



FOURTH EDITION

# NURSING INFORMATICS

and the Foundation of Knowledge

# The Pedagogy

**Nursing Informatics and the Foundation of Knowledge, Fourth Edition** drives comprehension through a variety of strategies geared toward meeting the learning needs of students, while also generating enthusiasm about the topic. This interactive approach addresses diverse learning styles, making this the ideal text to ensure mastery of key concepts. The pedagogical aids that appear in most chapters include the following:

## Key Terms

- |                           |                               |                |
|---------------------------|-------------------------------|----------------|
| » Artificial intelligence | » Connectionism               | » Intuition    |
| » Brain                   | » Decision making             | » Knowledge    |
| » Cognitive informatics   | » Empiricism                  | » Logic        |
| » Cognitive science       | » Epistemology                | » Memory       |
| » Computer science        | » Human Mental Workload (MWL) | » Mind         |
|                           | » Intelligence                | » Neuroscience |
|                           |                               | » Perception   |

**Key Terms** Found in a list at the beginning of each chapter, these terms will create an expanded vocabulary.

**Objectives** The chapter objectives provide instructors and students with a snapshot of the key information they will encounter in each chapter. They serve as a checklist to help guide and focus study. Objectives can also be found within the text's online resources.

## Objectives

1. Trace the evolution of nursing informatics from concept to specialty practice.
2. Relate nursing informatics metastructures, concepts, and tools to the knowledge work of nursing.
3. Explore the quest for consistent terminology in nursing and describe terminology approaches that

## Introduction

Those who followed the actual events of Apollo 13, or who were entertained by the movie (Howard, 1995), watched the astronauts strive against all odds to bring their crippled spaceship back to Earth. The speed of their travel was incomprehensible to most viewers, and the task of bringing the spaceship back to Earth seemed nearly impossible. They were experiencing a crisis never imagined by the experts at NASA, and they made up their survival plan moment by moment. What brought them back to Earth safely? Surely, credit must be given to the technology and the spaceship's ability to withstand the trauma it experienced. Most amazing, however, were the traditional nontechnological tools, skills, and supplies that were used in new and different ways to stabilize the spacecraft's environment and keep the astronauts safe while traveling toward their uncertain future.

This sense of constancy in the midst of change serves to stabilize experience in many different life events and contributes to the survival of crisis and change. This rhythmic process is also vital to the healthcare system's stability and survival in the presence of the rapidly changing events of the Knowledge Age. No one can dispute the fact that the Knowledge Age is changing health care in ways that will not be fully recognized and understood for years. The change is paradigmatic, and every expert who addresses this change reminds healthcare professionals of the need to go with the flow of rapid change or be left behind.

As with any paradigm shift, a new way of viewing the world brings with it some of the enduring values of the previous worldview. As health care continues its journey into digital communications, telehealth, and wearable technologies, it brings some familiar tools and skills recognized in the form of values, such as **privacy**, **confidentiality**, autonomy, and nonmaleficence. Although these basic values remain unchanged, the **standards** for living out these values will take on new meaning as health professionals confront new and different moral dilemmas brought on by the adoption

**Introductions** Found at the beginning of each chapter, chapter introductions provide an overview highlighting the importance of the chapter's topic. They also help keep students focused as they read.

**Research Briefs** These summaries encourage students to access current research in the field.

**Summaries** Summaries are included at the end of each chapter to provide a concise review of the material covered, highlighting the most important points and describing what the future holds.

#### RESEARCH BRIEF

Using an online survey of 1,227 randomly selected respondents, Bodkin and Miaoulis (2007) sought to describe the characteristics of information seekers on e-health websites, the types of information they seek, and their perceptions of the quality and ethics of the websites. Of the respondents, 74% had sought health information on the Web, with women accounting for 55.8% of the health information seekers. A total of 50% of the seekers were between 35 and 54 years of age. Nearly two thirds of the users began their searches using a general search engine rather than a health-specific site, unless they were seeking information related to symptoms or diseases. Top reasons for seeking information were related to diseases or symptoms of medical conditions, medication information, health news, health insurance, locating a doctor, and Medicare or Medicaid information. The level of education of information seekers was related to the ratings of website quality, in that more educated seekers found health information websites more understandable, but were more likely to perceive bias in the website information. The researchers also found that the ethical codes for e-health websites seem to be increasing consumers' trust in the safety and quality of information found on the Web, but that most consumers are not comfortable purchasing health products or services online.

