections of healthcare-related infographics.

Paul Sonnier

https://www.pinterest.co.uk/paulsonnier/digital-health-infographics-paulsonnier/

- Pinterest https://www.pinterest.com/dandunlop/healthcare-infographics/?lp=true
- HatchMed https://www.hatchmed.com/blog/2017/2/24/the-17-best-healthcare-infographicsof-2017
- Oliver Wyman Health http://health.oliverwyman.com/transform-care/2018/02/infographic\_the\_ yea.html

# The Nurse Data Scientist

Data science is a talent-based discipline comprised of three domains: technical skills, analytical skills, and subject matter expertise (Diesinger, 2016). I will throw in one more: "data wrangling." Technical skills center around the ability to code and use applications such as R, Python, or Mathematica. Analytical skills or problem-solving is at the root of data science and is a requisite to success in this complex discipline. Subjectmatter expertise is at our core. Nurse informaticists are knowledgeable in all aspects of the healthcare domain. Last but not least, "data wrangling" is a skill learned early on in our careers as nurse informaticists. I will argue that the nurse informaticist has the requisite subject-matter expertise and analytical skills, as well as the ability to wrangle data of all types. To make the leap into data science it is a matter of learning and applying computer science, math, and statistics. With additional education, the transition into a role of Nurse Data Scientist is a natural progression. My suggestion to you if are interested in data science is to seek out one to learn more. You may have a data science team in your organization. A great online resource to learn more about data science is Data Science Central (https://www.datasciencecentral.com), which is a site that is updated daily and sends out a daily email summarizing added content.

## Conclusion

To be successful with advanced analytics and their application to healthcare, you must commit yourself to be a lifelong learner. Additionally, you must be vigilant, always on the lookout for new analytics technologies, especially those outside of healthcare that can be adapted and applied to healthcare. In the past couple of years, I have moved away from following Healthcare IT bloggers and discovered that following technology-focused LinkedIn Groups and tweets by Healthcare IT leaders keeps me current and provides me with direction on analytics technologies to investigate. Here is a list of LinkedIn Groups and Twitter Handles you can follow:

#### LinkedIn Groups

- Advanced Business Analytics, Data Mining and Predictive Modeling
- Big Data Visualization
- Data Science Central
- Digital Health
- Healthcare Analytics & Informatics
- Healthcare and Social Media
- Healthcare Technology Alliance
- Internet of Things
- Precision Medicine & Big Data in Life Science.

#### Twitter Handles

- @ZDoggMD
- @AMIAinformatics
- @ANIAinformatics
- @Doug\_Laney
- @dr\_morton
- @drsanders
- @EdwardTuffte
- @HealthITNews
- @StanfordMed
- @HealthcareWen
- @ePatientDave
- @Paul\_Sonnier
- @MandiPro
- @EricTopol

- @TheNerdyNurse
- @wareFLO
- @Atul\_Gwande.

With the continued dependency on data to evolve models of care, consider enrolling in a certificate or postgraduate program in healthcare analytics or healthcare data science. There are several institutions that offer online programs. Table 5.2 lists a few for you to consider.

The next few years will bring tremendous change in the delivery of healthcare. As nurses and informaticists, we are uniquely positioned to lead this change through the careful and thoughtful application of advanced analytics. As healthcare technology leaders, we must be prepared and relevant, so stay informed and, above all else, bring your own unique perspective to the design of future analytics-enabled care delivery models. Attend data science conferences outside of healthcare, as there is much to be learned from other industries. Most of all, have fun! For further study, reference the suggested reading section at the end of the chapter.

Academic Organization	Program Offered	Website	
Georgetown University	Certificate	http://scs.georgetown.edu/programs_nc/CE0124/ data-analytics?dID=5	
University of California, Davis	Certificate	https://extension.ucdavis.edu/unit/health_ sciences/certificate/healthcare_analytics/	
University of California, Irvine	Certificate	http://unex.uci.edu/areas/it/predictive_analytics/	
Massachusetts Institute of Technology	Certificate	https://www.getsmarter.com/courses/us/ mit-sap-big-data-and-social-analytics-online- short-course	
Columbia University	Master of Science	www.cs.columbia.edu/education/ms/ machineLearning	
Dartmouth	Master of Science	https://www.dartmouth.edu/~qbs/program/ the-ms-curriculum.html	
North Carolina State University	Master of Science	https://analytics.ncsu.edu/?page_id=1799	
Northwestern University	Master of Science	http://sps.northwestern.edu/program-areas/ Graduate/predictive-analytics/index.php	

Table 5.2 Online Analytics/Data Science Certificate and Graduate Programs

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# Chapter 6

# Nursing Informatics—A Day in the Life

# Edited by Tina Dieckhaus

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As this book has made clear, nursing informatics (NI) as a specialty has evolved significantly over the decades. Nurses are making an exciting and profound impact in many areas of healthcare—from hospitals and academia to government and executive leadership.

This chapter—A Day in the Life—takes a look at the myriad professional roles taken by today's nurse informaticists and is designed to provide for the next generation of nurses a better understanding of the potential and opportunities of this specialty. As noted in *Nursing Informatics: Scope and Standards of Practice*, 2nd edition, "The nursing informatics specialty and its constituent members contribute to achieving the goal of improving the health of populations, communities, groups, families, and individuals ... [through] the identification of issues and the design, development, and implementation of effective informatics solutions and technologies within the clinical, administrative, educational, and research domains of practice."

This chapter is divided into several broad categories—Education/Academia/ Research; Clinical Settings; C-Suite; Consulting; and Government/Policy.

Though not a comprehensive list of all professions touched by NI, this chapter presents a look at the nurse informaticist as a leader.

# Education/Academia/Research

#### Nursing Informatics Student-University of Colorado

Sarah Knapfel, BSN, RN, CCRN, MSN

- **Years in the Field:** 2 (nursing informatics student)
- **Years in Current Role:** 6
- Education: Master's degree, Healthcare Informatics, University of Colorado Health Sciences Center; Bachelor of Science, Registered Nursing/Registered Nurse, Arizona State University College of Nursing; Associate's degree, Registered Nursing/Registered Nurse, Phoenix College.

My decision to pursue a degree in NI came about rather quickly. I never considered myself "technologically gifted," but realized the positive effects information technology (IT) had on the process of providing quality nursing care.

After having had the opportunity to work as a bedside nurse in many different arenas, I repeatedly found myself reflecting on my experiences and asking questions such as: What were we doing with all of the information being collected in the electronic health record (EHR)? How could we improve documentation methods for nurses? Could the implementation of this new product have gone better with improved planning?

Of course, my thoughts were not quite that sophisticated at the time, but my research led me down a valuable path into NI. I was fortunate enough to be accepted on an online program offering a Master of Science in Nursing degree with a concentration on healthcare informatics. Not only was my journey as a full-time student beginning, but so too was my ambition to improve care delivery on a grander scale.

#### A Day in the Life...

A typical day as a nursing informatics student begins even before my alarm clock has gone off. *Ding!* I am immediately reminded that I neglected to silence my phone the night before, as a fellow classmate two time zones away checks in with the group before she ends her night shift at the hospital. She is reminding everyone to attend the video conference call scheduled for later that night to finalize our group project in our Decision Support and Data Management course. I appreciate the reminder and begin to work through my email from the comfort of my warm bed.

I have learned as a student in NI that due to the vast number of technologies evolving at such a rapid rate, subscriptions to health IT websites and memberships of professional organizations are essential for staying up to date with the latest news, policies, and research. This desire to stay informed consumes a lot of inbox space but is found to be worthwhile when I discover an article related to new staffing measures for specialty areas, a subject that follows closely my informatics practicum project. I forward the article to my preceptor and indicate that I would like to discuss this topic when we meet later that morning.

I am completing my internship—a total of 270 hours—with a clinical services group at the corporate headquarters of a large national health system. I arrive at my practicum site just before 8 a.m., and call into the first meeting of the day. I spend the next few hours taking notes and listening to issues discussed by representatives from various facilities with regard to increasing the adoption of an organization-wide workforce management system. When the conference call concludes, my passion for problem-solving is fueled, and I begin to research literature and frameworks that support how to successfully manage this change. I spend the rest of my morning collaborating with my preceptor to formulate a proposal that will ultimately improve the organization's education plan for charge nurses who use this system.

While taking time out for a quick lunch, I meet a friend who is a nurse and currently works in a clinical setting. She begins the conversation with a question I have been asked a dozen times before: "So, you're going to school for what exactly?"

I've practiced my answer to this question many times: "It is a specialty of nursing that essentially bridges the gap between you, the bedside nurse using technology, and computer science experts in order to deliver safer, higher-quality care." I feel a sense of accomplishment when she can easily understand my short, broad explanation. Of course, this approval is usually met with the comment, "It's great what you are doing—I'm just not that technologically gifted!"

After lunch, I spend the remainder of the day conducting an article analysis for an upcoming presentation at the American Medical Informatics Association (AMIA) Annual Symposium. This is not the first time I have volunteered my time as a member of a professional informatics organization. It's a great way to network with fellow students and AMIA members who have an understanding of my interests and specialty.

At the end of my day, I log in to my online courses and continue to study our current module in preparation for tonight's meeting. Our group project, the use of a decision support tool relevant to a specific area of interest, has come together superbly. After thorough research, we are now justifying the use of an alert within the EHR to assist in properly preventing and treating hospital-acquired pressure ulcers based on facility policy and procedures. As complete as it is, we are well known for making last-minute updates to perfect our work. Being enrolled in an online program with nurses who work varying hours, and in varying time zones, has presented some scheduling challenges, as one can imagine. Over these past two years, we have become creative in our communication techniques—even if that includes an early morning group text message. After finalizing our project via videoconference and appointing a person to submit it, I say goodnight to my fellow classmates and breathe a sigh of relief. There are a few hours of relaxation before our next module begins in the morning.

#### Benefits and Value of a Nursing Informatics Degree

As my practicum comes to a close, I am beginning to understand the benefits and value this degree will have for me in the field. The specific scope and standards of practice in NI are the foundation for my graduate-level program. Over the course of the past two years I have been introduced to curriculum material related to the application of e-health tools, nursing language and classification systems, system development and implementation, and database management.

Additionally, the courses I have taken in nursing research, theory, and policy will help strengthen my skill set as an advanced practice nurse. My decision to return to school and earn this type of specialty degree in nursing has exceeded my expectations. And, finally, the supplementary skills I have attained, which include strategic organization, cohesive group communication, and effective time management, will further complement the healthcare informatics concepts I have been introduced to throughout the entirety of my program.

#### Informatics Nurse Specialist—Researcher

Susan McBride, PhD, RN-BC, CPHIMS

- Years in Field: 18
- **Years in Current Role:** 6
- **Education:** PhD, Nursing, Texas Woman's University; RN, BSN, Nursing, The University of Texas at Arlington.

As a traditional academic, a day in the life of a nursing researcher and faculty member offers a lot of variety for me. I have teaching responsibilities for online courses, including informatics, statistics, epidemiology, and policy courses at graduate school levels. My home residence is in Dallas-Fort Worth, and my home campus is in Lubbock, TX, over 300 miles from my home. I maintain a home office and fill a position as a full professor in a telecommuting role for which I travel across the state for teaching, research, and policy work on behalf of Texas Tech University Health Sciences Center (TTUHSC). My office is a virtual one, for the most part.

In the teaching role, I have led the development of the statistics and informatics Doctor of Nursing Practice (DNP) courses and participated in the team development of the epidemiology DNP course. I also led the development of the Master's core informatics course, and we evaluated various projects for their effectiveness to reinforce competencies in both the DNP and Master's essentials. We also used a mixed-methods research approach to collect data qualitatively and quantitatively to inform the curriculum development for our Master's curriculum; and we will be evaluating the effectiveness of the specialty courses for developing advanced skills in NI. As a clinical researcher with expertise in informatics, when I initially joined TTUHSC as an academic in 2009, the Office of the National Coordinator for Health Information Technology (ONC) released the ONC grants for the regional extension centers (RECs) and health information exchanges (HIEs). I designed and deployed the health IT strategy for the West Texas Regional Extension Center to support adoption, implementation, Meaningful Use, and evaluation of EHRs in 108 counties in west Texas (with \$7 million funding). This grant was largely a program grant, but critical to the goal was to collect the right data to evaluate the success of our strategy in, primarily, a very rural west Texas setting. The initiative was to deploy EHRs in small practices, Federally Qualified Healthcare Clinics (FQHCs), and small hospitals (<100 beds). Our target was approximately 1,000 providers (including nurse practitioners), and 70 critical access and small rural hospitals across 108 counties of some of the most rural territory in the United States.

I served as founding director and had oversight for the development of the support services and evaluation methods of those services for the West Texas REC. In this role, I also served on various national Cooperatives of Practice (CoPs) in conjunction with the other 62 RECs across the country to establish and share best practices with respect to services provided. In addition, I have served in a consulting role to the CentrEast Regional Extension Center. Both the West Texas and CentrEast RECs are housed within the two Rural Institutes in Texas.

In community and advocacy contributions, I was appointed to and served on the Texas Medicaid Health Information Exchange state advisory committee for two years and sat on the Nursing Workforces Studies Committee as a nursing researcher, as well as other various state advisory roles to the Department of State Health Services on the use of public domain data to inform public health and quality reporting.

We are currently working on research strategies within the TTUHSC Simulation Center to design methods for evaluating competencies on EHRs and to update clinical training scenarios with technology. We are examining safe medication practices and working with our University Medical Center to replicate medication errors within the simulated scenarios to reduce errors and promote best practices in computerized provider order entry (CPOE) and electronic bar-code administration.

In my role as Professor, I report to the Dean of the School of Nursing. With respect to the Regional Extension work I am involved with, I reported to the Senior Vice President at the Rural Institute. In summary, I find the role of an academic nursing informatics researcher to be rewarding work. The role provides opportunity to continue to improve practice through research, engage in the clinical practice setting with program activities, and foster the competency development of nurses and other healthcare professionals.

#### Adjunct Associate Professor

Beth L. Elias, PhD, MS

- **Years in Field:** 25
- **Years in Current Role:** 6
- Education: PhD, Instructional Technology, University of Virginia Curry School of Education; MS, Management of Information Technology, University of Virginia McIntire School of Commerce; BS, Computer Science, SUNY College of Technology.

With a background in computer science and health IT, I was not the most likely faculty candidate for a School of Nursing when I began this phase of my professional life more than five years ago. Formerly, my focus had been on computer systems administration, data management, and health IT implementation. During that time, working on the frontlines of IT in healthcare, I began to see that nurses are the primary and largest group of health IT users. It seemed to me that if we wanted to make progress in integrating IT into healthcare, we needed to support, listen to, and work with professional nurses. It also became painfully clear to me that many of the health IT tools we were giving nurses were poorly designed, did not fit their workflow, and more often than not made nurses miserable.

Armed with this understanding and a commitment to come out from behind my computer monitor and into the real world, I started teaching nurses about health IT in the Master of Science in Nursing (MSN) and Doctor of Nursing Practice (DNP) programs. In this situation I expected to feel like a fish out of water, a techno-geek in a strange land of touchy-feely nurses. Quite a change, I thought, from the world of machines and lines of code that I had been living in until then.

The Master's-level students I taught were NI students, many of whom had been working in informatics roles and were returning to school to gain the next level of formal education ahead of board certification. Some students signed on because they felt that informatics was key to the future of nursing and they wanted to be a part of that. The DNP students often saw health IT as a force to be reckoned with, but one that they were not fully prepared to integrate into their practice.

With our MSN in Nursing Informatics students, several of my stereotypes about the oil and water of nursing and techno-geeks fell by the wayside. These nurses devoured every bit of health IT knowledge I could give them, clearly able to blend the caring aspects of their nursing practice with the highly technical content of their coursework. They were all about realizing the full potential of health IT to advance nursing practice, improve patient outcomes, and move their organizations into the brave new world of IT-enabled healthcare. So, the two professional spheres seemed that they might not be mutually exclusive after all!

It took working with the DNP students to fully drop the scales from my eyes. Many of these students had not left paper charts behind that long ago (or at all) when they returned to school. With some gentle encouragement that they could and would gain an understanding of health IT from the informatics course—they soon began to bite off chunks of health IT content, swallow them whole, and come back for more. Wow, I thought: who knew that nurses would take to health IT content like ducks to water? This kicked off a period of musing for me on nursing—from an outsider's perspective and from the perspective of a professional who had felt our working worlds required very different sorts of people.

