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

**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.

**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.

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

**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...
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.

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  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.
Dee McGonigle, PhD, RN, FAAN, CNE
Professor, MSN-Online Program, Chamberlain College of Nursing
Sr. Advisor, Online Journal of Nursing Informatics (OJNI)
Member, Informatics and Technology Expert Panel (ITEP) for the American Academy of Nursing

Kathleen Mastrian, PhD, RN
Associate Professor and Program Coordinator for Nursing
Pennsylvania State University, Shenango
Sr. Managing Editor, Online Journal of Nursing Informatics (OJNI)
Substantial discounts on bulk quantities of Jones & Bartlett Learning publications are available to corporations, professional associations, and other qualified organizations. For details and specific discount information, contact the special sales department at Jones & Bartlett Learning via the above contact information or send an email to specialsales@jblearning.com.

Copyright © 2018 by Jones & Bartlett Learning, LLC, an Ascend Learning Company

All rights reserved. No part of the material protected by this copyright may be reproduced or utilized in any form, electronic or mechanical, including photocopying, recording, or by any information storage and retrieval system, without written permission from the copyright owner. The content, statements, views, and opinions herein are the sole expression of the respective authors and not that of Jones & Bartlett Learning, LLC. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not constitute or imply its endorsement or recommendation by Jones & Bartlett Learning, LLC, and such reference shall not be used for advertising or product endorsement purposes. All trademarks displayed are the trademarks of the parties noted herein. Nursing Informatics and the Foundation of Knowledge, Fourth Edition is an independent publication and has not been authorized, sponsored, or otherwise approved by the owners of the trademarks or service marks referenced in this product.

There may be images in this book that feature models; these models do not necessarily endorse, represent, or participate in the activities represented in the images. Any screenshots in this product are for educational and instructive purposes only. Any individuals and scenarios featured in the case studies throughout this product may be real or fictitious, but are used for instructional purposes only.

The authors, editor, and publisher have made every effort to provide accurate information. However, they are not responsible for errors, omissions, or for any outcomes related to the use of the contents of this book and take no responsibility for the use of the products and procedures described. Treatments and side effects described in this book may not be applicable to all people; likewise, some people may require a dose or experience a side effect that is not described herein. Drugs and medical devices are discussed that may have limited availability controlled by the Food and Drug Administration (FDA) for use only in a research study or clinical trial. Research, clinical practice, and government regulations often change the accepted standard in this field. When consideration is being given to use of any drug in the clinical setting, the health care provider or reader is responsible for determining FDA status of the drug, reading the package insert, and reviewing prescribing information for the most up-to-date recommendations on dose, precautions, and contraindications, and determining the appropriate usage for the product. This is especially important in the case of drugs that are new or seldom used.

Copyright © 2018 by Jones & Bartlett Learning, LLC, an Ascend Learning Company

All rights reserved. No part of the material protected by this copyright may be reproduced or utilized in any form, electronic or mechanical, including photocopying, recording, or by any information storage and retrieval system, without written permission from the copyright owner. The content, statements, views, and opinions herein are the sole expression of the respective authors and not that of Jones & Bartlett Learning, LLC. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not constitute or imply its endorsement or recommendation by Jones & Bartlett Learning, LLC, and such reference shall not be used for advertising or product endorsement purposes. All trademarks displayed are the trademarks of the parties noted herein. Nursing Informatics and the Foundation of Knowledge, Fourth Edition is an independent publication and has not been authorized, sponsored, or otherwise approved by the owners of the trademarks or service marks referenced in this product.
We want to express our sincere appreciation to the staff at Jones & Bartlett Learning, especially Amanda, Christina, and Carolyn, for their continued encouragement, assistance, and support during the writing process and publication of our book.
# Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preface</td>
<td></td>
<td>xvi</td>
</tr>
<tr>
<td>Acknowledgments</td>
<td></td>
<td>xix</td>
</tr>
<tr>
<td>Contributors</td>
<td></td>
<td>xx</td>
</tr>
</tbody>
</table>

## SECTION I: BUILDING BLOCKS OF NURSING INFORMATICS

### 1 Nursing Science and the Foundation of Knowledge

*Dee McGonigle and Kathleen Mastrian*

| Introduction | 7 |
| Quality and Safety Education for Nurses | 16 |
| Summary | 18 |
| References | 19 |

### 2 Introduction to Information, Information Science, and Information Systems

*Kathleen Mastrian and Dee McGonigle*

| Introduction | 21 |
| Information | 22 |
| Information Science | 25 |
| Information Processing | 26 |
| Information Science and the Foundation of Knowledge | 27 |
| Introduction to Information Systems | 28 |
| Summary | 32 |
| References | 33 |

