CHAPTER 1

Informatics and the Medication Use Process

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OBJECTIVES

1. Articulate definitions and relationships of key informatics terms.
2. Articulate the goals of biomedical and health informatics.
3. Describe the Institute of Medicine's five core competencies for health care professions education.
4. Enable readers to appreciate the driving forces behind pharmacy informatics educational requirements.
5. Describe the differences and examples of the two broad categories of information used in the clinical informatics domains.
6. Distinguish between a pharmacist who uses informatics in practice and a pharmacy informatician.
7. Describe the pharmacist informatician's roles and responsibilities in biomedical and health informatics.
8. Describe the foundational knowledge and skills required of pharmacy informaticians.
9. Describe the medication use process and each step within the process, including the pharmacist's responsibilities in each step.

This chapter introduces two topics: informatics and the medication use process. Informatics plays a critical, enabling role in a safe and efficacious medication use process. "Setting the Stage: Consensus-Based Development of Pharmacy Informatics Competencies" describes the development of informatics competencies for Doctor of Pharmacy programs accredited by the Accreditation Council for Pharmacy Education and how those competencies relate to the organization of this book. This chapter provides a foundational introduction to informatics, information technology (IT), other key concepts and terms, and related topics. The latter part of this chapter describes the organization of this book, with a focus on the medication use process as the framework for how the book is organized. The majority of the other chapters in this text address specific applications of pharmacy informatics' supporting role in the medication use process.

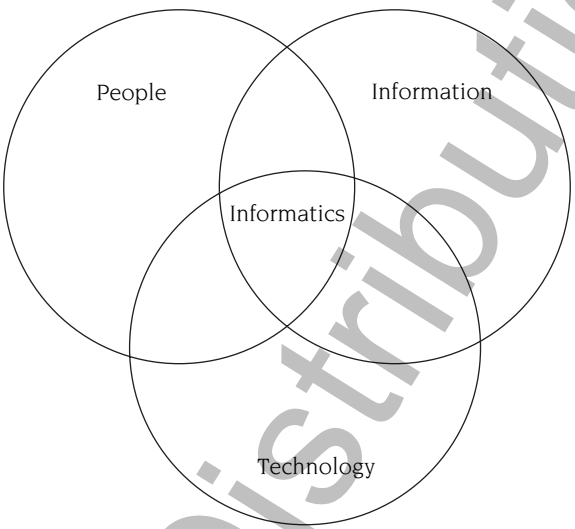
Historical Foundations and Contemporary Definitions

The term *medical informatics* first appeared in the 1960s in France. The first informatics programs appeared in the United States in the 1970s.[1] Today, the National Library of Medicine defines **medical informatics** as "the field of information science concerned with the analysis, use and dissemination of medical data and information through the application of computers to various aspects of health care and medicine."[2] Simply stated, **informatics** is the use of computers to manage data and information. Figure 1–1 illustrates that informatics exists at the intersection of people, information, and technology.[3] Throughout this chapter and book, authors will expand on these components of informatics.

Although the foundational definition of informatics is simple, in today's health care environment, many are likely to encounter confusion and a lack of clarity surrounding informatics. This chapter describes the most widely accepted terminology and structure for informatics, which is also the editors' preferred method for describing the field. Confusion about informatics has been attributed to what has been described as an "adjective problem" within informatics. The adjective problem arises from the addition of words—such as *pharmacy*, *dentistry*, *nursing*, and others—in front of informatics to narrow its focus. The most comprehensive term ***biomedical and health informatics*** describes the "optimal use of information, often aided by the use of technol-

FIGURE 1–1

Core components of informatics.



Source: Information extracted from Reference 3.

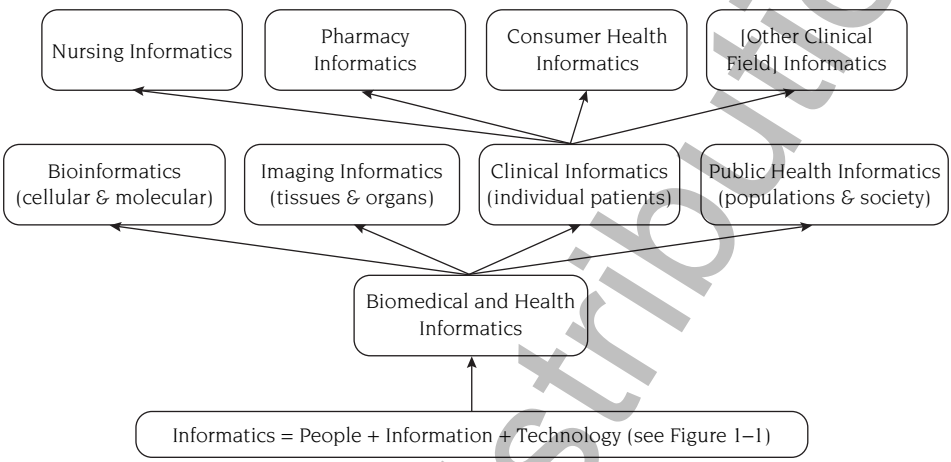
ogy, to improve individual health, health care, public health, and biomedical research."[3] The terms may be used separately (i.e., *biomedical informatics* and *health informatics*) in place of the comprehensive term.