Here are the three most important things that I came to realize:

- 1. Nurses are highly technical professionals who will instantly adopt anything and everything that can help them help their patients.
- 2. Nurses are the last safety check for patients and will not (and should not) tolerate increased risk to patients from badly designed technology—they will reject it.
- 3. Nurses are knowledge-based professionals who do not want a health IT application to be a substitute or a crutch for their critical-thinking skills.

I also realized some things about what nurses want from health IT techno-geeks like me. They want good, usable, supportive, and assistive technology. They want our help using these tools effectively and efficiently so they can do a better job taking care of their patients. They want us to show them some professional respect and see them as colleagues.

Nurses are highly skilled, knowledge-based, analytical, and committed professionals. They are and will continue to be the largest single group of health IT users, and therefore the largest group of health IT customers (vendors, are you listening?). They are fully willing and able to understand IT if we, as techno-geeks, are willing to help them do so. So, to nurses: Adopt a technogeek today. To techno-geeks: Start thinking differently about nurses. To both: Try actually talking to each other. Between us we can move mountains.

#### **Clinical Settings**

#### Electronic Health Record Trainer—Hospital Setting

Lou Barr, MSN/MHA, RN

- Years in the Field: Three years, critical care tech in emergency department; seven years, emergency department nurse; one year, emergency department educator; two years, nursing informatics builder; one year, clinical informatics trainer.
- Years in Current Role: 1
- **Education:** Bachelor of Science in Nursing; Master of Science in Nursing, Master of Health Administration.

After graduating from high school in 1999, my nursing story began at Northwest Mississippi Community College, in Senatobia, where I completed my Bachelor of Science in Nursing (BSN) prerequisites. Upon completion, I transferred to Georgia Southwestern State University (GSW), where I obtained my first job in healthcare in the emergency department (ED) as a critical care tech/secretary. I graduated with my BSN degree in 2004 and began my nursing career at a small hospital in Georgia.

In 2005, I moved back to the Memphis area, where I was hired as an ED staff nurse for Methodist South Hospital, serving on the nightshift team. Less than two years later, I was promoted to the night shift supervisor, and at that time I went back to school to earn a Master of Science degree in Nursing and a Master of Healthcare Administration degree.

After I completed my graduate studies, I was given the opportunity to become the educator of the ED. My goal was to move up the management ladder, but I quickly realized that I did not want to be in nursing management at that point in my life, primarily due to employment politics. While in an ED meeting, an announcement was made that Methodist was looking for an informatics analyst to help with the ED's EHR. I applied for the job, was hired, and served Methodist for two years in this role. Because I enjoyed this job, I wanted to see what else was out there in informatics. After job searching for a few weeks, a friend told me about a Clinical Systems Trainer job at St. Jude Hospital. I thought this would be perfect for me because it's the best of both worlds. Fortunately, I was a good fit for the department and was hired.

Why is a clinical training analyst job the best of both worlds? I will answer this by first giving you a description of the position, telling you about the responsibilities and reporting structure, and finishing with a description of a typical day.

According to Payscale.com, the annual salary for a Clinical Training Analyst is between \$41,526 and \$85,918. Most clinical training jobs require that you have a Baccalaureate degree or higher and at least two to three years' experience in a training role. In addition to the education and experience, a clinical background is preferred but not required.

Training analysts train both clinical and non-clinical personnel how to chart and locate information in a hospital's EHR. In addition, they also train staff on new enhancements to the EHR. Training analysts use the classroom, web-based training, job aids, and on-the-job training to accomplish these tasks. Adobe Captivate, Adobe Photoshop, Microsoft PowerPoint, Microsoft Word, and Microsoft Publisher are a few of the computer programs that are used to create training materials. A good training program plays a key role for new employees' transitional phase into their new jobs. It also helps alleviate some fears that they may be facing when using a very expansive EHR.

A training analyst provides answers to questions the employees will face on the job, such as:

- How do I log into the system?
- Where is the information that I'm looking for?
- How do I place information into the record?
- If I mess something up, how do I fix it, or who do I contact?

Creating the job aids and training materials and performing the actual training of the many users is time-consuming. One of the main advantages

of having a team solely dedicated to training is that they have time to ensure quality training for employees and produce quality materials and job aids. Quality training helps users navigate through the EHR effectively and efficiently. Quality training materials help trainers to be consistent and concise with their training. Quality job aids provide support in times of need as users work in the EHR.

Even though having a team solely dedicated to training has its advantages, it also has its disadvantages. One of the main disadvantages is that they are not in a clinical working environment. The training team is able to train employees in locating or charting information, but many times they do not know why they need to chart or locate the information. That is why a clinical background is preferred.

A good training team has members from different backgrounds. This is the reason that a clinical background is preferred and not required. As you read in my bio, my background includes working as an ED nurse. I'm very clinically oriented. I bring a clinical mindset to the training group. I'm able to answer the "Why?" However, I lack skills such as graphic design and adult training, which is why I depend on my team members who have more than 15 years' experience in these areas. As our teams goes through their dayto-day operations, we are able to use each other's strengths to develop and design high-quality adult education and training.

Now that you know more about what our clinical training analyst team does, let me lead you through a typical day. My day starts off around 8 a.m. I say "around" because one of the benefits of this job is flexibility. There is no real set schedule. The first thing I do each day when I get here is to THANK GOD I made it through the crazy Memphis traffic! The second thing is to check my calendar and email. As a training analyst, I go to many meetings and receive a lot of email. The email consists of training issues, people requesting job aids, and emails from users requesting or asking questions about training.

After replying to email, it is time for my first meeting: a design meeting about an upcoming enhancement to the EHR. Since training is key to successful implementation of changes to the EHR, training analysts are invited to many design meetings. After that meeting, I go to a process meeting about medication reconciliation. We play a key role in both design and process meetings since we are the ones in the EHR all the time and have face-to-face contact with the users. In these meetings we have an opportunity to provide input about training, process, and how the enhancements might impact the users.

Now it's time for lunch. Again, this job has a flexible schedule. I could go out, go to the cafeteria, or go home for lunch. Despite all these choices, I usually eat at my desk and work. On occasion, I will go out, but most of the time I eat at my desk. Working in the ED, I really didn't get a lunch, so I usually ate on the run or out of a pocket, which means I'm used to working and eating at the same time. It's an old habit that's hard to break, and I'm a bit of a workaholic. My condition is getting better as I get older and smarter.

Throughout my lunch and after lunch, I work on job aids or tutorials. This is the thing I like about the job. I get to learn how to use new software programs such as Captivate, Photoshop, and Publisher. I didn't have a need to use any of these programs in the ED. After working a couple of hours on these, I might even browse the Internet, or take a stroll around campus. Coming from a busy environment and going to a desk job can be stressful. This is why it is important to take several mini-breaks throughout the day. (See, I told you my workaholism was getting better.) Later, it's time to teach a few clinicians how to chart and place orders. Another thing that is fun about training is that I interact with a multitude of medical disciplines, an avenue that enables me to learn about different fields in medicine. This is another example of why it's a good idea to have a clinical background: having something in common with the people you are training. It is finally time to go home!

I enjoy being a nurse whose title is now Clinical Training Analyst. The pay is good; a flexible schedule is great; and the greatest thing is being away from the bedside but still having interactions with the different medical disciplines. Is this job for everyone? No. Is this job for the nurse who wants to get away from the bedside, start his or her move up the corporate ladder, learn about informatics, but not lose contact with the medical disciplines? Yes. Who better to train users on how to use an EHR? A nurse. Why? Nurses are in the system more than anyone else, and they know how to interact with a multitude of different personalities. This is why a clinical training analyst job is the best of both worlds.

#### Informatics Nurse Specialist—Hospital Setting

Minnie Raju, MS, RN

- **Years in the Field:** 9
- Years in Current Role: Four years as Clinical Documentation Lead, and two years as Liaison Lead (I am presently the Supervisor for both).
- Education: MS, Nursing Informatics, University of Maryland, Baltimore School of Nursing; BSN, University of Maryland, Baltimore School of Nursing; BS, Biology, State University of New York at Albany.

As the Nursing Liaison and Clinical Documentation (Clin Doc) Build Team Lead, I manage a staff that assumes a dual role. Under my direction, my team builds and integrates clinical and business functions into the hospital's information systems and services. By nurturing relationships within the nursing organization, we are able to effectively incorporate the goals of the IT department with that of the mission of the hospital.

As the Nursing Liaison, I am the primary intermediary between the IT department, clinical nurses, and research nurses. I provide clinical informatics support, communicating customer-oriented information that fosters clinical care and research. In my role as the Clin Doc Build Team developer, I facilitate the development of electronic clinical documentation to multidisciplinary clinicians and researchers throughout the hospital organization. This includes establishing process improvements/quality controls, implementing standardizations, and maintaining industry best practices of clinical standards of care. Clinical business and/or process improvement needs are identified and converted into functional requirements for implementation and integration into hospital information systems and services.

Both of my roles require an aptitude for effective collaboration and communication skills. This is done on a daily basis at organizational meetings, gathering requirements for creating and modifying clinical documentation, working with internal staff to ensure functional specifications are met, and reporting to the Deputy CIO of Clinical Informatics. These skills are also necessary when evaluating initiatives and projects for quality, benefit, efficiency, safety, and user satisfaction.

As an Informatics Nurse Specialist with a clinical background, my understanding of clinical process and workflow provides value to my hospital organization. I am able to serve as a conduit between clinicians and the IT department, which ensures that healthcare mandates are successfully incorporated into electronic clinical documents.

#### Quality Specialist—Physician Office Setting

Rhelinda McFadden, RN, CPHIT, CPEHR

- **Years in Field:** 16
- **Years in Current Role:** 12
- **Education:** Associate Degree of Science in Nursing; BSN anticipated in 2016.

As a Quality Specialist Nurse with the Arkansas Foundation for Medical Care (AFMC), my role varies from practice to practice and healthcare provider to healthcare provider. AFMC is part of a team recently awarded by the Centers for Medicare & Medicaid Services (CMS) contract to be a Quality Innovation Network-Quality Improvement Organization (QIN-QIO), working under the regional umbrella of the TMF QIN-QIO (TMF Health Quality Institute, headquartered in Austin, Texas) for Texas, Arkansas, Missouri, Oklahoma, and Puerto Rico.

AFMC's staff consists of more than 140 professionals in clinical medicine, data management, epidemiology, statistics, and quality improvement. As a team leader for a multi-project-focused team, I report directly to both a project manager and a departmental director.

Our mission is to improve the effectiveness, efficiency, economy, and quality of services provided to Medicare beneficiaries. By supporting healthcare professionals in Arkansas through education, outreach, sharing of best practices that have been successful in other areas, using data to measure improvement and through the active engagement of patients and families in their care, we improve healthcare for Arkansas.

Working in the rural primary care provider setting, the approach I take to my job is as different and unique as the office and healthcare provider with whom I am working. The majority of my time is spent functioning as a knowledgeable clinician, technology educator, and evaluator of data to define, maintain, and improve outcomes. I also mentor healthcare providers in becoming better technology consumers.

The majority of my work is defined by multiple state and federal initiatives. My priority is to identify methods to align and minimize the burden of participation in these initiatives on the rural practices I work with by being as informed as possible on the rapidly changing landscape of health IT.

Through the utilization of a consultative/face-to-face model of communication and education, I am able to implement quality improvement projects and activities for healthcare providers by developing an individualized plan for their practice and their specific EHR.

By providing expertise in the EHR systems most commonly used across our state, I serve as a knowledge resource and can facilitate the improvement of outcomes for targeted patient populations and/or specific clinical metrics. By being available to the healthcare providers in their practices, I can more effectively address their specific needs, which ultimately minimizes lost productivity and increases buy-in from providers and staff. For me, it is important to understand the pulse of a practice and the healthcare providers within it. This allows me to have a better understanding of their unique approach to patient care delivery and the associated workflows. As the practice and I work together, we are able to define processes to measure the changes we are putting in place and ensure that they are sustainable. Because so many of these providers are still relatively new users of EHR technology, they are struggling with changes in the care delivery design and process automation which moves them away from the security of "the way we have always done it" and toward a more seamless healthcare delivery system design.

By engaging our healthcare providers and their staff in more meaningful utilization of their EHR technology to measure and monitor the data, we are able to improve clinical outcomes through clinical decision support and more effectively transform clinical practice.

My unbiased assessment of a practice offers an opportunity to address process changes, some as simple as utilizing staff to the maximum of their licensure to something a little more complex such as how to implement proactive strategies for planned care at every visit. Both of these strategies empower the healthcare team and improve the efficiency, quality, safety, and effectiveness of the care being delivered.

In Arkansas, 75 percent of primary care providers are located in rural areas. These are primarily one- to two-provider practices with minimal clinical staff, resources, and time to research—or understand—current state and federal initiatives. Thus, identifying ways to align these initiatives to minimize the burden for providers is a priority.

As a quality specialist nurse and advocate for Arkansas healthcare providers and their practices, my job is to be a resource that is free to provide technical assistance, support, and information for all of these initiatives.

We are committed to be the resource of choice for our state and to serve as a first line of defense for healthcare in Arkansas.

#### Director of Informatics and Innovation/ Manager—Healthcare Setting

Kimberly Ellis Krakowski, MSN, RN, CAHIMS

- **Years in Field:** 20
- **Years in Current Role:** 6
- **Education:** MS, Nursing, George Mason University; BS, Nursing, University of Mississippi Medical Center; CAHIMS, HIMSS.

As the Director of Informatics and Innovation at Inova Health System, I manage a team of 14 informatics analysts and senior informatics analysts and report to the Chief Nursing Information Officer and Chief Medical Information Officer.

We support the needs of five hospitals and more than 250 clinics with the mission to promote the quality, safety, and usability of its clinical informatics systems and the medical informatics environment through strategic leader-ship and collaboration with all operational units.

It is my responsibility to prepare the clinical workforce for the use of technology so they may improve and deliver safe, effective clinical care. In addition, I oversee more than 30 departmental informatics transformation specialists (pharmacy, revenue, rehab, respiratory, case managements, and clinical outcomes).

I ensure strong, collaborative relationships and communication with the chief nursing officers, chief medical officers, chief financial officers, education department, information systems, training, human resources, stakeholders, and vendors. I work to facilitate application integration and expansion of the system functionality throughout the health system. In our department, we value education and certification. And while it is not a requirement that employees of the informatics department are certified, it is strongly encouraged. Prep courses are provided and employees receive a bonus when certification is obtained.

Imagine visiting an amusement park. I start my day with a ride on the carousel, otherwise known as "rounding" in the office. It's a simple ride that many skip because it's not exciting, but it is genuinely part of my routine because it provides greater rewards than winning a giant panda after knocking down milk bottles. As I walk to the main attraction, I get easily distracted by phone calls and email, just as kids are distracted by the cotton candy or music playing at all the rides. But, ultimately, I arrive at the amazing roller coaster, the Informatics Department (in this analogy). The Chief Medical Informatics Officer and Chief Nursing Informatics Officer support the organizational structure and provide the autonomy for me to lead the train that carries my team. When approaching the roller coaster, there is a sign that reads "STAND TALL," but it does not give a specific height. What it means is that to ride this train, or be a part of this team, you are required to stand tall for what you think is right at all times. There is also a sign that reads "CAUTION: The faint of heart should not attempt." It takes passion and commitment to be in this leadership

role. Having a Master's degree in Nursing Administration, certificates in Lean Process Improvement, certification as a builder in my EHR, and high emotional intelligence provides the knowledge and skills for me to lead my team.

My job in the lead car is to keep our goals in view and keep us on track, while knowing that sometimes things happen slowly, especially as we move forward to the top. I am also responsible for keeping the team aware of the twists and turns so that they do not get thrown for a loop. I know we can get turned upside down, but the momentum will keep us moving.

On a good day, everyone exits the ride smiling and laughing and wanting to ride it again. On other days, we may want to throw our arms in the air and scream! Often, we find ourselves designing the next great roller coaster because we must be constantly ready to improve the way we do things!

As the Informatics Director, I strive to provide the strategic leadership in the development of workflows and ongoing continuous process improvement of clinical information systems, ensuring the successful application of informatics principles for its clinics, service lines, and hospitals, while supporting organizational goals.

Sometimes, I trade my role in the lead car and instead walk around the amusement park in a clown suit passing out flowers, honking a horn, or giving high fives. Finding time to have fun and recognize others is just another role, or a hat the Director wears.

As the Informatics Director, I provide comprehensive leadership to complex projects. I use quality processes and evidenced-based practice to provide streamlined clinical solutions that meet the business needs related to clinical support applications, clinical work processes, and the redesign and enhancement of the core clinical IT platforms and workflows the core systems support.