### 3 Computer Science and the Foundation of Knowledge Model

*Dee McGonigle, Kathleen Mastrian, and June Kaminski*

| Introduction | 35 |
| The Computer as a Tool for Managing Information and Generating Knowledge | 36 |
| Components | 38 |
| What Is the Relationship of Computer Science to Knowledge? | 53 |
| How Does the Computer Support Collaboration and Information Exchange? | 54 |
| Cloud Computing | 57 |
| Looking to the Future | 59 |
| Summary | 61 |
| Working Wisdom | 61 |
| Application Scenario | 62 |
| References | 62 |
Contents

4 Introduction to Cognitive Science and Cognitive Informatics 65
Kathleen Mastrian and Dee McGonigle
- Introduction
- Cognitive Science
- Sources of Knowledge
- Nature of Knowledge
- How Knowledge and Wisdom Are Used in Decision Making
- Cognitive Informatics
- Cognitive Informatics and Nursing Practice
- What Is AI?
- Summary
- References

5 Ethical Applications of Informatics 77
Dee McGonigle, Kathleen Mastrian, and Nedra Farcus
- Introduction
- Ethics
- Bioethics
- Ethical Issues and Social Media
- Ethical Dilemmas and Morals
- Ethical Decision Making
- Theoretical Approaches to Healthcare Ethics
- Applying Ethics to Informatics
- Case Analysis Demonstration
- New Frontiers in Ethical Issues
- Summary
- References

SECTION II: PERSPECTIVES ON NURSING INFORMATICS 99

6 History and Evolution of Nursing Informatics 105
Kathleen Mastrian and Dee McGonigle
- Introduction
- The Evolution of a Specialty
- What Is Nursing Informatics?
- The DIKW Paradigm
- Capturing and Codifying the Work of Nursing
- The Nurse as a Knowledge Worker
- The Future
- Summary
- References

7 Nursing Informatics as a Specialty 127
Dee McGonigle, Kathleen Mastrian, Julie A. Kenney, and Ida Androwich
- Introduction
- Nursing Contributions to Healthcare Informatics
8 Legislative Aspects of Nursing Informatics: HITECH and HIPAA

Kathleen M. Gialanella, Kathleen Mastrian, and Dee McGonigle

Introduction 145
HIPAA Came First 145
Overview of the HITECH Act 148
How a National HIT Infrastructure Is Being Developed 153
How the HITECH Act Changed HIPAA 154
Implications for Nursing Practice 161
Future Regulations 165
Summary 165
References 166

SECTION III: NURSING INFORMATICS ADMINISTRATIVE APPLICATIONS: PRECARE AND CARE SUPPORT 169

9 Systems Development Life Cycle: Nursing Informatics and Organizational Decision Making

Dee McGonigle and Kathleen Mastrian

Introduction 175
Waterfall Model 178
Rapid Prototyping or Rapid Application Development 180
Object-Oriented Systems Development 181
Dynamic System Development Method 181
Computer-Aided Software Engineering Tools 184
Open Source Software and Free/Open Source Software 184
Interoperability 185
Summary 186
References 187

10 Administrative Information Systems

Marianela Zytkowski, Susan Paschke, Kathleen Mastrian, and Dee McGonigle

Introduction 189
Types of Healthcare Organization Information Systems 190
Communication Systems 190
Core Business Systems 191
Order Entry Systems 193
Patient Care Support Systems 194
Interoperability
Aggregating Patient and Organizational Data
Department Collaboration and Exchange of Knowledge and Information
Summary
References

11 The Human–Technology Interface
Dee McGonigle, Kathleen Mastrian, and Judith A. Effken
Introduction
The Human–Technology Interface
The Human–Technology Interface Problem
Improving the Human–Technology Interface
A Framework for Evaluation
Future of the Human–Technology Interface
Summary
References

12 Electronic Security
Lisa Reeves Bertin, Kathleen Mastrian, and Dee McGonigle
Introduction
Securing Network Information
Authentication of Users
Threats to Security
Security Tools
Off-Site Use of Portable Devices
Summary
References

13 Workflow and Beyond Meaningful Use
Dee McGonigle, Kathleen Mastrian and Denise Hammel-Jones
Introduction
Workflow Analysis Purpose
Workflow and Technology
Workflow Analysis and Informatics Practice
Informatics as a Change Agent
Measuring the Results
Future Directions
Summary
References