The term *medical informatics* is also often used. In the strictest sense, medical informatics describes the application of informatics in health care settings (which closely matches the National Library of Medicine's definition) and is a subordinate component of biomedical and health informatics. Other key definitions include the following[3]:

- **Bioinformatics:** Application of informatics to cellular and molecular biology.
- **Public health informatics:** Application of informatics in areas of public health (surveillance, reporting, and health promotion).
- **Consumer health informatics:** Application of informatics to support the patient's health activities.
- **[Other clinical field] informatics:** Application of informatics to specific health care disciplines.

FIGURE 1–2

Biomedical and health informatics relationships.



Source: Adapted from References 3 and 4.

Figure 1–2 depicts the relationships between these terms.[3,4] The figure illustrates that people, information, and technology provide the foundation of biomedical and health informatics. Bioinformatics and clinical, imaging, and public health informatics are subordinate components of biomedical and health informatics; these components exist on the same tier. Recall that medical informatics represents the application of informatics in health care settings to the care of individual patients. M*edical informatics* is often used interchangeably with *clinical informatics*. Pharmacy informatics and nursing informatics, for example, represent informatics applied to these specific health care disciplines and are types of clinical informatics. Consumer health informatics exists on the same tier as the informatics applied to pharmacy, nursing, and other clinical fields.[3] Table 1–1 contains additional definitions with which readers should become familiar.[3,5,6] These terms will be encountered throughout this text and in pharmacy practice.

The Case for Informatics: National Perspectives

In 1996, the Institute of Medicine (IOM) launched a series of reports (books) that examined the state of health care delivery in the United States. The first book identified and defined the problem, which was quite startling: Medical

TABLE 1–1

Core Informatics Terms and Their Definitions

Term	Definition
Information technology (IT)	Activities and tools used to locate, manipulate, store, and disseminate information.
Information and communication technology	Term often used to indicate IT with a focus on communication and networking.
Health information technology (HIT)	Use of information and communication technology in health care settings.
Health information management (HIM)	Discipline historically focusing on medical record management (in a paper environment); as medical records transition to digital, HIM has begun to overlap with informatics.
Imaging informatics	Broad term indicating the application of informatics to the management of images in health care.
Research informatics	Broad term indicating the application of informatics to health and biomedical research.
Informatician (informaticist)	Practitioners of informatics; they focus more on information than technology.
Clinical informatician	Clinically trained individuals whose expertise is applied at the intersection of IT and health care; focus is on successful adoption and use of HIT.

Source: References 3, 5, and 6.

errors lead to thousands of deaths each year in hospitalized patients, with estimates ranging from 44,000 to 98,000. The problem, however, was not found to originate with the people providing care; instead, the problem resided in the systems of care that lead to the occurrence of errors.[7] In an effort to improve the safety and quality of health care, subsequent books looked at the challenge of increasing the quality of health care delivery[8] and the role of the government (as a purchaser, provider, and regulator of health care) in influencing the private sector.[9] The fourth book brings us to the topic of informatics.

The IOM series of books had significant impact on health professions education, including the field of pharmacy and the domain of informatics. In the series, a clear progression was made: The first two books define the patient safety and medical error problem, identify factors influencing the problem, and identify methods to solve the problem. The third book (which focused on health care quality) called for an interdisciplinary

summit to determine the reform necessary to shift health professions education to a focus on safety and quality. The fourth book reports on the findings of the summit.

The summit, which included 150 participants from a variety of health-related disciplines, focused on the reality that health professions education did not adequately address the current and desired future state of health care delivery; health care professionals were not being educated in a manner that equipped them to adequately address the challenges they would face in practice. These challenges included:

- A health care system that was significantly segmented, leading to poor communication and continuity of care.
- A focus on acute care although the largest area of need is chronic care.
- An inability to efficiently and appropriately use the growing scientific knowledge base.
- Inadequate rate of adoption of IT.
- Inadequate involvement of the patient as a decision maker in the patient's care.
- An impending workforce shortage and discontentment among current health care workers.