It is critical to an organization's success to maintain up-to-date knowledge of trends and advances in the field of health IT, as well as new government and regulatory requirements for health information systems (HISs), including but not limited to Meaningful Use and core measures, then ensure their placement within the EHR. When it's time to leave the amusement park, I am still the Director of Informatics and Innovation. And I am a liaison and advocate to external health systems, professional associations, and government/regulatory organizations as a subject-matter expert in HISs through presentations, committee representation, and collaboration.

#### Vice President, Clinical Informatics—Long-Term Care Setting

Sylvia Rowe, MSN, RN-BC, LNHA

- Years in the Field: Worked with Ethica Health and Retirement Communities for 25 years in long-term care, beginning as a Certified Nurse Assistant; have been a Registered Nurse for 21 years and served in various roles in the long-term care setting, including Director of Nursing, Case Management, Care Plan Coordinator, and many other roles.
- Years in Current Role: 3
- **Education:** MSN, Informatics, Walden University; BSN, Nursing, Georgia College and State University.

To understand the role of the nurse informaticist in long-term care (LTC), one must first understand that LTC spans a variety of settings including assisted-living facilities, personal care homes, home health, hospice, skilled-nursing facilities, and LTC post-acute-care hospitals. Roles and responsibilities will differ in each of these settings due to variations in structure within the wide array of settings classified under the umbrella of LTC.

The following description will focus primarily on the role of the nurse informaticist working in the skilled-nursing facility (SNF) setting. It would be rare in LTC to find the nurse informaticist working in a local setting. More commonly, you will find the nurse informaticist working in a regional or corporate support role. The nurse informaticist's reporting structure will differ from organization to organization as well. Commonly, the nurse informaticist may report to the IT department, clinical practice, or compliance office. The nurse informaticist may be isolated in the department or may have direct reports such as health information management specialists, nursing analysts, implementation specialists, or support associates.

A day may find the nurse informaticist in the SNF setting conducting a facility walkthrough to inventory hardware and software or assess wireless coverage to identify any gaps in these areas for current or future needs. This walkthrough will facilitate a need for the nurse informaticist to ensure IT has a clear understanding of operational and clinical needs for the SNF and that operations and clinical areas have a clear understanding of any costs associated with filling in the gaps and the impact of gaps on workflow.

In addition to assessing needs and gaps, the nurse informaticist has a responsibility to collaborate with operations personnel, ensuring that replacement and maintenance of hardware and software are considered in the annual budget review process.

On another day you may find the nurse informaticist in the SNF setting, bringing user group(s) together to evaluate current software to determine if the software is meeting the current end-user needs, or if it is being utilized to its full potential. This may lead to working with end users and the vendor to develop additional training or sun-setting an application.

The nurse informaticist working with a user group or groups will also be responsible for guiding and directing product selection if a change in software is deemed necessary or if needs are identified outside the scope of what the current software is capable of providing. This may result in the nurse informaticist leading an implementation team for new software. Additionally, with growing interest around telemedicine brought about by need for access, cost control, and quality, the nurse informaticist in LTC will share responsibility for implementation, oversight, and management of telemedicine programs.

Any given day will be filled with multiple calls and meetings, both internal and external. Calls for the nurse informaticist may include general questions from end users, contract discussions with vendors, project management calls, or collaborating with other providers such as a doctor's office, hospital, or home health agency to help support provider initiatives.

The day includes various meetings for the nurse informaticist as well, such as security and privacy, compliance, project planning, organizational strategy, vendors, quality assurance and performance improvement, and enduser education and support. The day may also include the task of gathering and analyzing data, developing educational programs on new technology or processes, and general collaboration with IT to ensure everyone is working toward the same goal.

The nurse informaticist in LTC can bring value to many areas in this setting when skills and training are utilized effectively. As a clinician, the nurse informaticist can help prepare the organization for value-based purchasing, participation in accountable care organizations (ACOs), and providing the data needed to effectively collaborate with other healthcare providers moving forward. The nurse informaticist in LTC can be a leader within the organization by assessing current workflows to identify ways technology can be effectively and efficiently employed to enable safe, cost-effective, quality patient care through identification and elimination of redundancies in workflow processes.

Educational and clinical background requirements may vary from organization to organization. In many instances, this role will be filled with someone possessing a Bachelor's degree in nursing and experience in LTC. Other organizations may require more specific training and education in IT, business management, and/or NI. Someone in this role should, at a minimum, possess a nursing degree and have a working knowledge of basic IT principles.

#### Informatics Nurse Specialist—Retail Health Setting

Susan Brown, MSN, FNP-BC, CPHIMS

- **Years in Field:** 20
- Year in Current Role: 4
- **Education:** BSN, Kent State University; MSN/FNP, Case Western Reserve University.

Imagine the amount of data generated by 20 million patient encounters over a 14-year period. Consider the implications of more than 2,500 nurse practitioners (NPs) practicing autonomously in more than 950 clinics, in greater than half the states in the country, as they complete 4 million visits each year. Clearly, there is no shortage of data; the challenge resides in translating that data into actionable information that informs and improves the practice of those NPs. What tools does a retail healthcare company leverage to accomplish such a translation?

My morning begins with a webinar, as our Clinical Decision Support team meets to review our EHR implementation strategy. We are in the process of transitioning from a proprietary electronic medical record to a patient-centric EHR from a leading vendor—a change that will elevate our ability to transform the vast amount of data entered daily from our providers into clinical and business intelligence to support our commitment to highquality, affordable, accessible care.

Successful implementation of this new EHR requires a critical review of clinical documentation, understanding of principles of clinical decision support, and the translation of evidence-based clinical standards into structured data elements that can be queried through a reporting infrastructure.

As Director of Clinical Informatics, I assume the lead role as clinical subject-matter expert for the EHR implementation project, providing support and guidance to a team of NPs and application coordinators. Through the process of discovery, design, configuration, implementation, testing, and evaluation, we build a documentation platform that is customized to the unique practice of retail healthcare. A robust reporting infrastructure promotes on-demand clinical intelligence that—with appropriate expectations and feedback—allows providers to refine and improve their care delivery.

Those expectations and feedback mechanisms are part of our organization's quality improvement strategy, which is the topic of my afternoon webinar. An interdisciplinary team of clinicians from across the country consisting of Master's- and doctorally-prepared nurses, NPs and physicians convenes to discuss clinical quality measures in our retail healthcare setting. I've asked the team to consider measures for adoption in the coming year; the suggestions of the group members reflect the evolving nature of retail clinics, and underscore the pivotal role of NI in this practice setting, as we seek to integrate clinical quality measures that have historically been the purview of bedside nursing and primary care physicians.

As was the case with our EHR implementation project, my role includes translating data into actionable information. This time I lead the team through an exploration of the findings of my data evaluation and suggest recommendations for measurement metrics, based on my knowledge of analytics and informatics. I integrate the input from field and corporate leadership with the technical capabilities of our current and future EHRs to identify the best means of supporting our strategic quality goals. Our quality measures extend beyond the community base of our retail clinics to include promoting patient-centered medical care through affiliations with major medical systems across the country.

My last call of the day is with a nurse who is the program director for a university health system in a nearby state, with whom we have a clinical affiliation. Our public-private partnership aims to address gaps in care with chronic disease patients. As we review our project plan, we discuss integration of our patient records—something that will begin with the state's HIE and expand once our EHR implementation is complete.

As nurses, we are staunch advocates for data integration, without which our providers would not be able to address the patient's gaps in care or reinforce the patient's management plan. I share a draft timeline for our collaborative project, and suggest outcome measurements for each phase. Our next step is to present our recommendations to an interdisciplinary team of clinical and technology stakeholders for approval, after which I will continue to manage the project for our retail healthcare company.

In addition to project management, my position demands several core competencies, including expert knowledge of clinical care processes; use of enabling technology to standardize and optimize care delivery; proficiency in analyzing, developing, and re-engineering complex workflows and leveraging the capabilities of electronic systems to promote improved utilization and efficiency; and uniting interdisciplinary teams and individuals to support the clinical practice of our providers. Because I do not currently manage direct reports, my ability to connect teams is particularly important in my role: I must influence stakeholders and lead teams to execute and deliver, even without formal lines of authority.

As Director of Clinical Informatics, I report to our Chief Medical Officer through our Vice President of Medical Operations; I also work closely with our Chief Nurse Practitioner Officer, Vice President of Operations, Director of Quality, and Director of Information Systems. Collaboration within our organization's senior leadership is critical to understanding the needs and priorities of the company, and removes barriers to communication—allowing me to be more efficient in my short- and long-term projects.

As is the case with other clinical leadership roles within our organization, the position of Director of Clinical Informatics mandates both educational and certification requirements: a minimum of a Master's degree in a healthcare discipline, national certification as a clinical provider (nurse practitioner, physician, or physician assistant), and national certification in information technology (CPHIMS is preferred).

The responsibilities of the clinical informaticist in a retail healthcare setting continue to develop and grow, as the lines between traditional primary care, hospital nursing, advanced nursing practice, community-based clinics, and regional medical systems dissolve. In an industry that strives to provide convenient quality healthcare while promoting coordinated care delivery, my role challenges me to integrate data and people to produce relevant clinical intelligence—a mantle I am honored to carry and hope to pass on to other nurses in the future.

# **C-Suite**

#### Chief Nursing Informatics Officer—Inpatient/Ambulatory Care Setting

Mark Sugrue, RN-BC, FHIMSS, CPHIMS

- **Years in Field:** 25 years
- **Years in Current Role:** One year
- **Education:** BS, Biology, Psychology, University of Massachusetts Boston; BSN, Nursing, Regis College; MSN candidate (May 2015).

As the Chief Nursing Informatics Officer (CNIO), my role spans both the inpatient and ambulatory environments. I am responsible for strategic and operational nursing leadership in the selection, development, deployment, re-engineering, and integration of IT to support clinicians and patient service. In this role I report directly to the Chief Nursing Officer (CNO) and am a member of the hospital administrative leadership and nursing executive teams.

As the CNIO, I believe that it is important that my role spans all practice areas and not be isolated to the inpatient or ambulatory environments. Decisions I make impact nursing practice and therefore must be, first and foremost, grounded in the institution's nursing practice model and philosophy. While some variation in nursing practice may exist between the inpatient and ambulatory environments, it is important to continually return to the core nursing professional practice model, which is the same across all environments of care.

The reporting structure of the CNIO is evolving and varies greatly from institution to institution. In a research study conducted by Sarah Collins, RN, PhD, nurse informatician at Partners HealthCare Systems and instructor in medicine at Harvard Medical School/Brigham and Women's Hospital, it was found that the partnerships across the nursing structure, medical structure, and Information Services (IS) structures are integral.\* To achieve successful outcomes, the research suggests that informatics needs to be seen as a clinical project in collaboration with IS.

According to Collins and her team, "This requires leaders who understand the clinical needs and also can see the patient safety implications, while having an appreciation for the technical complexity of the work."

In my role, for example, I have a direct reporting relationship to our CNO. Since assuming the role, I have worked hard to establish a collaborative working relationship with our IS leadership. It is my opinion that this governance structure clearly puts the emphasis for my practice and leadership on nursing and patient care, while allowing for a strong connection with our IS team.

In many ways, my day-to-day work is guided less by our governance structure and more by the framework of the American Nurses Credentialing

<sup>\*</sup> Cadet, J.V. Governance for nursing informatics: Who dictates what? *Clinical Innovation* + *Technology*. March 27, 2013. Available at www.clinical-innovation.com/topics/analytics-quality/ governance-nursing-informatics-who-dictates-what?nopaging = 1. Accessed Aug. 2018.

Center's Magnet Recognition Program<sup>®</sup>. The Magnet framework includes transformational leadership; structural empowerment; exemplary professional practice; new knowledge; innovation and improvement; and empirical outcomes. The Magnet elements of innovation and improvement and empirical outcomes, for example, are fundamental to our efforts related to the implementation of our new EHR.

This implementation has provided many opportunities for the voice of nursing to be heard and to influence system design, build, and implementation. Ambulatory nursing practice, for example, will greatly transform as we migrate from our paper-based processes to a technology-rich care delivery environment across all ambulatory practice settings. On a daily basis I am working with our teams to develop innovative and transformational approaches to care delivery that are enabled by our new technology solution. Likewise, we are continually evaluating the empirical outcomes that we can achieve. Reduction in errors, improved safety, and improved patient and staff engagement are just a few of the key performance indicators that guide our daily work and help us measure performance.

Whether working on issues related to our current environment or leading our migration toward a new EHR, I believe that the most important role I play is a leadership role. Transformational leaders combine strong academic preparation along with years of management experience and skills to develop the leadership capacity of team members by providing both support and challenges. CNIOs are typically prepared at the Master's or Doctoral level and, like myself, bring 20 or more years of applied nursing and informatics experience to the table. Transformational leaders inspire team members to embrace a shared vision and encourage the use of innovative problem-solving methods.

In conclusion, the role of the CNIO is evolving and rapidly becoming recognized as a mission-critical member of the healthcare leadership team. The CNIO role adds value by elevating the voice of nursing and informatics to the C-suite and ensuring that clinical workflows are understood and patient care delivery is optimized.

#### Chief Nursing Information Officer-Healthcare System

Patricia Mook, MSN, RN, NEA-BC

- Years in Field: 34
- **Years in Current Role:** 14 months

 Education: BSN, Nursing, University of Vermont; MSN, Nursing Administration, George Mason University; Post Graduate Certificate, Leadership, Villanova; Advanced Certified, Nursing Executive Advanced; BC, American Nurses Credentialing Center; Doctor of Business Administration, California Southern University (enrolled).

I have the privilege of being the first CNIO for Inova healthcare system. It is my job to provide visionary leadership and establish direction for a comprehensive clinical informatics and education program with a primary focus on clinical and nursing practice, administration, research, and academic partnership in support of interdisciplinary patient-driven care.

In an effort to ensure we are a high-reliability organization for patient care, I strive to provide leadership within operational informatics and educational programming to support organizational goals. I oversee and lead all aspects of staffing, including workforce planning, recruiting, performance management, career development, and compliance for the informatics and Inova Learning Network.

The Director of Informatics and Innovation, who manages 68 full-time equivalents (FTEs) who are Informatics Analysts and Senior Analysts, is one of three direct reporting leaders. The Director of the Inova Learning Network and Simulation department, which includes ten FTEs in addition to the Manager of Epic Training, with 45 FTEs, also reports up through the CNIO. I matrix report up to the Senior Vice President and CNO and the Chief Medical Information Officer (CMIO) for the Inova Health System.

This reporting structure allows for excellent communication to the nursing operations side, the medical informatics contingency, and the IT areas. The CMIO reports directly to the Chief Technology Officer (CTO) for the health system. Together we provide for an interdisciplinary team that leads strategy, development, and implementation of IT to support nursing, nursing practice, clinical applications, and clinical/operational decision-making, in addition to incorporating the operational needs that encompass and support revenue-cycle informatics for five Inova hospitals and six Alliance hospitals, in addition to more than 250 clinics. My leadership team's primary focus is to maximize the ability of nurses and their interdisciplinary colleagues to use informatics and technology in a safe, efficient, and effective way that is evidence-based and grounded in education and research.

As the CNIO at Inova Health System, it is important that I focus on continual learning and education at all levels. I have a Master's degree in Nursing Administration, am Nurse Executive Advance-Board Certified, and a build-certified analyst for our EHR. Inova requires that all chief nurse executives have a minimum of an MSN degree and an advanced nurse executive certification. It is preferred that the person holding this position has a doctoral degree, and I am presently enrolled in a Doctor of Business Administration program. My certification as an analyst gives me the ability to truly understand what is capable for the end user as we make decisions regarding the clinical documentation build.

At Inova, IT is seen as an integral part of care delivery and my vision is to build the knowledge skills and experience not only of my nurse informaticists but of each and every nurse in the use of our IT systems. This requires a unique set of competencies that we incorporate into our professional development of nurses and all end users of our EHR.

As the CNIO, I champion the professional development of clinicians to ensure that their core competencies include computer skills, informatics knowledge and skills, and risk identification knowledge. Pre-employment training is essential, but in order to keep up with the unending pace of changes we had to think quickly and initiate a unit-based expert to assist in the development of knowledge and skill in the safe use of the EHR.

At Inova, I addressed this with the development of a collaborative "Super User" program that supports end users locally in their hospitals and clinics. They champion the adoption of new workflows and technology and serve as coaches to their clinical colleagues. I serve as a cheerleader to the ongoing education and certification of many of these Super Users by advocating for 50 nursing analysts to attend local training to support certification in an effort to improve competencies.