SECTION IV: NURSING INFORMATICS PRACTICE APPLICATIONS: CARE DELIVERY
14 The Electronic Health Record and Clinical Informatics
Emily B. Barey, Kathleen Mastrian, and Dee McGonigle
Introduction
Setting the Stage
# Contents

Components of Electronic Health Records 269
Advantages of Electronic Health Records 274
Standardized Terminology and the EHR 278
Ownership of Electronic Health Records 280
Flexibility and Expandability 283
Accountable Care Organizations and the EHR 285
The Future 287
Summary 287
References 287

## 15 Informatics Tools to Promote Patient Safety and Quality Outcomes 293
*Dee McGonigle and Kathleen Mastrian*

Introduction 293
What Is a Culture of Safety? 294
Strategies for Developing a Safety Culture 296
Informatics Technologies for Patient Safety 301
Role of the Nurse Informaticist 313
Summary 315
References 317

## 16 Patient Engagement and Connected Health 323
*Kathleen Mastrian and Dee McGonigle*

Introduction 323
Consumer Demand for Information 324
Health Literacy and Health Initiatives 325
Healthcare Organization Approaches to Engagement 327
Promoting Health Literacy in School-Aged Children 329
Supporting Use of the Internet for Health Education 330
Future Directions for Engaging Patients 335
Summary 337
References 338

## 17 Using Informatics to Promote Community/Population Health 341
*Dee McGonigle, Kathleen Mastrian, Margaret Ross Kraft, and Ida Androwich*

Introduction 341
Core Public Health Functions 343
Community Health Risk Assessment: Tools for Acquiring Knowledge 345
Processing Knowledge and Information to Support Epidemiology and Monitoring Disease Outbreaks 347
Applying Knowledge to Health Disaster Planning and Preparation 349
Informatics Tools to Support Communication and Dissemination 350
Using Feedback to Improve Responses and Promote Readiness 351
Summary 353
References 355
## 18 Telenursing and Remote Access Telehealth

*Original contribution by Audrey Kinsella, Kathleen Albright, Sheldon Prial, and Schuyler F. Hoss; revised by Kathleen Mastrian and Dee McGonigle*

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>359</td>
</tr>
<tr>
<td>The foundation of Knowledge model and Home Telehealth</td>
<td>359</td>
</tr>
<tr>
<td>Nursing Aspects of Telehealth</td>
<td>361</td>
</tr>
<tr>
<td>History of Telehealth</td>
<td>362</td>
</tr>
<tr>
<td>Driving Forces for Telehealth</td>
<td>363</td>
</tr>
<tr>
<td>Telehealth Care</td>
<td>366</td>
</tr>
<tr>
<td>Telenursing</td>
<td>370</td>
</tr>
<tr>
<td>Telehealth Patient Populations*</td>
<td>372</td>
</tr>
<tr>
<td>Tools of Home Telehealth</td>
<td>375</td>
</tr>
<tr>
<td>Home Telehealth Software*</td>
<td>378</td>
</tr>
<tr>
<td>Home Telehealth Practice and Protocols</td>
<td>380</td>
</tr>
<tr>
<td>Legal, Ethical, and Regulatory Issues</td>
<td>381</td>
</tr>
<tr>
<td>The Patient’s Role in Telehealth</td>
<td>382</td>
</tr>
<tr>
<td>Telehealth Research</td>
<td>383</td>
</tr>
<tr>
<td>Evolving Telehealth Models</td>
<td>385</td>
</tr>
<tr>
<td>Parting Thoughts for the Future and a View Toward What the Future Holds</td>
<td>386</td>
</tr>
<tr>
<td>Summary</td>
<td>387</td>
</tr>
<tr>
<td>References</td>
<td>388</td>
</tr>
</tbody>
</table>

### SECTION V: EDUCATION APPLICATIONS OF NURSING INFORMATICS

## 19 Nursing Informatics and Nursing Education

*Heather E. McKinney, Sylvia DeSantis, Kathleen Mastrian, and Dee McGonigle*

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction: Nursing Education and the Foundation of Knowledge Model</td>
<td>397</td>
</tr>
<tr>
<td>Knowledge Acquisition and Sharing</td>
<td>398</td>
</tr>
<tr>
<td>Evolution of Learning Management Systems</td>
<td>398</td>
</tr>
<tr>
<td>Delivery Modalities</td>
<td>400</td>
</tr>
<tr>
<td>Technology Tools Supporting Education</td>
<td>405</td>
</tr>
<tr>
<td>Internet-Based Tools</td>
<td>413</td>
</tr>
<tr>
<td>Promoting Active and Collaborative Learning</td>
<td>420</td>
</tr>
<tr>
<td>Knowledge Dissemination and Sharing</td>
<td>423</td>
</tr>
<tr>
<td>Exploring Information Fair Use and Copyright Restrictions</td>
<td>426</td>
</tr>
<tr>
<td>The Future</td>
<td>427</td>
</tr>
<tr>
<td>Summary</td>
<td>428</td>
</tr>
<tr>
<td>References</td>
<td>429</td>
</tr>
</tbody>
</table>