The full article appears in Bodkin, C., & Miaoulis, G. (2007). eHealth information quality and ethics issues: An exploratory study of consumer perceptions. *International Journal of Pharmaceutical and Healthcare Marketing*, 11(1), 27–42. Retrieved from ABI/INFORM Global (Document ID: 1515583081).

#### BOX 6-3 CASE STUDY: CASTING TO THE FUTURE

In the year 2025, nursing practice enabled by technology has created a professional culture of reflection, critical inquiry, and interprofessional collaboration. Nurses use technology at the point of care in all clinical settings (e.g., primary care, acute care, community, and long-term care) to inform their clinical decisions and effect the best possible outcomes for their clients. Information is gathered and retrieved via human–technology biometric interfaces including voice, visual, sensory, gustatory, and auditory interfaces, which continuously monitor physiologic parameters for potentially harmful imbalances. Longitudinal records are maintained for all citizens from their initial prenatal assessment to death; all lifelong records are aggregated into the knowledge bases of expert systems. These systems provide the basis of the artificial intelligence being embedded in emerging technologies. Smart technologies and invisible computing are ubiquitous in all sectors where care is delivered. Clients and families are empowered to review and contribute actively to their record of health and wellness. Invasive diagnostic techniques are obsolete, nanotechnology therapeutics are the norm, and robotics supplement or replace much of the traditional work of all health professions. Nurses provide expertise to citizens to help them effectively manage their health and wellness life plans, and navigate access to appropriate information and services.

nence granted physicians.

#### Summary

In this chapter, we have traced the development of informatics as a specialty, defined nursing informatics, and explored the DIKW paradigm central to informatics. We also explored the need for and the development of standardized terminologies to capture and codify the work of nursing and how informatics supports the knowledge work of nursing. This chapter advanced the view that every nurse's practice will make contributions to new nursing knowledge in dynamically interactive CIS environments. The core concepts associated with informatics will become embedded in the practice of every nurse, whether administrator, researcher, educator, or practitioner. Informatics will be prominent in the knowledge work of nurses, yet it will be a subtlety because of its eventual fulsome integration with clinical care processes. Clinical care will be substantially supported by the capacity and promise of technology today and tomorrow.