I see my role as CNIO as one that creates a climate that promotes staff engagement, and I hope to inspire nurses to adopt innovation as they think about their work at the side of a patient. All this is being considered in order to impact the overall outcomes of those whom we are privileged to serve every time and with every touch of our patients.

With the most recent operational informatics infrastructure that has been developed, we strive to be intermediaries between the clinicians and the technical build teams. Under my strategic direction, the informatics department coordinates interdisciplinary clinical input with design, testing, implementation, and evaluation of our applications. We support the development of clinical protocols to ensure that required changes are made to clinical documentation and order sets. Another area of engagement is focused on what is needed to meet Meaningful Use requirements, as they change at an astronomical speed.

I work collaboratively with the CMIO and the VP of Enterprise Applications to design and redesign the EHR as we follow our guiding principles. Our goal is to provide standardization and get to a OneInova process. My job is to persistently advocate for nursing practice and clinical documentation to be on an agreed-upon standard and to insist upon following best practice as it is defined by the organization. The design of nursing clinical documentation falls under the direction of the CNIO and the provider design team falls under the direction of the CMIO, with informatics team members ensuring that the OneInova goal is kept in sight at all times.

I also provide strategic direction to the Inova Learning Network (ILN) and the Epic training team. Our vision as an organization is to use more simulation and assist with outreach training. By strategizing with the System CNO, the Director of the Medical Residency Program, and the Director of the ILN and Simulation we are driving the development of a state-of-the-art Simulation Center where we will use innovative ways to accomplish scenario-based interdisciplinary teaching/learning.

I see my work culminating in the advocacy for superior patient outcomes, which often depend on the engagement of clinical end users in the design of our applications, while providing an atmosphere for research that will foster evidence-based care and best practice. This is supported through the IT Research Council, which has developed under my direction.

I see my position as a valuable asset to the organization at a time when change is moving at warp speed. I was recruited into this position because of my clinical and operational background. The goal was to lead the change from a very fragmented multiplatform EHR to one integrated system for five hospitals and close to 200 ambulatory sites. This endeavor needed to transition in less than two years. We were able to successfully build out the clinical documentation for all required areas. I lead the validation sessions, design teams, and all clinical build through testing and the implementation of the product.

The measurement of success has been determined by our successful completion of Stage 1 Meaningful Use, the improvement of Core Measure indicators, a decrease in mortality, and improvements in multiple true-north goals for the organization. As exemplified with this EHR implementation, as the CNIO, my value is measured by how I drive innovation, through interdisciplinary collaboration and support of end-user professional development in the areas of informatics, with the ultimate goal of optimal outcomes always in sight.

#### Consulting

#### Nursing Informatics Consultant—Software Company

Patricia Foley Daly, DNP, RN-BC

- **Years in the Field:** 25
- Years in Current Role: 4
- **Education:** DNP, University of Kansas.

A consultant is defined by the *Merriam-Webster Dictionary* as "one who gives professional advice or service." Typically, the NI consultant is someone outside the organization who is hired, as an expert, to address a specific need. The consultant is usually employed by a larger organization such as a software supplier or consulting organization. In the field of nursing informatics, consultants possess expertise in a wide variety of areas— EHR selection, clinical transformation, solution implementation, quality improvement, benefits realization, and workflow redesign, among them. A consultant will address any issues or needs for which the organization has hired them.

For a consultant in a software supplier organization, the NI roles are varied as well. For the purposes of this book, the consultant role discussed here will be the one responsible for implementation of the EHR. This role is often described as a clinical strategist. The clinical strategist is engaged in the implementation of all clinical software solutions. Many other roles are engaged in the project as well. The clinical strategist is responsible for working with nurse executives and other key nursing personnel to ensure a successful project.

The first activity the clinical strategist is involved in during an implementation is to understand the clinical objectives to be realized in the future state. This is important in the definition of the benefits to be realized postimplementation. As part of this process, the current-state baseline will be documented. The clinical strategist assists the organization in these activities.

The next activity is the current-state review in which the current clinical processes are reviewed for comparison with future state. This involves discussions with all clinical areas to understand their current processes. Data is collected via interviews, observations, and collection of current materials used for documentation. Clinicians are observed delivering care to validate the data obtained during the interviews. The clinical strategist leads these data-gathering activities. He or she is responsible for ensuring all processes are documented and all clinical areas represented. Often, he or she serves as a "translator" for the non-clinical members of the implementation team.

The next step in the implementation process is the design and build of the system. This is based on the future state and scope of the project. The scope is typically defined during the early planning phases of the implementation. During the design and build phase of the project, the clinical strategist works with the nursing team to ensure they understand the design and validate the build. The clinical strategist makes changes to the system build as necessary based on client feedback. This is an iterative process. Once the build is complete, testing begins. The clinical strategist assists the client in the development of test scripts. There are usually various levels of testing—unit and integration testing. During the testing phase, the clinical strategist assists the client as their staff work through the test scripts.

Throughout all these phases, the clinical strategist provides feedback and guidance to the nursing executive team on the progress of the project. The final activity prior to conversion to the new system is training. Although this is typically the client's responsibility, many activities must occur prior to training to ensure its success. The clinical strategist is responsible for training the subject matter experts who will then perform the training for end users. He or she is also responsible for assisting the nursing project team in the training planning.

Training is a significant event that is logistically challenging and must be planned for many months in advance. Conversion requires the support of the entire team. The clinical strategist plays a significant support role for the client team in their support of the nurses and other clinicians. The clinical strategist also assists in staffing the central area where the project team resides, fielding issues and dispatching resources as needed throughout the organization.

After conversion, the clinical strategist performs the post-conversion assessment. This again involves interviews and observations of the clinical processes that were automated. The benefits expected are measured or compared to the pre-implementation levels. This data is shared with the nursing leadership.

The clinical strategist is a key member of the team and integral to the activities described above. He or she understands the current state and clinical processes of the organization. In addition, he or she understands the new system/software being installed. So, he or she plays a key role in
assisting the staff to understand the new workflows and integrating the software into the organization to meet their goals.

Furthermore, the clinical strategist serves as a liaison to the nursing executive team throughout the project. This role is pivotal to the success of the implementation. This is just one example of the important roles nurse informaticists play in the consulting realm.

The clinical strategist is a member of the larger implementation client team. He or she is also a member of the clinical strategist consulting team at their software organization. The reporting structure of this team is very similar to the clinical reporting structure in a hospital. These individuals are predominantly nurses who report up to a nurse manager and, ultimately, a nurse executive. The strategist is the individual who works directly with clinicians at the client sites. So, the role is comparable to the bedside nurse in the hospital. From an education perspective, they are Bachelor-prepared nurses at a minimum. Some have advanced degrees in informatics as well. Certification is preferred but not typically a requirement. The software supplier I work for sponsors certification courses that are open to all nurses in the organization. Advanced degrees and certification denote an individual's desire to advance his or her learning and expertise in the informatics realm.

#### Nursing Informatics Consultant—Consulting Company

Lisa Anne Bove, DNP, RN-BC

- **Years in the Field:** 20
- **Years in Current Role:** 15
- Education: DNP, Nursing Informatics, Duke University; Post-Master's, Nursing Admin., Villanova University; MSN, Critical Care Nurse Specialist; BSN, Registered Nursing/Registered Nurse, Widener University.

I start my work week with an early Monday morning plane ride to my client. In my carry-on bag, I have everything I need for the week—sneakers, work clothes, toiletries, and something comfortable to wear after work hours. In my briefcase, I have everything I need in an office—computer, smartphone, power cords, paper clips, sticky notes, pens, hand sanitizer, and headphones. In my head, I have experience implementing clinical systems, workflow redesign, and system optimization. I will return home again on Thursday night or Friday. I am a healthcare informatics consultant. While travel can be tedious at times, my weekly commute is often shorter than that of many of my peers. In addition, I frequently get to work from home on Fridays and during major holiday weeks like Thanksgiving or Fourth of July. Many ask why anyone would do this, and the answer is the work. As an informaticist, I help my clients implement EHRs and redesign work process impacted by technology.

As a consultant, I bring outside experience and a neutral view to complicated changes in an organization. I partner with experts within the organization and help them get their voices heard. I often deliver the difficult messages without the same risks as an employee who has to continue to work within the organization whether the project succeeds or not. My dayto-day work varies with each project. I have implemented clinical systems, developed return-on-investment and cost-of-ownership scenarios, led teams to design best-practice future state of systems to meet regulatory requirements, as well as developed training plans for entire hospital systems rollout, strategic plans of IT departments, and hospital acquisitions. Each project can be like a new job!

Consultants can bring value in several ways. The first is that consultants are experienced with leading multiple projects. They may have done the same project at multiple client sites or with multiple vendor solutions and have seen a variety of ways to do the project. In this way, they can share the experiences and help the client choose the solution most likely to succeed in their environment. The second is that consultants go where the work is and are temporary.

For example, when an organization implements a new EHR, they need numerous team members—more than they will need to support the software after it is in use. Consultants can supplement staff and usually do not require additional education on the vendor's software but can instead "hit the ground running."

My reporting structure changes from project to project. Within the company, I report to a director who leads the group methodology and helps consultants find positions to fit their skills. On the project, consultants can report at almost any level. Often consultants follow the same reporting structure that other employees do. Analysts often report to managers in finance, IT, and/or a clinical department. Project managers tend to report to managers in IT. Advisory consultants tend to report to C-level executives.

The educational requirements for a consultant are similar to those for hospital employees, although more is better when it comes to certifications and education. For clinicians who are functioning in consulting roles, a Master's degree is helpful, but not required, as most clients see education as a credential demonstrating experience and skill.

Certification in a specialty like nursing informatics by the American Nurses Credentialing Center (ANCC) and/or a vendor product is also helpful to increase the possible opportunities. In addition, I am frequently asked if I have Project Management Professional (PMP) certification, as this is a standard in the industry for project and program managers, a role I frequently fill. While none of these certifications or advanced degrees guarantees a higher salary in consulting, they can help.

The key skills that consultants need are similar to those needed by nurses—change management, facilitation, communication, documentation, and experience working in complex healthcare organizations. When I first start a project, I work to learn about the organization's culture and how decisions are made. I get to know all the stakeholders—the people on or interested in the project. During this phase, I also work to learn the goals of the project, what the organization expects to gain from the project, and what, if anything, could happen if the project fails.

My next step is to plan how the team and I will accomplish the work. Sometimes the planning is the primary work and sometimes I actually get to help carry out the plan. One of the things that I try to bring to each project are lessons learned from previous projects, articles, and/or experts in the field. It's hard to see the same issues played out over and over again with various clients. While every organization is different, communication and clear, concise decision-making are issues at many client organizations. Showing examples of how to present data in ways to support decisionmaking or communication, such as dashboards, communication matrixes, or executive status reports, can help. Facilitating meetings with experts from other organizations so they can share best practices or brainstorm possible solutions is also helpful. Informatics can help improve patient care by presenting patient information to all caregivers, aggregating findings across patients, and reducing redundancies in care.

Because I am a consultant, as the project draws to a close, so does my time at the client site. Sometimes, I am ready to leave if I feel my work is done. Sometimes, moving on is hard, especially if there is a lot of work still to be done. Hopefully, before I leave, I have transitioned the skills and tasks needed to continue to move data along the continuum to knowledge and eventually wisdom. As I pack my bags to head to another client, I add the new information and lessons learned to my bag of tools.

### **Government and Policy**

#### **Policy Analyst**

Darryl W. Roberts, PhD, MS, RN

- **Years in the Field:** 25
- Years in Current Role: 2
- Education: PhD, Public Policy, University of Maryland, Baltimore County; MS, Nursing Informatics/Public Policy, University of Maryland, Baltimore; Graduate Certificate, Public Policy, University of Maryland, Baltimore County; BSN, Nursing, University of Maryland School of Nursing; ASN, Nursing, Essex Community College; LPN, Practical Nursing, Johnston School for Practical Nursing.

Health IT is an incredible field. It offers the perfect combination of tension between what clinicians want to see happen and what technology is capable of making happen. Tension breeds dissatisfaction; dissatisfaction breeds innovation; and innovation temporarily satisfies. It's wonderful. Think about it—nurses, physicians, pharmacists, and so many others seek efficiency, better processes, and easier and less socially invasive ways to get work done. Everyone wants better patient outcomes, reasonable reimbursements for good work, and strong incentives for excellent work. Underneath it all, many want the coolest gadget, too. Health IT vendors are willing to provide solutions to satisfy everyone. All purchasers need to do is find a way to pay the prices, which can range from very reasonable to incredibly expensive.

Attenuating and facilitating all of these interactions at a micro level are the individual actors: clinicians, vendors, payers, and—increasingly—patients. At the macro level, wonks come out to play. I am a wonk.

"What is a 'wonk'?" you ask. Wonks are the people who have an in-depth knowledge of the interactions around a certain aspect of public policy. They know the people in that arena. They attend the meetings, review the papers, write reviews, and respond to opportunities for public comments on federal rules and regulations, among myriad other things. My particular areas of wonkiness are healthcare quality and health IT. Some of us are physicians, economists, and political scientists. I am a registered nurse (RN). You don't necessarily need a higher education to be a wonk, but it does help. A considerable number of people in this area of expertise have graduate degrees and professional degrees; many are doctorally prepared.

What I learned over the past 25 years is that healthcare, healthcare research, and health IT are not about physicians, nurses, or even the all-knowing government. They are really about the patient. Yes, it sounds trite. I apologize for that, but it is actually, finally, true.

Organizations like the Agency for Healthcare Research and Quality (AHRQ) and the Patient Centered Outcomes Research Institute (PCORI) have forced those of us who depend on contract funding for our livelihoods to include the patient's voice in our planning, implementation, and evaluation designs. It makes perfect sense, but it is a reach for many in my generation of clinicians and researchers. We were trained to ask patients questions and attempt to meet their needs, but we were never trained to give them control. Today, many are taking charge of their own care. Technology has made that happen.

I got the basis of my health IT, quality, and public policy knowledge from school, but I learned so much more by doing the work and working with others in the field. Meeting experts—whether they are subject-matter experts in a certain field or patients and patient advocates—and socializing with them is a huge part of learning and working in these fields.

Jobs like informatics, policy analysis and policy advocacy require presence. I learn so much from conferences, like the Annual HIMSS Conference and Exhibition and the American Medical Informatics Association's Annual Symposium, and from meetings like the ONC's Health IT Policy Committee (HITPC) and the Bipartisan Policy Center's Learning Health System Committees. Attendees and presenters at these meetings are there to share and learn how to make the systems around us better for patients and clinicians alike.

Over the past few years, a considerable part of my work has been in public policy as it relates to health IT and healthcare quality. Many reading this might not think of this as NI. Nursing informatics is the confluence of cognitive science, information science, and computer science applied through the lens of nursing science. It focuses on how nurses use, implement, manage, and maintain information systems within a healthcare setting.\* Public policy sets the boundaries and standards for health IT and informatics. When I worked for the American Nurses Association (ANA), I kept track of changes in policy

<sup>\*</sup> Turley, J.P. Toward a model for nursing informatics. *IMAGE: The Journal of Nursing Scholarship* 1996;28(4):309–313.

that might affect nurses and patient care. In my new role, I write the quality measures that the government uses to assess the quality of care and I conduct research around the effectiveness of that care. This is nursing informatics.

### A Day in the Life

My charge in writing this essay is to discuss a day in the life of a policy analyst and advocate for the ANA. In this role, I review, respond to, and inform public policy that resides in the confluence of health IT and healthcare quality. Additionally, I advise ANA's leadership on methods of maximizing existing policy and recommend future policy improvement. In addition to my full-time work, I am an adjunct professor at the University of Baltimore's Health Services Management Program, where I teach undergraduate and graduate non-clinicians the essential roles and tools for managing healthcare systems. I also teach adjunct at the Stevenson University Graduate and Professional School, where I impart quality management to nurses. These roles require me to remain at the cutting edge of knowledge.

### Today Is a Tuesday in January

The day starts simple and ordinary. My iPhone awakens me at 5:30 a.m. and gives me immediate access to the *Commonwealth Fund e-Alert*, *Modern Healthcare A.M.*, and *Becker's Hospital CIO Report* feeds. At a glance, they tell me about the latest events in the world of health IT. Paging through them alerts me to a new *Commonwealth* blog post on Insurance Marketplaces that Promote Quality Improvement (http://bit.ly/1lqvGNd), which concludes that we have a long way to go. *Modern Healthcare* tells me that there is hope for relief from the "two-midnights" rule for hospitals (http://bit.ly/1ojSMj9) but concludes that hospitals could benefit from coaching on how to code better to maximize reimbursements. *Becker's* reports that patients want to be able to use their portals to schedule appointments online, view lab and test results, view bills or make payments, check prescriptions or refills, and send email to staff (http://goo.gl/g8RnOu). This one will be useful at today's HITPC meeting.

