management systems, and project scheduling and control systems (particularly useful in new construction and remodeling projects).

Preventive maintenance systems help extend the life of equipment and facilities and reduce costly failures. Routine maintenance can help organizations achieve significant cost savings by preventing repair and replacement costs. Additional benefits accrue, including preventing nonproductive downtime, improving the safety of the workplace, and decreasing the risk of patient or employee injury as a result of equipment malfunction.

Energy conservation is an important cost-saving strategy for healthcare organizations, as it is in all major sectors. Computer applications assist in monitoring routine and peak energy use, providing guiding tactics for reducing consumption. Actual utilization figures can be compared against calculated requirements, and a computer model can be developed to find economies and efficiencies. The energy management system also can be employed to implement the selected tactics, such as automatically lowering or raising room temperatures in areas that are unused at night or on the weekend.

Healthcare organizations frequently are involved in capital construction and major remodeling projects, and computer systems are an extremely useful aid in project management. These project scheduling and control systems typically employ a combination of integrated tools to manage personnel and activity scheduling, labor and materials costs, required resources, and periodic progress reporting. As a key component, these tools are used to document (1) all activities required to complete the project; (2) the relationships of these activities to one another, including those that can be carried out simultaneously and those that must follow a time sequence; and (3) time estimates for completing each activity. These data are used to generate a diagram of activities that shows the critical path (longest time required) for project completion and any opportunities for concurrent or fast-tracked activities. As activities are completed, actual completion times can be entered back into the calculation, and more accurate schedules can be prepared for the remaining work. These systems are excellent tools for dynamic scheduling and control of major projects. More detailed coverage of project management related to HIT is provided in chapter 10.

Office Automation Systems

Office automation helps to coordinate and manage people and workflow, link organizational units and projects, and coordinate work in the organization across levels and functions. Healthcare organizations use a variety of computing tools to carry out general office functions, such as word processing, email, project management, meeting schedules, and personnel calendars for work-related activities. These functions may be conducted using desktop workstations; laptop computers; or a variety of handheld devices, including tablets or smartphones. Use of systems for integrated word and graphic processing, scheduling, electronic filing of documents, and message or document transmission can dramatically improve administrative efficiency and reduce the costs of office operations.

Office systems can link parts of the organization together by scheduling meetings via electronic calendars and emails or texts. Email systems link offices and individuals, allowing electronic files to be forwarded to others or to be archived in a shared storage area for access by members of a work group. Laptops and handheld devices, wireless technology, and the internet have changed the way people work alone or together. Work groups and teams can meet and collaborate from anywhere—in the same conference room or in geographically separated offices—with full access to necessary software programs and organizational files.

This work environment is supported by *groupware*—collaborative software that enables sharing of information via an interactive network (e.g., a virtual workspace). This software–hardware combination not only facilitates real-time interaction among members of the group to improve problem solving and project management but also supports independent work tasks. Audio- and videoconferencing allow real-time interaction among team members. Group members may work asynchronously on project activities while maintaining the integrity of a shared work product. When used effectively, and provided employees are trained to use the electronic tools, the virtual office can be as productive as the traditional office. Typical groupware activities include the following:

- Email and discussion forums
- Teleconferencing
- Interactive videoconferencing
- Relational databases
- Document editing and management, including archiving and version tracking
- Group calendars and scheduling

SharePoint, a Microsoft product, is one example of groupware; Google Apps is another. Many other collaborative software products are available and include both synchronous and asynchronous functionality. Usage may be limited to single functions, such as shared space for document collaboration (Google Docs, Box) or virtual meeting space (Skype, GoToMeeting), or broad-scale integrated products to support the needs of virtual teams, sometimes referred to as computer-supported cooperative work (Grudin 1994).

Information Systems for Nonhospital Healthcare Organizations

As changes to payment models in the 1980s led to changes in delivery models during the 1990s, nonhospital healthcare organizations began implementing information systems to manage clinical services and business operations. Vendors quickly began designing and marketing software products to meet the special information needs of these organizations. Organization types that fall under the nonhospital category include ambulatory clinics; long-term care (LTC) facilities; home health agencies; physician practices; and many others, including retail clinics. Software applications used in these settings typically include multiple modules that meet the organizations' needs for clinical documentation, operations management, and financial management. In the current healthcare environment, these organizations' ability to share information with hospitals, health systems, payers, and regulatory agencies is paramount.