## 20 Simulation, Gaming Mechanics, and Virtual Worlds in Nursing Education

*Dee McGonigle, Kathleen Mastrian, Brett Bixler, and Nicholaus Miehl*

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>433</td>
</tr>
<tr>
<td>Simulation in Nursing Informatics Education</td>
<td>434</td>
</tr>
<tr>
<td>Nursing Informatics Competencies in Nursing Education</td>
<td>436</td>
</tr>
<tr>
<td>A Case for Simulation in Nursing Informatics Education and Nursing Education</td>
<td>437</td>
</tr>
</tbody>
</table>
Incorporating EHRs into the Learning Environment
Challenges and Opportunities
The Future of Simulation in Nursing Informatics Education
Game Mechanics and Virtual World Simulation for Nursing Education
Game Mechanics and Educational Games
Virtual Worlds in Education
Choosing Among Simulations, Educational Games, and Virtual Worlds
The Future of Simulations, Games, and Virtual Worlds in Nursing Education
Summary
References

SECTION VI: NURSING INFORMATICS: RESEARCH APPLICATIONS

21 Research: Data Collection, Processing, and Analysis
Heather E. McKinney, Sylvia DeSantis, Kathleen Mastrian, and Dee McGonigle
Introduction: Nursing Research and the Foundation of Knowledge Model
Knowledge Generation Through Nursing Research
Acquiring Previously Gained Knowledge Through Internet and Library Holdings
Fair Use of Information and Sharing
Informatics Tools for Collecting Data and Storage of Information
Tools for Processing Data and Data Analysis
The Future
Summary
References

22 Data Mining as a Research Tool
Dee McGonigle and Kathleen Mastrian
Introduction: Big Data, Data Mining, and Knowledge Discovery
KDD and Research
Data Mining Concepts
Data Mining Techniques
Data Mining Models
Benefits of KDD
Data Mining and Electronic Health Records
Ethics of Data Mining
Summary
References

23 Translational Research: Generating Evidence for Practice
Jennifer Bredemeyer, Ida Androwich, Dee McGonigle, and Kathleen Mastrian
Introduction
Clarification of Terms
History of Evidence-Based Practice
Evidence
Bridging the Gap Between Research and Practice
Barriers to and Facilitators of Evidence-Based Practice
The Role of Informatics

References
## Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developing EBP Guidelines</td>
<td>503</td>
</tr>
<tr>
<td>Meta-Analysis and Generation of Knowledge</td>
<td>504</td>
</tr>
<tr>
<td>The Future</td>
<td>505</td>
</tr>
<tr>
<td>Summary</td>
<td>506</td>
</tr>
<tr>
<td>References</td>
<td>507</td>
</tr>
</tbody>
</table>

## SECTION VII: IMAGINING THE FUTURE OF NURSING INFORMATICS

### 24 Bioinformatics, Biomedical Informatics, and Computational Biology

Dee McGonigle and Kathleen Mastrian

<table>
<thead>
<tr>
<th>Subsection</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>511</td>
</tr>
<tr>
<td>Bioinformatics, Biomedical Informatics, and Computational Biology Defined</td>
<td>511</td>
</tr>
<tr>
<td>Why Are Bioinformatics and Biomedical Informatics So Important?</td>
<td>514</td>
</tr>
<tr>
<td>What Does the Future Hold?</td>
<td>516</td>
</tr>
<tr>
<td>Summary</td>
<td>518</td>
</tr>
<tr>
<td>References</td>
<td>519</td>
</tr>
</tbody>
</table>

### 25 The art of Caring in Technology-laden environments

Heather E. McKinney, Sylvia DeSantis, Kathleen Mastrian, and Dee McGonigle

<table>
<thead>
<tr>
<th>Subsection</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kathleen Mastrian and Dee McGonigle</td>
<td>525</td>
</tr>
<tr>
<td>Caring Theories</td>
<td>526</td>
</tr>
<tr>
<td>Presence</td>
<td>529</td>
</tr>
<tr>
<td>Strategies for Enhancing Caring Presence</td>
<td>530</td>
</tr>
<tr>
<td>Reflective Practice</td>
<td>533</td>
</tr>
<tr>
<td>Summary</td>
<td>534</td>
</tr>
<tr>
<td>References</td>
<td>535</td>
</tr>
</tbody>
</table>

