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System Design and Engineering

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After reading this chapter, you should know the answers to these questions:

• What key functions do medical computer systems perform?
• Why is communication between medical personnel and computing personnel crucial to the successful design and implementation of a medical information system?
• What are the trade-offs between purchasing a turnkey system and developing a custom-designed system?
• What resources are available remotely for medical computer systems?
• What design features most heavily affect a system’s acceptance by health professionals?
• Why do systems in health care, once implemented and installed successfully, have a long lifetime?

5.1 How Can a Computer System Help in Health Care?

In Chapter 4, we introduced basic concepts related to computer and communications hardware and software. In this chapter, we see how information systems created from these components can be used by health professionals to support healthcare delivery. We describe the basic functions performed by health information systems and discuss important considerations in system design, implementation, and evaluation. You should keep these concepts in mind as you read about the various medical computing applications in the chapters that follow. Think about how each system meets (or fails to meet) the needs of its users and about the practical reasons why certain systems have been accepted for routine use in patient care whereas other systems have failed to make the transition from the research environment to the real world.

At a minimum, a system’s success depends on the selection of appropriate hardware and on the implementation of efficient data-storage, data-transmission, and data-processing methods. We do not discuss, however, the technical issues related to specific hardware and software choices—those determinations are beyond the scope of this book. Instead, we provide a general introduction to prac-
tical issues in the design and implementation of systems. In particular, we stress the importance of designing systems that not only meet users’ requirements for information but also fit smoothly into users’ everyday routines. There are many types of users of a healthcare information system, and often it is necessary to consider each, one at a time.

There are healthcare professionals, for whom the quality of the results is paramount, but who are invariably pressed for time. There are administrators, who have to make personnel and financial decisions crucial to institutional well-being. There are clerks, who may enter and retrieve much of the data. Some systems also provide for direct interaction by patients. In addition, there are operational personnel who maintain the system and ensure its reliability. Initially there are professional system designers and implementers, but their numbers and availability decrease as the systems move into routine operation. Before they depart, designers and implementers must provide adequate documentation and training. For instance, clerks require clear procedures for their interaction with the system so that errors are minimized. A central theme of this chapter is the importance of communication between healthcare and computing professionals in defining problems and developing solutions that can be implemented within an institution. With this perspective, we explore the factors that create a need for automation and discuss important considerations in the design, development, and evaluation of medical information systems.

5.1.1 What Is a System?

Until now, we have referred freely to medical information systems and computer systems. What do we mean when we refer to a system? In the most general sense, a system is an organized set of procedures for accomplishing a task. It can be described in terms of (1) the problem to be solved, (2) the data and knowledge required to address the problem, and (3) the internal process for transforming the available input into the desired output (Fig. 5.1). When we talk about systems in this book, we usually mean computer-based (or just computer) systems. A

![Figure 5.1](image_url)