Ambulatory Care Information Systems

Significant components of the healthcare continuum are delivered in outpatient and ambulatory care settings. Information systems that support ambulatory care and assist primary care providers in their practices have become a niche market. The availability of powerful and inexpensive microcomputers and practice management software packages has brought this technology within the reach of even small medical groups and solo practitioners. Meaningful use legislation and incentives to adopt electronic health record (EHR) technology have contributed to the current state, in which more than 70 percent of physicians have adopted certified EHRs (Heisey-Grove and Patel 2015). The EHR was discussed in more detail in chapter 8.

A typical practice management system (Slovensky et al. 2006) includes modules to support such business functions as the following:

- Operations management (e.g., scheduling, reminders, billing, authorizations)
- Services (email, groupware)
- Claims processing
- Document processing, spreadsheets, and databases
- Transcription
- Personnel management
- Inventory management
- Waste management
- Energy management

Clinical applications in medical practices and freestanding clinics include EHRs, prescription management, and disease management resources. Patient applications—an emerging software market—include electronic communication, monitoring, educational resources, and telehealth applications. Various vendor products offer full-service suites or selected modules based on the practice's needs.

Automating practice functions increases operational efficiency and reduces errors in information processing, both of which contribute to patient satisfaction and reduced risk and liability exposure. Automating or using web-based patient communication for services—such as callbacks, prescription renewals, and similar activities—can be helpful as well.

Office practice computers can be linked to local hospitals in addition to serving the management needs of the practice. Many hospitals or integrated delivery systems have developed computer linkages with physician offices to enable clinicians to preadmit patients; order diagnostic tests; and query the patient information system for lab results, progress notes, and other current clinical information. Healthcare organizations use such linkages as incentives to attract physicians to their facilities.

Long-Term Care Information Systems

The LTC sector was a late adopter in implementing computer systems, in part because software vendors were slow to develop products tailored to the needs of nursing homes and continuing care communities. This situation changed as the scope and volume of healthcare delivered in subacute care and post-acute care facilities increased. Typical requirements for LTC systems include census management, initial and periodic resident assessments, documentation of care services provided, documentation of physician orders, nutritional assessments and menu planning in the dietary department, and pharmacy applications.

The ability to communicate clinical information between caregivers and the admitting physician is especially important, as the physician usually is not physically present on a daily basis. Remote access to clinical documentation facilitates timely intervention in an acute episode and contributes to better health outcomes. As with other HIT applications, remote access can be achieved using various computing devices or telephone systems. System security and controlled system access are extremely important.

For LTC facilities that are components of larger integrated delivery systems, electronic sharing of clinical and administrative information with hospitals, clinics, ambulatory care facilities, and other system components is a business essential. Once again, data sharing among the enterprise units and IT strategic partners is a key driver in system design.

Home Health Care Information Systems

Home health care services have expanded rapidly in recent years as an alternative to more costly institutional care. As service volume has increased and the scope of services expanded, information systems have been developed specifically to meet the needs of home care provider organizations.

Many home health agencies use laptop computers and other remote access devices for on-site documentation of patient care and for access to treatment plans and records of previous encounters. Home health nurses and other caregivers enter information at the treatment sites and upload it to the centralized data repository. Relevant data can be accessed during a service visit by any provider. These systems reduce the amount of administrative work needed to document care, allowing nurses and home health aides to spend more time providing patients the care and services they need to achieve desired clinical outcomes.

Electronic devices also can transmit clinical information via telephone lines or the internet for the purpose of routine health monitoring between visits. Patients and family members follow the documented treatment plan, take and record measurements as indicated, and submit data for evaluation by the clinical personnel overseeing their care.