The train ride from my apartment in Southwest Washington, DC to my office in Silver Spring is usually a period of intermittent cellular connectivity, which I capitalize on to catch up on email without interruptions by phone calls or text messages. Today proved no different. Emails about new projects intermingled with the agenda for today's HITPC meeting and some ANA talking points. Mostly, my boss reminds me to respond to policymakers with remarks considerate of patients' needs and remain mindful of a nursing workload that prevents them from meeting those needs.

Another thing I like to remind policymakers to do is remain provider neutral. Nearly one-third of Medicare beneficiaries will receive care from an advance practice registered nurse (APRN; e.g., nurse practitioner or clinical nurse specialist) in any given year, so ONC and CMS ought to keep that in mind when making rules and regulations from laws that permit care from eligible professionals. These include APRNs and physician's assistants, among others. While APRNs might not legally benefit from the Medicare quality incentive programs, there is no reason to write them out of the rules and regulations set by ONC.

An overheard conversation on the train pertained to getting a "doctor that takes Obamacare insurance." I don't interject. I just listen. Everything is knowledge that might inform today's or tomorrow's conversations. A good wonk knows how to remain purple, which is neither red nor blue, but independent. The Affordable Care Act and all other laws, regulations, and other policies related to healthcare are things that I need to know and understand, particularly as they pertain to implementation, maintenance, or evaluation. These policies affect patients, clinicians, payers, vendors, and the government. Whether they affect me is immaterial. My job is to use my skills and knowledge to inform the policies and learn from those who develop and implement them. When working for ANA, my lens is patient outcomes and nursing inputs. Remaining independent allows me to do my job effectively and in an unbiased way. I arrive at ANA headquarters by 7:30 a.m.

My desk is tidy in a violent sort of way. Things are in piles a week old. I usually straighten and start anew on Monday. I'm so glad it is not Monday. I am going to need this weekend. Among the piles, I see a brief I prepared on the implementation of ONC's BlueButton and Direct initiatives. The review for the two-page brief included a thorough read of the Department of Veterans Affairs (VA) website on the topic, ONC's Standards & Interoperability Framework wiki, Buzz Blogs, the BlueButton+ style sheets, as well as reading analyses by HIMSS and *Becker's*, among others. It's interesting that association leadership—for that matter, all leaders—expect that a person can summarize hundreds of pages of regulation, analysis, and opinion into two pages. I did my level best. I spend five minutes chatting with my close colleague Maureen Dailey, RN, PhD, CWOCN. She is a Senior Policy Fellow, a noted expert on quality nursing care, and the reason I schlepped into the office before the meeting. She reminds me of a few important considerations before I leave.

I arrive in time to meet the (then) new National Coordinator, Dr. Karen DeSalvo, before the meeting starts. Ensuring that you get in front of public officials frequently, so that they know your name and whom you represent, is an important part of getting work done in this city. We engage in some polite conversation about her impending meeting with ANA's leadership. She seems excited—that's great news! She leaves me to take her seat at the head of the table for the first time. After the call to order, the Chair, Dr. Paul Tang, introduces her as co-Chair. She makes some eloquent opening remarks, which includes her goals for the committee and the ONC.

After this, multitasking becomes the order of the day. While monitoring the meeting, I am still responsible for reviewing the latest update from the University of Kansas School of Nursing report on the development of the pressure ulcer electronic quality measure (eMeasure). This is the first eMeasure developed for the National Database of Nursing Quality Indicators (NDNQIs). It might also be the first eMeasure currently implemented. Great people, like Drs. Nancy Dunton and Rosemary Kennedy, are developing and testing this incidence measure. So far, they have it implemented in two EHRs. The report and my reply with recommendations share time with the presenters' updates from CMS on EHR certification and Meaningful Use (MU) criteria. Robert Anthony of CMS mentions Direct addresses, which are essential for MU Stage 2 success. For MU Stage 2, providers must give patients a mechanism through which to view, download, and transmit (VDT) their health data in a secure way. This gains my full attention. Later, Drs. Tang and George Hripcsak update the committee on the work of the MU Workgroup. This, too, mentions VDT. I listen to this and take notes. I had not planned to make public comments, but today will be a good day to do that.

I have been tracking this committee, the Standards Committee, and the news from vendors regarding VDT for some time now. At this point, it is a great but fledgling idea. After the ONC Standards update comes the first opportunity for public comments. I stay silent. My ideas have not quite come together. I'll make my comments at the day's end. I spot an empty outlet, so I can charge my nearly dead laptop while I have lunch with colleagues. We have sandwiches while discussing VDT and standards. This is a great time to network, but I have to run back early to make an appointment to meet with Dr. Dailey at ANA headquarters after the meeting. Maureen and I will plan tomorrow's meetings with the ANA leadership team to update them on the eMeasure. It's 1:00 p.m. and the HITPC starts exactly on time.

The committee discusses privacy and security issues, including patient interactions. Kimberly Lynch presents an update on the work of the Regional Extension Centers, which give physicians and other eligible providers access to resources to achieve MU and obtain certified EHR technologies.

Finally, Michelle Consolazio, who keeps the meetings on track, calls for public comments. She gives commenters three minutes. I stand, walk to the table, and sit before the microphone looking directly at Dr. DeSalvo to make my comments on Direct addresses. You can find the transcript and audio at http://healthit.gov/facas/calendar/2014/01/14/hit-policy-committee.

No one responds. The committee never responds directly to the public. I leave the table and retake my seat. It is now 3:00 p.m. I spend a few moments chatting with colleagues, make my way to the front to reiterate my comments to Dr. DeSalvo, shake her hand, and leave for the train again. Very few people are on it, so I spend the time starting my meeting report to the leadership. I arrive at ANA headquarters again at 3:45 p.m.

It is such a pleasure to meet with Maureen. She is a knowledgeable nurse with the heart and soul of a New Yorker. Meetings are all business, until they are not. In either case, they move at a considerable pace. We chat a few minutes about our days and then tear into the eMeasure report. Things are going very well, which makes for a nice leadership report. After preparing a one-pager, we decide that we ought to write something about the eMeasure for the *American Nurse*, a monthly journal published by ANA. We plan to meet to discuss it later in the week. It's 5:30 p.m. and time to go home.

Update: Since I wrote this 'Day in the Life' entry, I left ANA to become a Senior Social Scientist for Econometrica, Inc., a federal contractor based in Bethesda, Maryland. The company implements, manages, and evaluates public policy instruments, including quality measures and health IT standards. The roles, while functionally different, are quite similar. In my current role, I implement and evaluate the effectiveness of policy as it affects clinicians and patients but make no advocacy-based recommendations for policy. Essentially, these are just two different lenses focusing on the same outcomes: improvements in the processes and outcomes of healthcare. By the way, I heard that ONC might be postponing some of the VDT aspects of MU. They are also discussing how to simplify Direct addresses. I am not sure whether my comments affected that, but I think they might have contributed in some way.

#### Former Deputy National Coordinator, Office of the National Coordinator for Health IT

Judy Murphy, RN, FACMI, FHIMSS, FAAN\*

- **Years in Field:** 30
- Years in Current Role: 1
- **Education:** BSN, Nursing, Alverno College.

As Deputy National Coordinator for Programs and Policy at ONC, in the U.S. Department of Health & Human Services (HHS) in Washington, DC, I led federal efforts to assist healthcare providers in adopting health IT to improve care and promote consumers' greater understanding and use of health IT for their own health. I was responsible for coordinating all of the HITECH (Health Information Technology for Economic and Clinical Health) programs, part of the American Recovery and Reinvestment Act of 2009 (ARRA). These included:

- Regional Extension Center (REC) program
- State Health Information Exchange (HIE) program
- Beacon Community program
- Consumer eHealth program
- Workforce Development program
- EHR Certification program.

Later, as Chief Nursing Officer at ONC, my federal role changed and I was responsible for coordinating all health IT-enabled quality policy and standards, integrating standardized clinical decision support into clinical practice, and improving the safety of health IT. In my contribution here, I will highlight some of my experiences in both of those roles.

Internally, as with many leadership positions, I spent time managing staff and projects, and ensuring that there was harmony and consistency between the various teams and programs. I put in place project tracking and monitoring tools in order to define and measure deliverables, as well as ensure alignment with ONC and HHS strategic plans and annual goals. I built bridges between ONC's sometimes conflicting priorities for developing new

<sup>\*</sup> Ms. Murphy is currently Chief Nursing Officer and Director, Global Business Services at IBM Healthcare.

policies and executing on existing programs. The Meaningful Use Program is an example of a policy-driven initiative in which regulations are written governing the activities of the program. There is a very specific cadence for rule-making, with notification of proposed rules and public comment periods resulting in the publication of a final rule. In other cases, the ONC might convene stakeholders or coordinate activities, but let the industry take the lead making the necessary changes without regulation. It was always both a balancing act and a judgment call to determine when and where the government should intervene by setting policy versus letting the market drive the changes.

Externally, I coordinated ONC's work to "get down into the weeds" with EHR suppliers and healthcare providers, thus making it possible for citizens to benefit quickly from the incentive structures put into place under the HITECH Act. This often involved meetings with vendors, provider organizations, and industry and specialty organizations like the American Hospital Association (AHA), American Nurses Association (ANA), American Medical Association (AMA), American Academy of Family Physicians (AAFP), or American Association of Retired Persons (AARP). This outreach also often included presentations at meetings or conferences describing ONC's work, progress in the Meaningful Use program, and movement on achieving strategic goals. I also worked closely with ONC's federal advisory committees and the Health IT Policy and Standards Committees to ensure the policy, regulatory, and non-regulatory vision for advancing the benefits of using health IT became a reality.

As with many organizations, the ONC needed to have our "feet on the ground and our eye on the prize"—essentially balancing current operational tasks with future planning and goals. Something I brought to the table here was my unique breadth and depth of health IT implementation experience over the previous 25 years. I had been in the trenches with my feet planted firmly on the ground and I understood the many facets of EHR work, including vendor issues and clinical users' concerns. Additionally, I was responsible for the HITECH efforts at Aurora Health Care, where I helped shepherd half of their hospitals and eligible providers to achieve MU and receive EHR incentive payments in 2011. This helped my role at the ONC immensely and gave me credibility both internally with staff and externally with stakeholders. I used my experience and nursing skills every single day in interpreting requirements and evaluating how EHRs are and should be used.

As a nurse, I know what it's like to be on the frontlines of patient care, whether in a physician's office, hospital, long-term care facility, rehabilitation clinic, or patient's home. I know what it's like not to have care continuity across the continuum or not to have the information you need at each transition of care. EHRs are installed in many of our healthcare venues; now the challenge at the national level is interoperability of those EHRs and getting health information exchanged between them in order to provide patient-centric care. Who better than a nurse to help coordinate the national foundation for health IT at ONC in order to build a 21st-century healthcare system?



## Chapter 7

## Tips and Advice for Obtaining Your First Nursing Informatics Job

### Patricia P. Sengstack

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Nursing informatics is a growing and evolving specialty whose expertise is increasingly in demand. In February of 2018 there were 4,568 informatics jobs advertised on the American Nursing Informatics Association website (ANIA, 2018), 1,426 posted on the job-search website Indeed (Indeed, 2018), 251 on Glassdoor (Glasssdoor, 2018), and 131 on Career Builder (Career Builder, 2018). As organizations continue to implement and optimize electronic health records (EHRs) and embrace advances in technology, informatics nurses will be needed to ensure effective system design and clinician support. Yet, nurses interested in working in the area of informatics, or who have completed an informatics graduate program, are oftentimes challenged with landing their first position in the field. Every journey needs a beginning and that first position in the field is just a starting point for what can be a very rewarding and fulfilling experience. Whether you are a clinician interested in transitioning into an informatics role or someone who has just graduated from an informatics program, it can be difficult getting into that first job to start your journey. This chapter will provide tips and advice for nurses who are pursuing that first informatics job. It will cover some of the challenges often seen with "getting your foot in the door" and provide advice on how to leverage what you already know. It is hoped that following this advice will lead to a call for an interview and a well-negotiated job offer.

### **Leveraging Past Experience**

Getting into the field of informatics does not always require that you possess formal experience in the field. Organizations and vendors are looking for nurses with experience in healthcare delivery and patient care. They are looking for nurses who have used technology as part of their daily work. Healthcare today requires that nurses interact with multiple technologies such as the EHR, vital sign devices, IV pumps, glucometers, electronic beds, and telemetry monitors, to name just a few. Having an understanding of how nurses and other clinicians interact with various technologies is the core of what hiring organizations require. The opinion that you must have at least one EHR implementation under your belt is no longer valid. With most hospitals and providers already possessing EHRs, this can no longer be a foundational requirement for employment in the field.

To begin, start to categorize your experience with technology in your current and past positions. List the various devices and software platforms that you've become familiar with. Also, list whether or not you were involved in helping to identify any improvements to those technologies. Chances are that at some point you brought an issue to a manager to make a positive change to a device or software program. Even better, list any projects you may have been involved in that addressed the use of some type of technology in your department. Your contributions as a project member helped serve to ensure that the end user's voice was included in any improvement efforts and certainly counts as experience. Saying, "I only have clinical experience" needs to transition to, "I have a significant amount of experience in the use of technology" and "Let me tell you about it."

### **Initial Advice**

While not having formal informatics experience does not preclude nurses from obtaining a job in the field, some formal informatics experience does help. Additionally, it helps to understand the body of knowledge unique to informatics practice obtained in an accredited graduate informatics program. With the American Nurses Association (ANA) recognizing nursing informatics as a nursing specialty—with an evidence-based foundation of knowledge and published standards—it is attractive to potential employers to see that degree on a resume. A degree in informatics indicates to a potential employer that you are serious about your professional career and that you have the drive and passion to complete a rigorous graduate program. Schools of nursing offering a Master's program or a Post-Master's program in informatics are on the rise. To see a list of the best nursing informatics programs, including those available online, see the U.S.News website:

https://www.usnews.com/best-graduate-schools/top-nursing-schools/ nursing-informatics-rankings.

If you are a recent graduate from an informatics program, another way to advance your knowledge and impress potential employers is to become certified in nursing informatics through the ANA's American Nurses Credentialing Center (ANCC). Mentioned in Chapter 1, board certification in nursing informatics has been offered by the ANCC since 1995. The requirements to sit for the exam include (ANCC, 2017):

- Holding a current, active RN license in a State or territory of the United States or holding the professional, legally recognized equivalent in another country.
- Holding a Bachelor's or higher degree in nursing or a Bachelor's degree in a relevant field.
- Having practiced the equivalent of two years full-time as a registered nurse.
- Having completed 30 hours of continuing education in informatics nursing within the last three years.

And meeting one of the following practice hour requirements:

- Having practiced a minimum of 2,000 hours in informatics nursing within the last three years.
- Having practiced a minimum of 1,000 hours in informatics nursing in the last three years and completed a minimum of 12 semester hours of academic credit in informatics courses that are part of a graduate-level informatics nursing program.
- Having completed a graduate program in informatics nursing containing a minimum of 200 hours of faculty-supervised practicum in informatics nursing.

Either a graduate degree or ANCC board certification (or both) sets you apart as a serious candidate and can increase your chances of getting that initial interview. While employers are looking for some experience, they also want to see the commitment, passion, and drive of a potential employee.

### Take a Self-Assessment

Because there are so many varied opportunities in the field of informatics, it's important to do some thinking about where you want to start your job search. Ask yourself some of the following questions:

- Where do I want to work?
  - acute care or hospital-based
  - ambulatory care
  - skilled nursing facility/long-term care
  - academia
  - research.
- Is there a particular area of focus where I have interest?
  - EHR optimization
  - medical device integration with the EHR
  - improving continuity of care across the care continuum
  - population health
  - data analytics
  - health information technology policy
  - health information technology security and privacy.

- Is there a role within the vendor community that might interest me?
  - designer
  - builder
  - customer relations
  - sales team.
- Would I mind traveling for work? What percent of time?

Self-reflection using these types of questions helps to narrow the job search and provide focus to your resume. They provide a starting point for your search and help identify whom you might talk to. With thousands of potential jobs available, you will need to spend some time thinking about what you want to do as a nurse informaticist. Maybe even shadow someone in the role to get an idea of what it entails. Reach out to someone in a role you are contemplating and interview them. Discover where you have passion. You'll be spending a lot of time doing it so make sure it's something you think is fun!