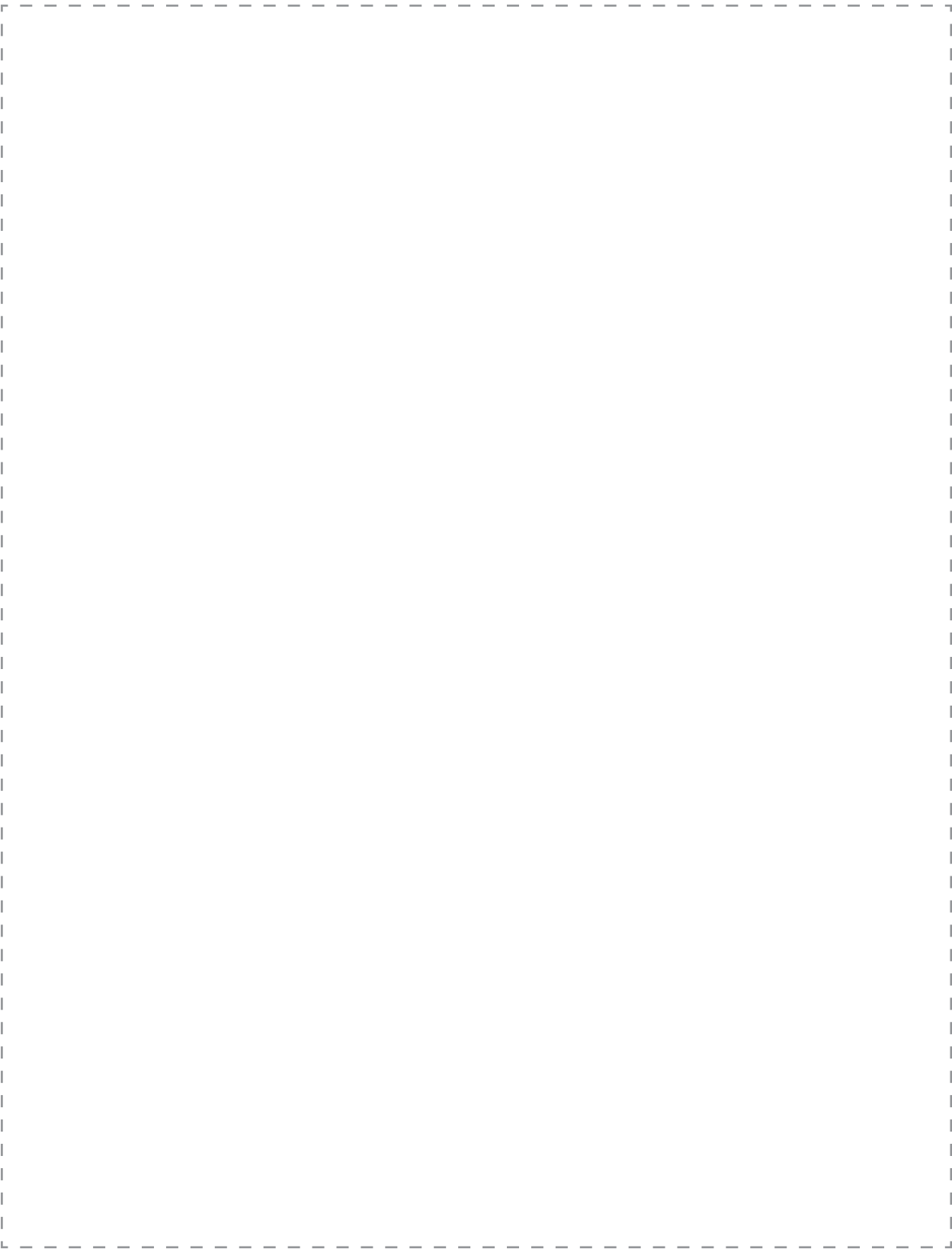
Most importantly, readers need to contemplate a future without being limited by the world of practice as it is known today. Information technology is not a panacea for all of the challenges found in health care, but it will provide the nursing profession with an unprecedented capacity to generate and disseminate new knowledge at rapid speed. Realizing these possibilities necessitates that all nurses understand and leverage the informatician within and contribute to the future.

**Case Studies** Case studies encourage active learning and promote critical thinking skills. Students can ask questions, analyze situations, and solve problems in a real-world context.

#### THOUGHT-PROVOKING QUESTIONS

1. Imagine you are in a social situation and someone asks you, "What does a nurse do?" Think about how you will capture and convey the richness that is nursing science in your answer.
2. Choose a clinical scenario from your recent experience and analyze it using the Foundation of Knowledge model. How did you acquire knowledge? How did you process knowledge? How did you generate knowledge? How did you disseminate knowledge? How did you use feedback, and what was the effect of the feedback on the foundation of your knowledge?

**Thought-Provoking Questions** Students can work on these critical thinking assignments individually or in a group while reading through the text. In addition, students can delve deeper into concepts by completing these exercises online.



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FOURTH EDITION

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# Preface

The idea for this text originated with the development of nursing informatics (NI) classes, the publication of articles related to technology-based education, and the creation of the *Online Journal of Nursing Informatics (OJNI)*, which Dee McGonigle cofounded with Renee Eggers. Like most nurse informaticists, we fell into the specialty; our love affair with technology and gadgets and our willingness to be the first to try new things helped to hook us into the specialty of informatics. The rapid evolution of technology and its transformation of the ways of nursing prompted us to try to capture the essence of NI in a text.

As we were developing the first edition, we realized that we could not possibly know all there is to know about informatics and the way in which it supports nursing practice, education, administration, and research. We also knew that our faculty roles constrained our opportunities for exposure to changes in this rapidly evolving field. Therefore, we developed a tentative outline and a working model of the theoretical framework for the text and invited participation from informatics experts and specialists around the world. We were pleased with the enthusiastic responses we received from some of those invited contributors and a few volunteers who heard about the text and asked to participate in their particular area of expertise.