### 26 Nursing Informatics and the Foundation of Knowledge

Dee McGonigle and Kathleen Mastrian

<table>
<thead>
<tr>
<th>Subsection</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>537</td>
</tr>
<tr>
<td>Foundation of Knowledge Revisited</td>
<td>537</td>
</tr>
<tr>
<td>The Nature of Knowledge</td>
<td>540</td>
</tr>
<tr>
<td>Knowledge Use in Practice</td>
<td>541</td>
</tr>
<tr>
<td>Characteristics of Knowledge Workers</td>
<td>544</td>
</tr>
<tr>
<td>Knowledge Management in Organizations</td>
<td>545</td>
</tr>
<tr>
<td>Managing Knowledge Across Disciplines</td>
<td>547</td>
</tr>
<tr>
<td>The Learning Healthcare System</td>
<td>548</td>
</tr>
<tr>
<td>Summary</td>
<td>550</td>
</tr>
<tr>
<td>References</td>
<td>551</td>
</tr>
</tbody>
</table>

Abbreviations

Glossary

Index
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 advances 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...
Preface  xvii

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: Precare 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.
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

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!
Contributors

Ida Androwich, PhD, RN, BC, FAAN
Loyola University Chicago
School of Nursing
Maywood, IL

Emily Barey, MSN, RN
Director of Nursing Informatics
Epic Systems Corporation
Madison, WI

Lisa Reeves Bertin, BS, EMBA
Pennsylvania State University
Sharon, PA

Brett Bixler, PhD
Pennsylvania State University
University Park, PA

Jennifer Bredemeyer, RN
Loyola University Chicago
School of Nursing
Skokie, IL

Steven Brewer, PhD
Assistant Professor, Administration of Justice
Pennsylvania State University
Sharon, PA

Sylvia M. DeSantis, MA
Pennsylvania State University
University Park, PA

Judith Effken, PhD, RN, FACMI
University of Arizona
College of Nursing
Tucson, AZ

Nedra Farcus, MSN, RN
Retired from Pennsylvania State University, Altoona
Altoona, PA

Kathleen M. Gialanella, JD, RN, LLM
Law Offices
Westfield, NJ
Associate Adjunct Professor
Teachers College, Columbia University
New York, NY
Adjunct Professor
Seton Hall University, College of Nursing &
School of Law
South Orange & Newark, NJ

Denise Hammel-Jones, MSN, RN-BC, CLSSBB
Greencastle Associates Consulting
Malvern, PA

Nicholas Hardiker, PhD, RN
Senior Research Fellow
University of Salford
School of Nursing & Midwifery
Salford, UK

Glenn Johnson, MLS
Pennsylvania State University
University Park, PA

June Kaminski, MSN, RN
Kwantlen University College
Surrey, British Columbia, Canada

Julie Kenney, MSN, RNC-OB
Clinical Analyst
Advocate Health Care
Oak Brook, IL

Margaret Ross Kraft, PhD, RN
Loyola University Chicago
School of Nursing
Maywood, IL
The Editors also acknowledge the work of the following first edition contributors (original contributions edited by McGonigle and Mastrian for second edition):

**Kathleen Albright, BA, RN**  
Strategic Account Manager at GE Healthcare  
Philadelphia, PA

**Schuyler F. Hoss, BA**  
Northwest Healthcare Management  
Vancouver, WA

**Audrey Kinsella, MA, MS**  
Information for Tomorrow  
Telehealth Planning Services  
Asheville, NC

**Peter J. Murray, PhD, RN, FBCS**  
Coachman’s Cottage  
Nocton, Lincoln, UK

**Nancy Staggers, PhD, RN, FAAN**  
Professor, Informatics  
University of Maryland  
Baltimore, MD

**Jeff Swain**  
Instructional Designer  
Pennsylvania State University  
University Park, PA

**Denise D. Tyler, MSN/MBA, RN-BC**  
Implementation Specialist  
Healthcare Provider, Consulting  
ACS, a Xerox Company  
Dearborn, MI

**Susan M. Paschke, MSN, RN**  
The Cleveland Clinic  
Cleveland, OH

**Sheldon Prial, RPH, BS Pharmacy**  
Sheldon Prial Consultance  
Melbourne, FL

**Jackie Ritzko**  
Pennsylvania State University  
Hazleton, PA

**Marianela Zytkowski, MSN, RN**  
The Cleveland Clinic  
Cleveland, OH