### **Develop a Strong Resume**

There always seems to be confusion around whether to prepare a resume or a curriculum vitae (CV). There are essentially three differences: the length, the purpose, and the layout. A resume is a brief summary of your skills and experience over one or two pages, while a CV is more detailed and can stretch well beyond two pages. The purpose of the resume is to highlight your work experiences, and should be tailored to the specific job for which you are applying. The CV does not really change in content. Any areas not highlighted in the body of the CV can be mentioned in a cover letter. The layout of a CV is typically reverse chronological order that lists your work over an entire career. It is often used for academic positions. A resume is more flexible and information can be moved around based on the employer's specific requirements. In short, the CV is intended to represent the candidate's entire career while a resume is a concise and focused list of experience, skills, and achievements (University of North Carolina, 2018). Understanding these differences it is most likely that you will be preparing a resume that reflects your work.

In developing a resume, start with a template. There are multiple templates available online. A template will help with organizing your thoughts in a way that is consistent and standardized. A typical resume has the following sections (ANA, 2018):

- Name—Put your contact information at the top.
- Experience—List each position held in reverse chronological order (most-recent first).
  - Provide the organization name, your title, and the dates worked. For each position held include a description for each job that includes any exposure to use of technology.
  - Keep it short—bullet points can be used to list out your experience for each position held. Here is where you can tailor and highlight the work that is pertinent for the particular job you are seeking. If the position you are applying for is a clinical analyst position, include any exposure you've had in improvement efforts related to the EHR or other system/device. Use the employer's job description to help guide the information you provide in this section.
  - Use action verbs to describe your work experience and clearly articulate any outcomes you and/or your team have achieved as a result of your work. Use Bloom's Taxonomy for examples of action verbs (Bloom's Taxonomy of Action Verbs, n.d.).
  - Include projects you were involved in from your informatics graduate program—they count.
  - Include any awards you've received.
- Education—List each school attended in reverse chronological order.
  - List the university, the location, the year graduated, and the degree obtained.
- Skills—List any skills you possess in relation to the use of technology. It could be something like:
  - "proficient in Microsoft Word, PowerPoint, Excel, Outlook".
  - "proficient in use of..." (list EHR you use every day, and/or other systems or devices).
  - "familiar with..." (list any technologies you know well, but with which you may not be an "expert").
- Presentations—List any podium, panel, or poster presentations. Include:
  - The name of the conference.
  - Conference sponsor.
  - Location.
  - Title of your presentation.
  - Presentation date.

If you do not have any presentations, leave this section out of your resume.

- Publications—List any articles, books, book chapters, evidence-based guidelines that you have published. Include:
  - the title of your publication.
  - the journal or other location where it is published.
  - the date of publication.

If you do not have any publications, leave this section out of your resume.

- Licensure—Include the State in which you are licensed to practice and the date it became effective.
- Certifications—Include any certifications you have along with the date you became certified. If you do not have any certifications, leave this section out of your resume. For example:

- Board Certified in Nursing Informatics (ANCC). Dec. 2010-present.

- Professional organizations—List any professional organizations you belong to and include the date you joined. If you've had any involvement with that organization you can also describe it here. For example:
  - Healthcare Information and Management Systems Society, May 2015–present.
    - volunteered at HIMSS annual conference, assisting with poster presentation logistics (2017).
  - American Nursing Informatics Association, June 2016-present.
    - active member of ANIA's social media work group.

## **Begin Where You Are**

Breaking into the field of informatics can truly be a challenge. One recommended way is to ease into it where you currently work. Take advantage of your organization's "superuser" program, if it exists. Ensure that you are your department's superuser and the "go-to" resource for EHR issues. Superusers typically receive additional training with routine updates as improvements are made to the system. Take the superuser role to the next level to benefit your peers, and work with your organization's informatics team to conduct in-services related to EHR updates, tips, and efficiencies. Create tip sheets that end users can refer to for some of the more challenging system issues. The more you are seen as an informatics resource the better. Serving in a superuser role provides experience, increases your understanding of the system, and gives you more to highlight on your resume.

Partnering with your organization's informatics team is also a strategy to increase your visibility as an informatics resource where you work. Volunteer to serve on your organization's EHR end user committee or nurse documentation workgroup. Any opportunity to provide input to design teams that are building and improving the EHR will further elevate your level of experience. Your ongoing involvement and exposure to informatics work makes your organization see you as someone that could add value in an informatics role. Whether they are formally hiring or not should not dissuade you from getting involved. It is not an unusual situation for organizations to create new informatics roles based on the value they believe you can add. Persevere—and ask—when you think the time is right.

Beginning your career in an organization you are familiar with has several benefits. You know the people, and you know who to ask what you think are "dumb" questions without feeling intimidated. You have established relationships with numerous people in many departments. You know the physical layout and where every department is located. You know the culture and understand why some things can't be done a certain way (because "that's not how we do it here"). Transitioning into an informatics role for the first time can be anxiety producing. Beginning your journey in a familiar place allows you to focus on learning the new language of informatics and technology without the need also to learn a new organization.

### Join a Professional Organization

There are several professional organizations that provide local, regional, national, and global perspectives on the informatics industry. Some provide focus specifically on nursing informatics. The benefits of joining one of these organizations are many. They provide educational opportunities, usually with approved contact hours, which are needed in order to sit for ANCC's board certification. Annual in-person conferences or meetings held by these organizations provide an excellent opportunity to network with others in the field. Developing relationships with informatics specialists at other organizations helps expand your network as you let people know you are looking for a position. Using your peer networks is very important.

The three organizations below have available informatics jobs listed on their websites. They also allow you to post your resume so employers seeking informatics nurses can find you. Informatics recruiters are very familiar with these organizations and this would be an excellent place to post your resume as you search for that perfect job. These organizations have been developing local chapters over the last several years making opportunities to connect in person more convenient, if one is located near you. Monitor their respective websites to see if there is an active chapter that you could join. There are countless volunteer opportunities within these organizations that can increase your network even further.

- Healthcare Information and Management Systems Society (HIMSS)—JobMine https://jobmine.himss.org/jobseeker/search/results/
- American Nursing Informatics Association—(ANIA)—Job Bank https://jobs.ania.org/jobseeker/search/results/
- American Medical Informatics Association—(AMIA) Career Center https://jobs.amia.org/jobseeker/search/results/

### Leverage Social Media

There are several ways to take advantage of social media in this era of ubiquitous use of applications such as LinkedIn, Facebook, and Twitter. To start, let your friends and connections know you are looking and what type of job you are looking for. Chances are they may not be aware of anything but letting them know may lead to a call in the future. Social media sites have made multiple enhancements to their apps to help connect job seekers and employers. LinkedIn has the ability to generate a list of jobs you may be interested in based on your profile, with the ability to use filters and search fields to further narrow the search. Facebook now has the ability to search and apply for jobs directly from the social network's website and mobile app. You can use Twitter to follow organizations where you may be interested in working. But you can also follow informatics recruiters, professional organizations (HIMSS, ANIA, AMIA), informatics related publications, job forums, and industry leaders. Developing an online relationship within an organization of interest by replying to tweets and retweeting can make you stand out and possibly lead to a direct message for an interview.

Carefully read each site's privacy and security policies to ensure that you are comfortable with how your information will be handled and be sure to understand the site's confidentiality settings. Most sites now have the ability

to conduct confidential job searches in instances where you do not want to share with your current location that you are seeking employment elsewhere. And, of course, be sure your social sites do not contain anything that you would not want a prospective employer to see. Privacy settings need to be reviewed and configured to put your best face forward. Links for more information on job searching using these sites are listed below:

- 1. LinkedIn
  - a. https://www.thebalance.com/how-to-use-linkedin-to-job-search-2062600
  - b. https://www.linkedin.com/jobs/
- 2. Facebook
  - a. https://www.facebook.jobs/
  - b. https://money.usnews.com/money/blogs/outside-voices-careers/ articles/2016-07-13/fix-your-facebook-profile-for-job-searching
  - c. http://time.com/money/4674436/facebook-new-jobs/
  - d. https://money.usnews.com/money/careers/slideshows/10-smart-ways-to-use-social-media-in-your-job-search?slide=4
- 3. Twitter
  - a. https://twitter.com/hashtag/jobsearch?lang=en
  - b. https://www.huffingtonpost.com/2015/06/16/twitter-job-search\_n\_ 7571260.html

### Ace the Interview

With all of your hard work completed resulting in an in-person interview with a prospective employer, preparation is now key. Taking the time to adequately plan for the meeting is essential. Start with an understanding of interviewing fundamentals (Somers, 2002):

- Dress professionally.
- Arrive a few minutes early.
- Shake hands with everyone before and after the meeting.
- Bring copies of your resume to share with those attending.
- Ensure a balance between talking and listening.
- Leave a business card if you have one.
- Smile and be pleasant and maintain good eye contact.
- Send a "Thank you for your time" note or email after the interview.

In addition to the fundamentals, the day before your interview, re-read the job posting and/or job description from the employer. Know the skills and experience they are looking for. Also, read through your resume again. Make sure it's fresh in your mind, as the interviewers may ask questions related to your work experience. Knowing what they are looking for, you can point out things in your resume or share verbally ways you can add value. Additionally, in preparation, you should spend some time reviewing the company's website. Research the organizational demographics, such as size, composition, geographic locations (if in multiple sites), number of employees, and number of licensed beds, etc. Read through their mission/ vision statements and see if you can find not only the overall strategic plan but find out if there is a health IT strategic plan. Look for which EHR vendor they use. Anything you can find out related to their use of technology will be helpful during the interview. See if the website includes information on the organizational leaders or any organizational charts. Comments you make can clearly indicate that you have done your homework.

Typically, an interview will start with the employer sharing a bit about their organization and the job they need to fill. It will probably then lead to the next phase of the interview, "So, tell us about yourself." Here is your opportunity to share your prepared introduction that recaps your experience and promotes your most valuable assets. Having this prepared using your knowledge of what they are looking for and what you can bring to the table will help set a positive tone right from the beginning. Based on your introduction, the conversation can get into more detail around areas of interest. Bring into the conversation pieces of data about the organization that let the interviewers know you've done your research. Respond to questions using your knowledge of what the organization is looking for based on the job description and the organization's strategic plan. Some questions that you may be asked include:

- 1. What do you see as your greatest strengths?
- 2. What do you see as opportunities for growth? (If asked about your weaknesses, turn it around into areas of growth; areas that you are interested in improving—and add how you might go about that growth in this organization.)
- 3. If we asked your peers, what would they say about you?
- 4. Tell us about a time you encountered a conflict. How did you handle it? How was it resolved?
- 5. Tell us about your experience with EHRs or technology in general.

- 6. Tell us about a time you led a project team. What was the outcome?
- 7. Why should we hire you?

Not only should you be prepared to respond to questions, but you should have a list of questions to ask the interviewers. You are interviewing them in the same way they are interviewing you. You need to ensure that the job itself, the people and the organizational culture, are a good fit for you too. Have questions listed on a notepad and be prepared to take notes. Some questions you might ask include:

- 1. What does success look like in this role?
- 2. Tell me about the onboarding and orientation programs?
- 3. Does this role have any direct reports? How many?
- 4. Does the organization support continuing education? In what way?
- 5. What do you think the biggest challenges would be for someone in this position?
- 6. Is the job description in its final form, or is there an opportunity to refine it?
- 7. What opportunities are there for advancement and growth in this position?

Assuming that you have an understanding of the basics such as salary, location, travel, hours, etc., realize everything is negotiable. At this stage in your informatics career, though, you probably feel that you have limited bargaining power. There are, however, some standards upon which to base some negotiations. In 2017, HIMSS conducted a Nursing Informatics Workforce Survey (HIMSS, 2017). Nurse informaticists were asked about their background, experience, salary, employment, and the tools they use on a day-to-day basis. There were 1,279 responses to the survey representing nurses across the United States. Respondents were asked to identify their current base salary as of December 1, 2016 (not including benefits or bonuses). See Figure 7.1. Twenty-five percent of respondents reported their salary ranged between \$86,000 and \$100,000. The second highest salary range was \$61,000-\$85,000 (24 percent). This was followed by the range of \$101,000-\$115,000 (20 percent). Nearly half (46 percent) of respondents indicated a salary of over \$100,000. Salaries based on geographic location, level of education, and ANCC board certification are broken down into separate data visualizations and can be found at https://www.himss.org/ ni-workforce-survey.



## Figure 7.1 HIMSS 2017 Nursing Informatics Workforce Survey. Salary ranges for n=1,279 nursing informatics respondents. (From HIMSS 2017 Nursing Informatics Workforce Survey. Used with permission.)

This survey is something that can be shared with the organization's Human Resources department as you discuss things like salary and support for informatics-related conferences or continuing education. Do not be afraid to negotiate. Employers expect it, but nurses are generally not good at it. Ask for a salary in line with national standards and support for your ongoing growth and learning. It will benefit both you and the organization.

### Summary

The need for nurses with specialization in informatics continues to grow as advances in healthcare technology burgeon at a speed that's hard to keep pace with. Nurse informaticists are positioned in the best place possible to design effective use of hardware, software, and electronic medical devices with their understanding of care delivery, workflows and technology. One would think that getting that first job in the field would be easy, yet it's not always the case. The lack of formal informatics experience can cause qualified nurses to shy away from pursuing that first role. By leveraging experience from both on-the-job involvement with technology and project work from school programs, nurses can add numerous technology-related skills to their resume. Adding board certification and graduate study in the field of informatics can increase a prospective employer's interest. Landing that initial interview can be supported by networking through professional organizations and the appropriate use of social media. Coming well prepared with a strong resume will give you the best chance of success as you begin your journey in the field of nursing informatics.

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## Afterword

### Sharon B. Kirby

The field of nursing informatics (NI) has quickly gained popularity in recent years. Many early informatics programs sprung up organically out of a need to identify nurses who had an affinity for technology. These early informatics programs morphed over the years and in 1992 the American Nurses Association (ANA) identified nursing informatics as its own nursing specialty. It wasn't until 2009, however, when the American Recovery and Reinvestment Act (ARRA) was signed into law, that we saw explosive growth in the nursing informatics field. It was this act that earmarked over \$19 billion to drive adoption of "meaningful use" of the electronic medical record (EMR) (HIMSS, 2018). This historic adoption gave way to an integrated network of patient data that was once a fragmented paper process.

### **Nurse Informaticist Role**

The nurse informaticist serves a unique role that is often misunderstood. Many times, a Nurse Informaticist title is used interchangeably with an Information Technology (IT) Analyst. The ANA clearly distinguishes between the two roles, stating, "the synthesis of data and information into knowledge and wisdom is a core principle of nursing informatics, while information technology supports a system lifecycle process" (ANA, 2005). It is the nurse informaticist that possesses the skill set to serve as translator or liaison between clinical practice and IT. They uniquely understand the implications a technology implementation can have on clinical workflow. It is this unique vantage point that serves to mitigate unintended consequences of technology implementations and ensure patient safety (Kirby, 2015).

## **Data Stewards**

Nurse informaticists perform a number of functions in their day-to-day work including that of a "data steward." "Data stewardship is a concept with deep roots in the science and practice of data collection, sharing, and analysis" (Rosenbaum, 2010). The nurse informaticist is well positioned to ensure the data they work with is of high quality and integrity. They can uniquely synthesize and validate the data through the lens of a clinician understanding not only the data's origin but it applicability. This enables them to educate clinicians on the importance of quality documentation that drives the output of meaningful, actionable data. Nurse informaticists work closely with IT analytics and often participate on committees such as data governance to bring their expertise and skill set to the table. They serve as system thinkers that operate on data-driven strategies to solve healthcare problems.

## **Lifelong Learners**

The nurse informaticist should aspire to be a lifelong learner that keeps abreast of new technology and innovation. The practice of nursing informatics cannot stagnate but rather consistently delves into how the latest technology can provide solutions that will improve healthcare delivery. By understanding functional requirements and available technology, nurse informaticist are able to analyze gaps between the technology and clinical workflow.

In my own journey to becoming a nurse informaticist, I began as a clinical nurse and served as a superuser to implement a new EMR. It was that experience that gave me a desire to learn more about the informatics field and soon after I pursued my graduate studies in informatics and began working in the role. As I reflect on my informatics career, I feel the best asset I brought to the role was my solid clinical background prior to going into informatics. If there is one piece of advice I would give nurses that aspire to enter the field of informatics, it is to first build a strong foundation in clinical practice. Without a substantial clinical background, you will lack one of the most valuable contributions a nurse brings to informatics: the experience to understand the clinical impact of the technology on the clinician's workflow and more importantly on the patient.