In the second edition, we invited the original contributors to revise and update their chapters. Not everyone chose to participate in the second edition, so we revised several of the chapters using the original work as a springboard. The revisions to the text were guided by the contributors' growing informatics expertise and the reviews provided by textbook adopters. In the revisions, we sought to do the following:

- Expand the audience focus to include nursing students from BS through DNP programs as well as nurses thrust into informatics roles in clinical agencies.
- Include, whenever possible, an attention-grabbing case scenario as an introduction or an illustrative case scenario demonstrating why the topic is important.
- Include important research findings related to the topic. Many chapters have research briefs presented in text boxes to encourage the reader to access current research.
- Focus on cutting-edge innovations, meaningful use, and patient safety as appropriate to each topic.
- Include a paragraph describing what the future holds for each topic.

New chapters that were added to the second edition included those focusing on technology and patient safety, system development life cycle, workflow analysis, gaming, simulation, and bioinformatics.

In the third edition, we reviewed and updated all of the chapters, reordered some chapters for better content flow, eliminated duplicated content, split the education and research content into two sections, integrated social media content, and added two new chapters: *Data Mining as a Research Tool* and *The Art of Caring in Technology-Laden Environments*.

In this fourth edition, we reviewed and updated all of the chapters based on technological advancements and changes to the healthcare arena, including reimbursement mechanisms for services. We have pared this edition down to 26 chapters from the previous edition's 29; one chapter each was deleted from Sections II, V, and VII. Section I includes updates to the same five chapters on the building blocks of nursing informatics, with extensive changes to Chapter 3, *Computer Science and the Foundation of Knowledge Model*. To improve flow, we combined content. In Section II, the previous four chapters were narrowed to three. New Chapters 6, *History and Evolution of Nursing Informatics* and 7, *Nursing Informatics as*



*a Specialty*, were developed and appropriate material from previous Chapters 6, 7, and 8 were assimilated. This section ends with an updated Chapter 8, *Legislative Aspects of Nursing Informatics: HITECH and HIPAA* (formerly Chapter 9). Section III contains the same five chapters, although all were updated and Chapter 13, *Workflow and Beyond Meaningful Use* (formerly Chapter 14) now reflects the payment models and reimbursement issues that we are adjusting to after meaningful use has gone away. Section IV contains the same five chapters with updated content and some name changes to reflect the current status of informatics and healthcare. Chapter 15 was renamed to *Informatics Tools to Promote Patient Safety and Quality Outcomes*, and Chapter 16 has been changed to *Patient Engagement and Connected Health*. Section V went from three chapters to two chapters: Chapter 19 (formerly Chapter 20) was updated, while the new Chapter 20, *Simulation, Game Mechanics, and Virtual Worlds in Nursing Education*, had content from former Chapters 21 and 22 integrated during its development. Section VI was renamed to Research Applications of Nursing Informatics. It still has the same four chapters, which have been updated, but the first chapter in this section, 21, was renamed to reflect nursing research; its new name is *Nursing Research: Data Collection, Processing, and Analysis*. Section VII went from three chapters to two chapters. Because emerging technologies are discussed throughout the text, the chapter focusing specifically on that was removed. The two chapters that remain are Chapter 25, *The Art of Caring in Technology-Laden Environments*, and the new Chapter 26, *Nursing Informatics and Knowledge Management*. In addition, the ancillary materials have been updated and enhanced to include competency-based self-assessments and mapping the content to the current NI standards.

We believe that this text provides a comprehensive elucidation of this exciting field. Its theoretical underpinning is the Foundation of Knowledge model. This model is introduced in its entirety in the first chapter (*Nursing Science and the Foundation of Knowledge*), which discusses nursing science and its relationship to NI. We believe that humans are organic information systems that are constantly acquiring, processing, and generating information or knowledge in both their professional and personal lives. It is their high degree of knowledge that characterizes humans as extremely intelligent, organic machines. Individuals have the ability to manage knowledge—an ability that is learned and honed from birth. We make our way through life interacting with our environment and being inundated with information and knowledge. We experience our environment and learn by acquiring, processing, generating, and disseminating knowledge. As we interact in our environment, we acquire knowledge that we must process. This processing effort causes us to redefine and restructure our knowledge base and generate new knowledge. We then share (disseminate) this new knowledge and receive feedback from others. The dissemination and feedback initiate this cycle of knowledge over again, as we acquire, process, generate, and disseminate the knowledge gained from sharing and re-exploring our own knowledge base. As others respond to our knowledge dissemination and we acquire new knowledge, we engage in rethinking and reflecting on our knowledge, processing, generating, and then disseminating anew.