Other Information System Applications in Healthcare

Information systems support most processes in healthcare. While many applications can be categorized by their use for a defined function, many serve the needs of multiple providers and managers in disparate service areas. Clinical information may be combined with administrative information or used for an administrative purpose exclusively. Alternately, administrative information may be applied in the delivery of clinical care.

Websites and patient portals have become essential communication tools for engaging patients in their own care as well as for intrinsic marketing value. It is essential that websites contain current and accurate information and that navigation is intuitive and efficient.

Many healthcare organizations take advantage of the relative ease with which people access the internet via their smartphones to provide information to improve the total patient experience. (See Finding the Way for an example of one app that has helped a wide variety of users.)

Clinical Decision Support Systems

Clinical decision support systems (CDSSs) are designed to assist physicians and other providers in diagnosis and treatment planning. CDSSs fall into two categories: passive and active.

Finding the Way

The University of Alabama at Birmingham (UAB) campus covers more than 100 city blocks and includes dozens of healthcare delivery sites in addition to many academic and administrative buildings. Because UAB Hospital is a tertiary care facility, patients often travel significant distance for care and are unfamiliar with the campus. UAB Medicine Wayfinder is a Bluetooth-enabled app that can be accessed on a smartphone or a computer device. The free app, which has functionality similar to Google Maps, is available on Apple's App Store. In addition to maps and voice directions to clinics and diagnostic sites, the app also offers parking guidance, dining options, and other useful information. Additional information is available at www.uabmedicine.org/wayfinder.

Passive CDSSs use the computer to collect, organize, and communicate clinical data for interpretation and analysis by the physician. They make clinical information, including medical history, physical examinations, and diagnostic tests, more readily available and usable but do not process the information for further analysis. Clinical information systems—such as laboratory, pharmacy, radiology, and other clinical services applications—are examples of passive CDSSs in that they capture clinical data and make them available to caregivers. These applications become more useful to clinicians for decision support when they are fully integrated and can provide complete medical information (both current data and historical information on the patient) through simple, user-friendly access. For example, caregivers could view temperature, heart rate, and blood pressure readings over time to see patterns in relation to medication administration, physical activity, or food ingestion.

Active CDSSs provide direct assistance to the physician in diagnosis and treatment planning. They combine patient-specific data with generalized medical knowledge to reach a conclusion or make a recommendation to the caregiver. These systems may use a branching logic or rule-based structure, or a statistical probability algorithm, to suggest an appropriate diagnostic or treatment response to a clinical condition described by the physician. These systems incorporate validated clinical guidelines and treatment protocols that represent current best practices in clinical medicine.

The types of active CDSSs available include the following three:

1. *Expert systems* contain three major components—knowledge base, patient-specific information, and inference engine. A general knowledge base of medical information, obtained from a panel of experts in a given medical specialty, has been rigorously validated through scholarly

research, clinical practice, and consensus support from the medical community. This knowledge base is matched against patient-specific information retrieved from the healthcare organization's clinical database and may include subjective information as well as objective clinical findings. A rule-based inference engine generates conclusions for consideration by the physician. The system is dependent on the quality of the expert knowledge base and the "reasoning power" of the rules used by the inference engine.

2. *Probabilistic algorithms* employ statistical probabilities, which include a calculated element of randomness, rather than relying solely on knowledge collected from expert human beings. Expert knowledge is based on a combination of academic preparation and experiential learning, and variation may occur in either component of an expert's knowledge base. Extrapolations outside an expert's existing knowledge contribute to experiential learning. While a consensus viewpoint among experts incorporates nonquantifiable variability, a statistical probability allows the decision maker to control the degree of uncertainty tolerated in the system's output.
3. *Clinical reminders and alerts,* incorporated into clinical computer applications, suggest potential medical conditions or other problems that should be given attention in setting treatment plans. Examples include pharmacy information systems that alert the physician to potentially negative interactions between two drugs prescribed for the same patient as well as systems that suggest certain drugs or treatments should not be employed when specific lab results contraindicate their use. This function can also be used to suggest less expensive (but equally effective) alternatives when a high-cost drug has been ordered. Alternative drugs may also be suggested when the prescribed drug has significant risks for certain types of patients.