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# **Appendix: Case Studies**

## **Chapter 1 Case Study**

### Career Options for Nurses Working with Informatics

Many nurses are intrigued by the idea of working in a position that integrates technology into healthcare. A tremendous need exists for nurses who understand clinical informatics in order to provide solutions to existing problems in the healthcare arena. How does a clinical nurse position himself or herself to help meet this need and have a valuable career focusing on healthcare informatics?

### Why Would a Nurse Want a Job in Informatics?

One must have a passion for healthcare informatics and not just use it as an escape to get out of undertaking hands-on patient care. The work can be hard, involve long hours, and include working shifts other than Monday through Friday during the day. On the bright side, nurses working with informatics can have the satisfaction of making a significant impact on the care of every patient in the organization, helping to provide safe, quality, and cost-effective care.

### Positioning Oneself for a Job in Healthcare Informatics

Clinical expertise is a first requirement for working as an informatics nurse. It is not a good position for a new graduate who is not yet adept at the current workflow and knowledgeable about how it can be improved. The strength of an informatics nurse is his or her clinical experience coupled with knowledge of information technology (IT). Assess your skills and strengths. Are you good at the technical aspects of IT? Do you have good communication, teaching, and conflict-resolution skills? Do you have knowledge of the organization in which you want to work, including the workflow and culture? Assess your ability to relocate or move. Not all jobs will be available in your home town. Do you want to work for a hospital or other healthcare facility, vendor, or consulting firm, or in an academic role?

Let others know about your desire to find a position that includes informatics. Networking is a key activity. Many positions are discovered by word of mouth and not in the mainstream job channels. One will never find this job in the local newspaper! Meet the employees of the IT department as well as Human Resources and understand what positions might be available.

Volunteer within the organization in which you are already known. You might volunteer to be a superuser or to help test a system that is being implemented.

Take continuing education courses on topics related to nursing and healthcare informatics. Many in-person courses, online courses, and webinars are available on a variety of healthcare informatics topics.

Membership of organizations like HIMSS (www.himss.org) is extremely important for education and networking. HIMSS offers a student rate, which provides many of the same benefits of regular membership at a greatly reduced rate. HIMSS has a job board that can be searched to see what positions are available and the requirements for those positions.

Networking is key. If your organization has an informatics nurse, take him or her to lunch to interview them for ideas of what the role entails. If a position is available, this informatics nurse might think of letting you know about the job. Join any of the groups of the Alliance for Nursing Informatics (www.allianceni.org). Attend local, state, and national conferences in order to increase your education and find out what jobs are available. Many of the healthcare informatics organizations, like HIMSS, have nursing support groups and electronic mailing lists.

One might consider working with a recruiter to find a job in healthcare informatics. A recruiter will help with sample resumes, getting your resume in order and positioning you for your first or next job in informatics.

Social networking sites such as LinkedIn may help in the job search. Search for leaders in NI, pay attention to what they put on their social media sites and use that as a model.

### **Typical Positions**

The first position a nurse may hold may be that of a superuser within the organization. Sometimes one will volunteer for these positions or sometimes one is selected. This is a good reason why it is important to let others know of your interest in informatics. In this position, the superuser may be trained on a particular software product, then will turn around and train others on his or her unit. The superusers may be asked to test new products prior to the release of that product. One may do this job full time without patient assignments for a period of time, then later work part time as a superuser and return to the previous patient care work as well.

The next job within the same organization might be that of a clinical analyst. In this role, one examines the current workflows of nurses and others and determines processes that allow for more efficient, effective, and safer patient care. One would attend meetings to customize or optimize specific software. One might be called upon to assist in selecting software, or training others on a product. This might be a stepping-stone to work for a vendor installing software. Some nurses work for a consulting company to advise clients on any aspect of the system life cycle—assessment, planning, design, build, implementation, testing, evaluating, maintaining, and support systems.

### Education in Nursing/Healthcare Informatics

Certification in NI is available through the American Nurses Credentialing Center for those who have experience as a nurse, at least one year of experience as an informatics nurse, and continuing education hours. If two nurses are applying for the same position, and all other credentials are the same, it is likely that certification could be the deciding factor to determine who gets the position.

A wide range of educational programs are available in nursing informatics (NI). Many jobs in informatics do require a Master's degree or higher. Some traditional brick and mortar or online programs offer Certificates, a Master's degree, a Post-Master's degree, a Doctor of Nursing Practice, or a Doctor of Philosophy (PhD) in NI. Holding a degree does not guarantee a job in informatics but is a good idea for those who intend to work in the field. Programs at the Master's level typically include a practicum experience. Many have leveraged a practicum experience into a permanent position. Nursing is a rewarding and varied career. Many opportunities exist for continuing that rewarding career by combining nursing and informatics.

### **Discussion Questions**

- 1. In your environment, would it be preferable to report to Information Services (IS)/IT or the Nursing Department? Discuss the pros and cons.
- 2. Does the definition of NI incorporate those new to the profession of nursing? Justify your answer.
- 3. If you are just starting out in a NI role, which one (or more) of the functional areas of NI would be of interest to you? Defend your position.

### **Chapter 2 Case Study**

### Using Standards Development Processes to Establish Industry Baselines and Norms

Nursing informatics' short history has been characterized by revolutionary change and constant innovation. Emergent technologies have been introduced and have thrived or failed. Technologies from other industries have been adopted by nurses, such as when Sue Kinnick observed the use of bar codes to expedite the return of her rental car and adopted the same technology to make the process of providing medications safer through bar code medication administration (Wood, 2003). Quick application and assimilation of new technologies are easier to implement on a small scale, but the real opportunity lies with broad industry adoption of common practices that allow for new knowledge about nursing or the human condition to be generated through large, similar data and information stores.

The ability to capture data about nursing practice and patient outcomes on a large scale has quickly advanced the body of knowledge generated by the discipline of nursing. Similar ideas, implemented in non-standard ways, slow down the opportunities for broad measurement, research, and refinement of practices. Nurse informaticists have successfully used standards development processes to be able to drive consistent development of nursing terminologies, health IT functionality, and data standards. The following case study traces the history of one standardization effort that was led by, or had participation of, a large number of nurse informaticists.

### Background

In 2003, a public–private activity supported by the U.S. Department of Health & Human Services (HHS), Department of Veterans Affairs (VA), HIMSS, and the Robert Wood Johnson Foundation, asked Health Level Seven (HL7) to accelerate the work they were performing to develop a consensusbased standard for the functionality of an electronic health record (EHR). This case study represents the activities of the HL7 Electronic Health Record Technical Committee from 2003 to today to illustrate how nurse informaticists can have historical impact on nursing practice and the broader healthcare industry. Nurses have always been part of the leadership of this highly influential technical committee. Other leaders have included physicians, industry leaders, and technologists.

When the HL7 EHR Technical Committee approached the problem, a number of similar but slightly different ideas existed throughout industry, domestically in the United States, but also internationally. The HL7 EHR Technical Committee could have limited their scope to move quickly to a final product, but knew that there was an international need for a common language by which to describe EHR functionality. The activity started with an international outreach to find others that were working on similar ideas. Once these activities were identified, negotiation toward consensus led to international cooperation on the work products. The final result is an internationally accepted standard that has been used domestically and internationally as a standard for a common language and framework for vendors, users, policymakers, and researchers.

#### Data/Research or Information for Reader

In 2000, the "best of breed" hospital IT systems were beginning to merge into seamless solutions called electronic health records. While many of these systems were deployed, there was no consensus on exactly what an EHR was or should be. How could the government give out incentives for their use? How could vendors communicate succinctly to users about their functions and how they exceeded industry norms? How could professional associations and health information management professionals communicate domain-specific needs for EHRs?

Domestic and international standards development organizations (SDOs) used varying language to describe EHRs. The American Society for Testing and Materials (ASTM) used electronic medical records (EMR); the
International Organization for Standardization (ISO) used electronic health record systems (EHR-S); and HL7 used electronic health record (EHR), but had not yet created a formal standard for the term. Along with the conflict in naming, a lack of understanding existed regarding what was in scope and what was out of scope of an EHR system.

## Challenges

Faced with international ambiguity, the HL7 EHR Technical Committee first sought coordination with other SDOs. Domestically, ASTM was not creating standards for EHR system functionality. Internationally, ISO was well underway building a standard for EHR-S Scope Definition and Context work. It was negotiated that HL7 would create functional standards and submit the work to ISO for inclusion into the ISO body of standards. In return, HL7 would adopt the ISO EHR system definitional work and not create redundant work.

The Institute of Medicine (IOM) was also working on a letter report entitled "Key Capabilities of an Electronic Health Record System: Letter Report." Through a coordinated effort, the IOM work informed the early work of the HL7 EHR Technical Committee while at the same time the work of HL7 was considered a significant input to the IOM work and was thus acknowledged.

## **Decisions/Actions**

Once the broader scope was negotiated and decided upon across SDOs and others, the detailed work began. The team at HL7 wanted to create a functional model that provided a language by which users, vendors, researchers, policymakers, and others could speak about EHR systems. But any EHR system would be a subset of available functions.

Each function includes a "Function ID," "Function Name," "Function Statement," "Function Description," "Examples" of the function, the ability to link the function to similar functions by a "See Also" field, and "Conformance Criteria." The original EHR-S functional model contained approximately 130 functions; the current Release 2 of the EHR-S FM contains approximately 300 functions. The functions are arranged into seven chapters, as depicted in Figure A.1.

While the EHR-S functional model has a high level of specificity about functions, few, if any, practice sites will require all functions. The team



Figure A.1 Sections of the HL7 Electronic Health Record System Functional Model, Release 2 (from Health Level Seven<sup>®</sup> International. Used with permission)

created the ability for users to rate each function with "Shall," "Should," or "May," which allowed the user to indicate required ("Shall"), desirable ("Should"), or optional ("May") functionality. This has led to communities of practice to gather and create practice-specific profiles which are freely available at www.hl7.org.

An example of a Care Provision function and its sub (child) functions are depicted in Figure A.2.

Care Provision	CP.1	Manage Clinical History		
	CP.2	Render Externally-sourced Information		
	CP.3	Manage Clinical Documentation		Example child functions:
	CP.4	Manage Orders		
	CP.5	Manage Results	CP.1	Manage Clinical History
	CP.6	Manage Treatment Administration	CP.1.1	Manage Patient History
	CP.7	Manage Future Care		Manage Allergy, Intolerance and Adverse Reaction
	CP.8	Manage Patient Education & Commun	CP.1.2	List
	CDO	Manage Care Coordination & Reportin	CP.1.3	Manage Medication List
	CP.9	Manage care coordination & Reportin	CP.1.4	Manage Problem List
			CP.1.5	Manage Strengths List
			CP.1.6	Manage Immunization List
				Manage Medical Equipment, Prosthetic/Orthotic,
			CP.1.7	Device List
			CP.1.8	Manage Patient and Family Preferences

Figure A.2 Care Provision Function (from Health Level Seven<sup>®</sup> International. Used with permission)

## Outcomes, Lessons Learned

International collaboration allowed for learning from global best practices and promulgation of this work with the international SDO community. Now that the work is published, those that work internationally are able to use this common framework. For example, vendors that are responding to requests for services or certification guidelines from different countries will find a similar language and expectation of EHR-S functionality that does not need to be modified dramatically for each country within which they work. The interdisciplinary nature of the team led to a comprehensive model which describes an EHR-S for all users.

Early coordination with multiple domestic and international SDOs resulted in recognition of the work being undertaken by HL7, and allowed for inclusion of the HL7 work into other SDOs. This has resulted in the acceleration of complementary work as multiple SDOs are not put in the position of promulgating their unique functional standards, as has been seen with health IT interoperability messaging standards. Today, coordination of this work takes place across six different SDOs.

The HL7 EHR Technical Committee has stayed current with technology trends over more than the last decade, and has expanded their work to include new technologies as they have become more prevalent. Community of interest involvement has significantly impacted the expansion of the original EHR-S scope to include personal health records (PHRs).

## Conclusion

NI leadership was critical to this formalized effort to bridge the users of health IT systems and the systems themselves. Because nurse informaticists were positioned in leadership roles at HL7, they were able to have significant influence over the creation of this functional standard. In addition, the two nurses who sequentially co-chaired the HL7 EHR Technical Committee were also peer-voted to be Directors at Large of the HL7 Board of Directors. This further expanded the NI influence on the development of health IT standards. While nurse informaticists were instrumental in leading the international standardization of functional models for EHR systems, this is just one example of the many efforts nurse informaticists have led to standardize the NI specialty, the domain of nursing, and the healthcare sector.

## **Discusion Questions**

- 1. NI history has many examples of similar ideas arising at the same time. What are some of those?
- 2. When similar ideas have arisen, what has been the progression?
- 3. What have been the advantages to the NI profession of this push towards standardization?

4. What were some of the professional skills exhibited by the nurse informaticists who co-chaired this effort?

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## **Chapter 3 Case Study**

## Using Kaizen to Improve Workflow and Clinical Documentation Post-EHR Implementation

A healthcare system has implemented a new EHR in a multi-hospital environment. The design, build, testing, and implementation for this phased project was completed over two years and considered by the software vendor to be a very aggressive timeline. It becomes evident as the organization lifts itself out of the implementation phase that there are areas of workflow concerns and clinical documentation issues or defects that need to be addressed. Subject-matter experts representing all five hospitals, ambulatory care areas, and emergency care centers, as needed, are invited to participate in Kaizen (the practice of continuous improvement) events to review the ten most common workflows. The goal is to identify the areas for improvement and create a new workflow that would maximize efficiency and improve patient safety and outcomes. This case study will reflect a Kaizen to evaluate the STEMI (ST segment elevation myocardial infarction) patient that presents at a hospital or emergency care center that does not have a cardiac cath lab.

#### Background

At this health system, the process for reporting issues is by calling customer support, which is available 24/7, or by contacting the assigned nursing informatics analyst. Some end users will contact the EHR build team analyst directly, though it is discouraged. Due to the number of issue tickets created related to the STEMI workflow, it was selected as the first Kaizen to occur. During the design phase of the EHR implementation, the cardiac cath labs at the three hospitals had difficulty standardizing their practices. This became evident after go-live when workarounds began to evolve. The need to document a workflow mapping through a Kaizen Lean process was established.

The event was scheduled over two full days and was facilitated by a Lean Specialist and the Director of Informatics and was sponsored by the Chief Nurse and Chief Medical Information Officers. Participants included Emergency Department (ED) physicians, ED nurses, Registration, Unit Secretaries, Cath Lab techs, Cath Lab nurses, Cardiology, Cardiac Critical Care nurses, Bed Placement Coordinators, Nurse Informatics Analysts and Application Build Analysts. Day One included current state workflow mapping. Each workflow step was placed into one of five categories: Non-EHR Process Step, EHR Process Step, Non-EHR Issue Opportunity, EHR Issue Opportunity, or Patient Action Step (see Figure A.3).

During Day Two, participants identified three primary areas/clusters where error or issues occur. These areas were then listed in a table format for the participants to evaluate the issues affected. Using a scale of 1 to 5 on Patient Safety (x-axis) and also its affect on End User Efficiency (y-axis), the facilitator mapped each issue on a grid. Once the issues were scored, they were then listed in order from highest to lowest. Once ranked, the Application Build Analysts and representatives from the EHR vendor assisted



Figure A.3 Current State Workflow Mapping

the group in reviewing the EHR Process Steps and EHR Issue/Opportunities. They were critical in the expectation setting of whether the issue/opportunity could be fixed/enhanced using the current state EHR platform, or if it would have to wait for the system enhancements that would be included in the upgrade to occur within the next 12 months.

#### Assessment

The Kaizen workflow mapping determined there were currently 32 sequential steps and 87 steps in total within the workflow. There were as many as six steps occurring simultaneously by the 11 end-user roles involved.

The Kaizen participants, Build Team analysts, and EHR representatives determined that within the top 11 issues there were three for which the Training Team and Informatics Analysts would provide additional education to improve compliance with the existing workflow while using existing tools. Only two items would require waiting for the upgrade to have the functionality needed for the change, which left six items for immediate resolution optimizing the current EHR System (see Figure A.4).



Figure A.4 Top issues for education and support

## Recommendation

All 11 items were assigned owners. The six Optimize Current System items identified by the Kaizen participants were assigned to the Application Build Team to resolve. The three Use Current System items were given to the Training Team to create tip sheets that were given to the Informatics Analysts for distribution and end user support. The two items that would not be possible until the upgrade were placed on the "To Do" list for the appropriate Application Teams.