The purpose of this text is to provide a set of practical and powerful tools to ensure that the reader gains an understanding of NI and moves from information through knowledge to wisdom. Defining the demands of nurses and providing tools to help them survive and succeed in the Knowledge Era remains a major challenge. Exposing nursing students and nurses to the principles and tools used in NI helps to prepare them to meet the challenge of practicing nursing in the Knowledge Era while striving to improve patient care at all levels.

The text provides a comprehensive framework that embraces knowledge so that readers can develop their knowledge repositories and the wisdom necessary to act on and apply that knowledge. The text is divided into seven sections.

- Section I, *Building Blocks of Nursing Informatics*, covers the building blocks of NI: nursing science, information science, computer science, cognitive science, and the ethical management of information.
- Section II, *Perspectives on Nursing Informatics*, provides readers with a look at various viewpoints on NI and NI practice as described by experts in the field.

- Section III, *Nursing Informatics Administrative Applications: Pre-care and Care Support*, covers important functions of administrative applications of NI.
- Section IV, *Nursing Informatics Practice Applications: Care Delivery*, covers healthcare delivery applications including electronic health records (EHRs), clinical information systems, telehealth, patient safety, patient and community education, and care management.
- Section V, *Education Applications of Nursing Informatics*, presents subject matter on how informatics supports nursing education.
- Section VI, *Research Applications of Nursing Informatics*, covers informatics tools to support nursing research, including data mining and bioinformatics.
- Section VII, *Imagining the Future of Nursing Informatics*, focuses on the future of NI, emphasizes the need to preserve caring functions in technology-laden environments, and reviews the relationship of nursing informatics to organizational knowledge management.

The introduction to each section explains the relationship between the content of that section and the Foundation of Knowledge model. This text places the material within the context of knowledge acquisition, processing, generation, and dissemination. It serves both nursing students (BS to DNP/PhD) and professionals who need to understand, use, and evaluate NI knowledge. As nursing professors, our major responsibility is to prepare the practitioners and leaders in the field. Because NI permeates the entire scope of nursing (practice, administration, education, and research), nursing education curricula must include NI. Our primary objective is to develop the most comprehensive and user-friendly NI text on the market to prepare nurses for current and future practice challenges. In particular, this text provides a solid groundwork from which to integrate NI into practice, education, administration, and research.

Goals of this text are as follows:

- Impart core NI principles that should be familiar to every nurse and nursing student
- Help the reader understand knowledge and how it is acquired, processed, generated, and disseminated
- Explore the changing role of NI professionals
- Demonstrate the value of the NI discipline as an attractive field of specialization

Meeting these goals will help nurses and nursing students understand and use fundamental NI principles so that they efficiently and effectively function as current and future nursing professionals to enhance the nursing profession and improve the quality of health care. The overall vision, framework, and pedagogy of this text offer benefits to readers by highlighting established principles while drawing out new ones that continue to emerge as nursing and technology evolve.

# Acknowledgments

We are deeply grateful to the contributors who provided this text with a richness and diversity of content that we could not have captured alone. Joan Humphrey provided social media content integrated throughout the text. We especially wish to acknowledge the superior work of Alicia Mastrian, graphic designer of the Foundation of Knowledge model, which serves as the theoretical framework on which this text is anchored. We could never have completed this project without the dedicated and patient efforts of the Jones & Bartlett Learning staff, especially Amanda Martin and Emma Huggard. Both fielded our questions and concerns in a very professional, respectful, and timely manner.

Dee acknowledges the undying love, support, patience, and continued encouragement of her best friend and husband, Craig, and her son, Craig, who has made her so very proud. She sincerely thanks her cousins Camille, Glenn, Mary Jane, and Sonny, and her dear friends for their support and encouragement, especially Renee.

Kathy acknowledges the loving support of her family: husband Chip; children Ben and Alicia; sisters Carol and Sue; and parents Robert and Rosalie Garver. She dedicates her work on this edition to her dad, Robert, who died September 17, 2016. Kathy also acknowledges those friends who understand the importance of validation, especially Katie, Bobbie, Kathy, Anne, and Barbara.

## Authors' Note

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This text provides an overview of nursing informatics from the perspective of diverse experts in the field, with a focus on nursing informatics and the Foundation of Knowledge model. We want our readers and students to focus on the relationship of knowledge to informatics and to embrace and maintain the caring functions of nursing—messages all too often lost in the romance with technology. We hope you enjoy the text!

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