Computers can aid decision-making by simplifying access to data needed to make decisions, providing reminders and prompts, assisting in order entry, assisting in diagnosis, and reviewing new clinical data to issue alerts when important patterns are recognized. Systems are more likely to be successful when they give patient-specific suggestions, save time, and are incorporated into the regular workflow of the organization. Researchers at the University of Alabama at Birmingham (UAB) found that physicians using a decision-support rule accessed via a handheld device made better prescribing decisions than those who did not (Berner et al. 2006). The study, a randomized controlled trial, examined ordering practices for nonsteroidal anti-inflammatory drugs (NSAIDs). Physicians accessing the rule were more likely to order NSAIDs that were considered "safer" when considering gastrointestinal risk factors.

CDSSs that are well integrated with the enterprise EHR software offer great promise for personalized medicine (Bresnick 2016). Responding to variability among individual patients and applying the ever-increasing body of medical knowledge require information processing on a scale that cannot be achieved by human means. Well-designed systems can process large volumes of knowledge-based data filtered by personal clinical data and even by personal preferences for options among treatment modalities. Patients can be evaluated for risk factors for specific conditions, advised about prevention and early detection strategies, and assessed for probable effectiveness of various treatment options should the condition occur.

Executive Information Systems

The business corollary to CDSSs is the executive information system (EIS). Sometimes referred to collectively as *business intelligence*, EISs include systems designed to access and merge internal and external data into meaningful information reports. Executives identify critical environmental trends and facility performance indicators related to strategic objectives to guide their information capture and analysis. Data to support the EIS may be extracted from clinical and administrative databases serving the healthcare enterprise as well as from public and proprietary data repositories. The information needed from an EIS for decision support generally is not provided by standard reports. Users must be able to select the variables and data sources needed to answer specific questions, so ad hoc reporting capability is essential.

In many analysis scenarios, it is important to begin with general data aggregations and then reduce subsets of the data to increasingly greater detail, a process referred to as *drilling down*. The EIS must support this type of processing through an easily managed user interface. Chapter 11 provides a detailed discussion of the value, indeed, the necessity, of robust analytics capability to ensure the business intelligence and clinical evidence bases are sufficient.

Evidence-Based Medicine and Disease Management Systems

Evidence-based clinical practice guidelines, also referred to as *evidence-based medicine* (EBM), are intended to assist clinicians and healthcare organizations in standardizing decisions about the care of individual patients to achieve cost and quality benefits. Accumulated evidence from clinical research is used to formulate statements of the "right" things to do for patients with a given diagnosis or condition. Ideally, guidelines ensure that patients receive appropriate diagnostic tests and treatments in an efficient and cost-effective manner. Guidelines are assumed to lower treatment costs by avoiding unnecessary tests. Although managed care organizations and health insurers employ such guidelines to make decisions about treatment options, covered services, and other aspects of patient care, practice guidelines are not without significant limitations. Among these limitations are differences in local standards of care, access to recommended technologies, and unique patient characteristics.

While linkages to EBM resources are commonly incorporated in clinical systems for large inpatient facilities or integrated healthcare delivery systems, small clinics or medical practices may rely on independent access to EBM resources via the internet. In these types of primary care settings, the clinician typically is using some component of the office automation system—desktop computer, laptop, or handheld mobile device—for internet access. In this type of environment, convenience is an important factor in determining whether the clinician will seek external information. Research has shown that primary care providers who report using HIT resources as part of their patient encounter routines are likely to conform to evidence-based standards of care (Davis and Pavur 2011). An important caveat to this finding, however, is that providers who used small handheld devices as their primary computing tool did not have the same level of compliance with these standards. As noted in chapter 5, the size of the display screen relative to the output being displayed is an important system design characteristic. The small screens on handheld devices and the difficulty of entering precise input data using an ultracompact keyboard make them a poor choice for this purpose.