## **Discussion Questions**

- 1. Were the appropriate roles selected to participate in this Kaizen event? Was anyone excluded?
- 2. What questions could have been asked during the Kaizen, or what could have occurred post-Kaizen to improve the outcomes and/or experience?

## **Chapter 4 Case Study**

## Nurse Responsibility in Managing Technology in the Care Setting

The future is bright for healthcare and nursing informatics, as more and more technology will streamline workflows, make care safer, improve outcomes, and support our patients' and consumers' ability to better manage their health. However, this comes with challenges as well. Nurses will be adopting new devices, all of which will have a technology component, can be integrated into a patient's health record, and must be monitored, validated, and managed in the setting where used. How will nurses learn to manage this barrage of technology, and what will their responsibility be? Even in our current environment, we have integration for vital signs, IV pumps, beds, ventilators, and other types of monitoring equipment. Lola Rust, RN, a nursing informaticist at Texas Health Resources, says, "It's not enough for the nurse to critically think the patient, now they will need to critically think the equipment." What does this do to the burden on the nurse for their practice? In addition, there will be more tools available to patients and families and all healthcare consumers providing greater access and insight into their health and their health record. How will they learn to leverage these tools, not only in how to use them but their purpose and benefits? We are now hearing a lot about documentation burden, and the impact of documentation on clinicians, but what about an overall technology burden. Let us think about this in this case study.

As an informatics nurse in a large community hospital, you are working on a project for customer engagement. The patients at your hospital have access to the following:

Patient portal that connects them to their EHR data, including results, notes, medication, patient education, and patient-generated data from their devices such as fitness apps, nutritional tracking, glucometers, scales, and other medical devices.

- Interactive TV that allows access to a variety of hospital services, including menu ordering (based on ordered diet), room temperature control, patient education materials, ability to send requests to the care team, video visits with providers and other healthcare professionals, telehealth access for consults, and other online services.
- Patients also have video access to friends and family where they can send and receive eCards, and access entertainment features such as movies or music through streaming. They can also access interpretive services or other communication and adaptive applications.
- They can interact directly with their EHR, getting push notifications on their interactive TV or portal access for things such as rating their pain; or they can complete a medical history on admission, sign consents, acknowledge understanding of instructions or education, and other documentation that then becomes part of their health record.

All of these activities can be completed in multiple languages from any device, including the TV in the room, a hospital-provided computer tablet, or a personal device. The functionality of these features for the patient and family is somewhat intuitive, based on level of expertise with computers; but even for non-computer-users it is relatively easy to teach the patient how to access these tools and get them set up and ready to go. There are also great tutorials that can be accessed by patients within the systems that provide additional instruction on how to use the various features offered.

However, as the informatics nurse, your challenge is what and how much information to provide the nursing staff about how patients interact with these tools and define the role of the nurses and clinical staff in assuring that patients and families understand these tools and how to use them.

Consider the following:

- 1. What are ways in which patients can be provided with information on the basic set up and use of these tools. Should it be included in the orientation of the room? Are there other ways to orient the patient?
- 2. How much training and education should the nurse have in understanding how the patient and family engage with and utilize these tools?
- 3. What should the nurse's role be in educating the patient and family regarding these tools? Is it part of the nursing role to educate patients on the technology tools available to them while in the hospital? What other staff or hospital representatives could perform these functions?

- 4. In what ways does a patient's use of these tools help with the documentation burden of the nurse or improve nursing efficiency? What are some potential ways that use of these tools could add to nursing's workload? How can those be managed?
- 5. Should nurses trust the information generated by the patient when using these tools?
- 6. What impact does it have on nursing to know that all their notes and documentation are visible to the patient (not just lab results or clinical values, but all entries)?
- 7. As the informatics nurse, what are some considerations you can bring forward in the development, planning, and implementation of these patient tools in order to promote safe and quality care and to support the role of the nurse.

## Chapter 5—Case Study

## Developing A Modern Healthcare Data Ecosystem

## Introduction to the Problem

In 2017, the Data Science Institute Team at an academic medical center was challenged to develop a Modern Healthcare Data Ecosystem to advance the clinical, operational, quality, educational, financial, and research needs of the organization. The infrastructure not only had to meet the immediate needs but also had to meet future, yet unknown, organizational needs.

## Background

The Data Science Institute Team included a neuroscientist, solutions architect, three nurse informaticists, four programmers, and a biostatistician. The extended team included a development partner with expertise in the technology selected, staff from operations, clinicians, staff from quality, and researchers. At the time, the organization did have an analytics strategy, enterprise data warehouse, and visualization tools. Lacking was the requisite infrastructure to propel the organization from one relegated to lag metrics to one that would be able to produce real time metrics and provide real time insights be they clinical, operational, educational, financial, or research based.

## Discussion

An initial assessment of the needs of all stakeholders was conducted. Faceto-face interviews and focus group sessions were conducted with over 20 members of the organization. Stakeholders included clinicians, staff from operations, staff from quality, education, legal, and researchers. Significant findings from these interviews included:

- The organization's primary source of data was the enterprise data warehouse.
- There was no data governance structure in place.
- Data acquisition was a batch process with lag times from 24 hours to 30 days, depending on the data source.
- There was no single source of truth and many duplicated manual reports with conflicting data.
- Researchers were not able to take advantage of streaming data sets, blend data from disparate systems, or extract data from documents.
- The organization was operating with lag metrics of up to 30 days' latency to address quality issues.
- Current analytic infrastructure was based on a relational database schema.

With this information in hand as well as the mandate for both an immediate and long-term solution the team decided on an iterative approach to developing the ecosystem. By providing iterative functionality the immediate, intermediate, and future analytic needs of the organization could be met. Before starting the development of the modern healthcare data ecosystem certain foundational work was conducted; this work included:

- Initiating a data governance model.
- Developing a data dictionary of all data elements, internal as well as external to the organization, that were going to be ingested into the ecosystem.
- Researching within as well as outside the healthcare environment for suitable components to build out a data ecosystem.

Once the fundamentals were addressed, the team started the development of the modern healthcare data ecosystem. Recognizing the team would be introducing a solution based on "Big Data" technologies and the scarcity of "Big Data" technologies in healthcare, the team looked outside of healthcare for solutions. After conducting research and analyzing the technologies behind Facebook, LinkedIn, Twitter, Google, and Yahoo it was decided to use the same technologies that powered those applications. As the team was not experienced in these technologies a development partner was brought in to build out the modern healthcare data ecosystem. This was helpful for two reasons: the first being speed (the solution was built out over a reasonable amount of time), the second, knowledge transfer (the project team worked side by side with the development partner to ensure their ownership and knowledge of the solution).

The first decision the team made was to go public cloud for the infrastructure, and phase in a private cloud solution in the future, if warranted. This decision for public cloud, in this case Amazon Web Services, was twofold. First, speed—the infrastructure was spun up in one week whereas a private cloud would take months to materialize. Second, cost—the initial cost of a public cloud is much less than the infrastructure required for a private cloud. Had the project not been successful the public infrastructure could be shut down incurring no future costs to the organization.

The second decision that was made was regarding the software component parts required to deliver the desired functionality. The following software components were procured:

- Hortonworks Hadoop Distribution
- NiFi
- Spark
- SpliceMachine
- Collibra Data Governance
- Imosphere Atmolytics
- Open EMPI
- Open NLP
- R
- Kafka

The technology partner provided the expertise to deploy and configure the component parts to enable the required functionality. NiFi provided the data ingestion pipeline, routing data through Kafka into Spark for real time analytics and into the Hadoop File System for storage. Initial data sources were the hospital-based EMR, outpatient EMR, and the dental EMR. As the decision was made for this build out to be iterative, only the components that matched the required functionality were deployed.

The Modern Healthcare Data Ecosystem allowed the organization to ingest data from any source including:

- EMR
- dental
- financial
- legacy data
- physiological monitoring data
- ventilator data
- ancillary system data
- medical IoT data
- social media data
- social predispositions of health
- omics data
- exposome data
- open data.

Functionality developed within the platform included:

- real time monitoring of patient condition
- real time monitoring of organizational performance metrics
- integration of wearable and home monitoring data
- machine learning
- predictive modeling
- cohort discovery
- data blending from multiple sources
- social media analytics
- event notification.

The iterative approach for delivering functionality was a success. The first application delivered was a cohort discovery tool that gave researchers the ability to interrogate data without exposing protected health information (PHI). During the build process, machine learning was applied to the data set yielding previously undiagnosed hypertensive patients. This gave the project team organizational credibility. There were many stakeholders in

the organization that did not expect the project to succeed. Organizations are not receptive to analytics projects that fail to deliver as expected and are drawn out for months. Keeping the stakeholders informed though the process is essential. There was a breakdown in communication when it came to the delivery of functionality. Little was communicated early on regarding the initial deliverables of the project. The response to this issue was conducting educational sessions throughout the project to ensure stakeholder understanding.

Looking outside of healthcare for technologies that successfully deliver functionality was also successful. There is much to learn from other industries and how they utilize technology.

## Conclusion

The development of a modern healthcare data ecosystem at the academic medical center was successful in large part by employing an iterative solution that provided value from the first deployment of technology. How would you go about deploying an iterative technology solution, keeping in mind the need to deliver value early on? Although the initial communication to the organization was sound, the ongoing communication was lacking leading to mismatched expectations. For your organization, what might a sustainable communication model look like? It cannot be overstated how important the foundational work was to the project. How would you obtain organizational buy-in for establishing an enterprise architecture, functionality roadmap, and ensuring data consistency throughout the organization?

Consider the following:

- 1. What would be your strategy for ensuring that you keep up to date on emerging analytic technologies?
- 2. Why do we want to avoid a System 2 response when visualizing operational data?
- 3. What does the nurse informaticist have to offer a vendor considering the development of a modern healthcare data platform?

# Acronyms

AAFP	American Academy of Family Physicians	
AARP	American Association of Retired Persons	
ACA	Affordable Care Act	
ACO	accountable care organization	
AFMC	Arkansas Foundation for Medical Care	
AHA	American Hospital Association	
AHRQ	Agency for Healthcare Research and Quality	
AI	artificial intelligence	
AMA	American Medical Association	
AMIA	American Medical Informatics Association	
ANA	American Nurses Association	
ANCC	American Nurses Credentialing Center	
ANI	Alliance for Nursing Informatics	
ANIA	American Nursing Informatics Association	
AONE	American Organization of Nurse Executives	
APM	alternative payment model	
APRN	Advanced Practice Registered Nurse	
ARRA	American Recovery and Reinvestment Act of 2009	
ASTM	American Society for Testing and Materials	
BPA	best practice alert	
BS	Bachelor of Science	
BSN	Bachelor of Science in Nursing	
CAHIMS	Certified Associate in Healthcare Information and Management	
	Systems	
CAP	College of American Pathologists	
CCAN	Council on Computer Applications in Nursing	
CCC	clinical care classification	
CENP	Certified in Executive Nursing Practice	

CHCIO	CHIME Certified Healthcare Chief Information Officer	
CHIME	College of Healthcare Information Management Executives	
CHIP	children's health insurance program	
CI	clinical intelligence	
CIO	Chief Information Officer	
Clin Doc	<b>Doc</b> clinical documentation	
CMIO	Chief Medical Information Officer	
CMS	Centers for Medicare & Medicaid Services	
CNIO	Chief Nursing Informatics Officer or Chief Nursing Information	
	Officer	
CNO	Chief Nursing Officer	
CoPs	Cooperatives of Practices	
CPEHR	Certified Professional in Electronic Health Records	
CPHIMS	Certified Professional in Healthcare Information and	
	Management Systems	
CPHIT	Certified Professional in Health Information Technology	
CPHQ	Certified Professional in Healthcare Quality	
CPOE	computerized provider order entry	
СРТ	current procedural terminology (code set)	
CRM	crew resource management	
CSIO	Chief Security Information Officer	
СТ	clinical terms (as in SNOMED clinical terms)	
СТО	Chief Technology Officer	
CV	curriculum vitae	
CWOCN	Certified Wound, Ostomy and Continence Nurse	
DNP	Doctor of Nursing Practice	
DSRIP	Delivery System Reform Incentive Program	
ED	Emergency Department	
EH	eligible hospital	
EHR	electronic health record	
EHR-S	electronic health record system	
EMPI	enterprise master patient index	
EMR	electronic medical record	
EP	eligible professional	
ETL	extract, transform, and load	
FAAN	Fellow of the American Academy of Nursing	
FACHE	Fellow of the American College of Healthcare Executives	
FACMI	Fellow of the American College of Medical Informatics	
FHIMSS	Fellow Healthcare Information Management System Society	

FNP-BC	Family Nurse Practitioner (Board Certified)
FTE	full-time equivalent
GAO	Government Accountability Office
GSW	Georgia Southwestern State University
HCM	Human Capital Management certification
HCP-LAN	Healthcare Payment—Learning and Action Network
HDFS	Hadoop Distributed File System
ннс	Home Health Care Classification
HHS	U.S. Department of Health & Human Services
HIE	health information exchange
HIMSS	Healthcare Information and Management Systems Society
HIPPA	Health Insurance Portability and Accountability Act
HIS	health information system
HIT	health information technology
HITECH	Health Information Technology for Economic and Clinical
	Health Act
HITPC	Health IT Policy Committee
HL7	Health Level Seven
HPC	high performance computing
ICD	International Classification of Diseases
ID	identification
IDN	Integrated Delivery Network
ILN	Inova Learning Network
IN	informatics nurse
INS	Informatics Nurse Specialist
IOM	Institute of Medicine
ΙοΤ	Internet of Things
IS	information systems or Information Services
ISO	International Organization for Standardization
IT	information technology
IV	intravenous
LAN	Learning and Action Network
LNHA	Licensed Nursing Home Administrator
LTC	long-term care
MACRA	Medicare Access and CHIP Reauthorization Act
MHA	Master of Healthcare Administration
MIPS	merit-based incentive payment system
MS	Master of Science
MSN	Master of Science in Nursing

MU	Meaningful Use (https://www.cdc.gov/ehrmeaningfuluse/	
	introduction.html)	
NANDA	North American Nursing Diagnosis Association (Taxonomy)	
NDNQI	National Database of Nursing Quality Indicators	
NE-BC	Nursing Executive (Board Certified)	
<b>NEA-BC</b> Nursing Executive Advanced (Board Certified)		
NI	nursing informatics	
NIC	Nursing Interventions Classification	
NiFi	NiagraFiles (from Apache Software Foundation)	
NIH	National Institutes of Health	
NIS	Nursing Information System	
NLM	National Library of Medicine	
NLN	National League for Nursing	
NLP	natural language processing	
NMDS	Nursing Minimum Data Set	
NOC	Nursing Outcomes Classification	
NP	nurse practitioner	
NPO	nil per os [Latin for "nothing by mouth"]	
ONC	Office of the National Coordinator for Health Information	
	Technology	
РСМН	Patient-Centered Medical Home	
PCORI	Patient-Centered Outcomes Research Institute	
PDCA	Plan-Do-Check-Act process	
PhD	Doctor of Philosophy	
PHI	personal health information	
PHIT	personal health information technology	
PHR	personal health record	
PMI	Project Management Institute	
PMP	Project Management Professional	
QIN-QIO	Quality Innovation Network—Quality Improvement	
	Organization	
QPP	quality payment program	
REC	Regional Extension Center	
RFP	request for proposal	
RN	Registered Nurse	
RN-BC	Registered Nurse (Board Certified) (in a specific specialty)	
RTLS	real-time location service	
SAFER	Safety Assurance Factors for EHR Resilience	

SBAR	Situation, Background, Assessment, and Recommendation
	technique
SCAMC	Symposium on Computer Applications in Medical Care
SDO	Standards Development Organization
SNF	skilled nursing facility
<b>SNOMED CT</b>	Systemized Nomenclature of Medicine Clinical Terms
<b>SNOMED RT</b>	Systemized Nomenclature of Medicine Reference
	Terminology®
SQL	Structured Query Language
STEMI	ST segment Elevation Myocardial Infarction
TIGER	Technology Informatics Guiding Education Reform
TMF	Texas Medical Foundation
TTUHSC	Texas Tech University Health Sciences Center
TV	television
UCI	University of California, Irvine
UK	United Kingdom
UMLS	Unified Medical Language System® (UMLS® Metathesaurus)
UMMC	University of Mississippi Medical Center
USNS	United States Naval Ship
USPHS	United States Public Health Service
VA	United States Department of Veterans Affairs
VDT	view, download, and transmit
VoIP	Voice over Internet Protocol
VP	Vice President



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