The combination of all of these challenges indicated a need for substantial change in how health care was delivered in this country. This redesign of health care delivery could not occur without the efforts of the health care professionals within the delivery system. Unfortunately, the report concluded that health care professionals were not being educated in a manner that would equip them with the knowledge and skills to perform the necessary redesign. This signaled a need to change the content of health professions education.[10]

On the basis of the described challenges, the summit developed recommendations for the changes that should occur in health professions education. Specifically, the summit identified five core competencies. These competencies were intended to equip health care professionals with the knowledge and skills necessary to effectively navigate today's health care system while focusing on the requisite redesign that must occur to address the described challenges. The five core competencies are as follows[10]:

1. Provide patient-centered care: Focus on patients' needs, desires, and values by placing them at the center of their care; emphasize wellness and prevention.
2. Work in interdisciplinary teams: Providers should collaborate on patient care to ensure continuity.
3. Employ evidence-based practice: Augment clinical experience with the best available research.
4. Apply quality improvement: Apply safety principles to the process of care; measure quality and improve processes and systems where appropriate.
5. Utilize informatics: Use IT to communicate, manage knowledge, and support clinical decision making.

The publishing of these core competencies established a benchmark for health professions education. Some of the recommendations require a change (the necessary redesign) in the philosophy of health care delivery (establishing the patient as the driver of care), whereas others focus on the systems of care (interdisciplinary teams and quality improvement). The requirement to utilize informatics emphasizes the importance of health care providers' ability to use timely, relevant, and authoritative information that is critical to providing quality patient care. In fact, Leape et al. found that 78% of errors leading to adverse drug events (ADEs) and potential ADEs in a hospital setting were caused by seven system failures, and that all could have been improved through the use of better information systems.[11]

Does this suggest that informatics is intended to replace the judgment or knowledge of pharmacists and other health care professionals? Absolutely not. Informatics is a tool to support decision making by health care professionals. It extends the capabilities of pharmacists by equipping them with actionable knowledge to promote better patient care decisions. A theorem has been proposed to represent the relationships within informatics (Figure 1–3). The premise of the theorem is that a person working in conjunction with an information source is able to achieve greater results than if the person works alone. Several tenets of the theorem are important. First, the information source must provide information beyond what the person already possesses. Second, the person (pharmacist) and the information source work collaboratively to achieve a desired outcome. Although represented by a plus sign, the magnitude of the outcome is not numerically additive; instead, it is influenced by the interaction of the

FIGURE 1–3

A proposed theorem of informatics.

Source: Adapted from C. Friedman's description of the fundamental theorem of biomedical informatics in Reference 12.

person with the information source (as designated by the parentheses). Finally, the theorem does not suggest that the information source alone is able to achieve greater results than the pharmacist alone.[12]

Readers will see throughout this book that informatics tools are applied at the point of decision making. However, informatics activities also occur "upstream," where information is generated, collected, organized, and shared among systems to eventually be applied at the point of decision making. The key concept to recognize is that informatics supplements (or extends) the pharmacist's ability to provide patient care but does not replace the pharmacist as the medication use expert.

The Case for Pharmacy Informatics Education and Training

The Accreditation Council for Pharmacy Education (ACPE) is the national organization that defines the educational standards for pharmacy programs seeking accreditation. As described in the discussion of the development of competency standards, ACPE's current standards and guidelines (adopted in 2006 and became effective July 2007) identify informatics as a requirement for Doctor of Pharmacy programs. (See "Setting the Stage: Consensus-Based Development of Pharmacy Informatics Competencies" for discussion of the current state of the informatics requirement and how the requirement relates to the competencies in this book.) ACPE's standards are established through an extensive process that includes expert opinion, a multifaceted

open comment process, and a thorough review of the literature. For the current standards, this process lasted 3 years.

The standards are designed to equip graduates with the knowledge and skills to enter pharmacy practice. Accordingly, the standards reflect the current and anticipated future state of pharmacy practice. As such, current pharmacists can also benefit from foundational informatics education. For student pharmacists and pharmacists alike, the goal of this book is to equip readers with fundamental pharmacy informatics concepts, skills, and information, as defined in the discussion of the development of the competencies and developed according to ACPE's Standards 2007. All pharmacists will be impacted by information systems in virtually every aspect of practice. Patient records, medication usage information, insurance information, laboratory tests and results, and medication administration histories are just a few of the categories of information that are managed in electronic environments. Pharmacists must be able to input, access, share, critically evaluate, and use information in these systems to support their patient care efforts, regardless of practice setting. This book was written for these patient care efforts that every pharmacist performs.

For readers who desire a career in pharmacy informatics, the foundational information in this book will serve as a core component of the education necessary to develop expertise in pharmacy informatics. This book, however, is not intended to develop pharmacy informatics experts who are ready to step into a pharmacy informatics position after closing the book. Expertise in informatics is often developed through years of practical experience. Table 1–2 lists additional informatics resources, including professional associations and journals. The list is not exhaustive but does include the majority of the most well-known informatics resources.

Pharmacy Informatics Applied to Pharmacy Practice

As described in previous text, all pharmacists rely on informatics to support their practice. Regardless of the setting, pharmacy practice (like the practice of most other health care providers) is an information-based science. Pharmacists spend much of their time gathering, synthesizing, and acting on information. There are two broad categories of information used in the clinical informatics domains (Figure 1–2), including pharmacy informatics: patient-specific and knowledge-based information.[13]