Disease management information systems and software products are designed to assist healthcare organizations in designing processes to provide quality care at the most reasonable cost possible. For the most part, they are disease specific and focus on high-volume, high-cost chronic conditions such as asthma, diabetes, and congestive heart failure. The typical approach is to involve patients in self-management of their condition and to create monitoring and feedback processes that encourage compliance with treatment plans. The information system may include capturing blood or urine test data, blood pressure readings, and other clinical information in the patient's home and transmitting it to the healthcare organization via mobile or remote monitoring devices. Communication between patients and providers may be via telephone or the internet. While routine patient monitoring assists in daily decision-making, analyzing aggregated data can guide case managers and physicians in modifying treatment plans for better long-term clinical outcomes.

Computer-Assisted Medical Instrumentation

Virtually every piece of medical equipment used for diagnostic testing and treatment now contains a microprocessor. The processors are used for instrument control, image enhancement, or processing medical data and interpreting the results of the testing or treatment process. Common examples include electrocardiograms, electroencephalograms, and pulmonary function testing. Computer systems interface directly with patient-monitoring devices for continuous surveillance of a patient's vital signs and periodic display of physiological data. These systems are particularly useful in critical care and postsurgical units.

The first step in the process is acquiring data from monitoring equipment attached to the patient and then converting that data for computer processing and display. Data are stored and made available for periodic display or display on demand. Computer programs enhance the measured data through structured analysis of clinical data in accordance with programmed decision rules. Trend data are followed to monitor changes in patient vital signs over time. Patient-monitoring systems can operate at the individual patient bedside, a central station designed to monitor a small number of intensive care beds, or a remote location linked back to the care unit by telecommunication equipment. For example, output from cardiac monitors may be monitored remotely by trained monitoring personnel, who in turn alert caregivers about aberrant readings. Many of these systems also have electronic linkages for transmission of clinical data to the EHR.

Coupling automated patient identification with electronic biomedical devices can produce significant efficiency gains in many routine tasks. UAB Hospital in Birmingham, Alabama, for example, found that using a bar code scanner to read codes on the patient's electronic monitor and armband, and transmitting recorded vital signs to the EHR, resulted in a 92 percent efficiency gain in recording vital signs and decreased the number of errors in documentation significantly (Hicks 2009).

Telemedicine and Telehealth

Telemedicine—now sometimes referred to as telehealth or e-health systems—is the application of computer and communications technologies to support healthcare provided to patients at locations remote from the provider. Telemedicine often involves telephone and online communication between a primary care physician, nurse practitioner, or physician's assistant who is treating patients in a rural area and specialty physicians located at a distant medical center. Audio communications and videoconferencing equipment are used in conjunction with computer access to patient records to establish primary diagnoses or provide expert consultation and second opinions. The systems may employ teleradiology for transmission of medical images for review by specialty physicians. Telemedicine systems can save patients travel time and costs as well as deliver healthcare cost savings to patients and providers.

Telemedicine applications have increased in recent years, resulting in part from the advent of mobile computing, which enabled the deployment of *mHealth*—health-focused applications accessible to the general public. These user-friendly and low-cost applications allow patients to monitor and report health indicators such as blood pressure or blood glucose easily and conveniently. A 2016 Congressional report estimated that "61 percent of healthcare institutions currently use some form of telehealth," including

40–50 percent of hospitals (Mack 2016). The most prevalent uses are remote patient monitoring, communication with patients, and providing counseling for patients with conditions related to cardiovascular disease, diabetes, behavioral health complications, rehabilitation, and respiratory disease (Totten 2016).

However, for traditional telemedicine applications such as specialist consultation or remote diagnostic procedures, many challenges related to reimbursement for remote services, patient privacy protection, and government regulations have been impediments (Thompson 2006). One long-time limiting factor, state licensure of health professionals when the system crosses state or national borders, is being mitigated through the Interstate Medical Licensure Compact Commission (Stewart 2017). Licensure boards in states that pass legislation to adopt the compact agree to share information with other boards to streamline the licensure process. Clinical outcome benefits achieved through various telemedicine applications vary, as do cost savings.

The types of articles published in the *Journal of Telemedicine and Telecare* over the past few years suggest that the number and variety of telemedicine applications continue to increase as technology innovations offer more opportunities. Research on patient satisfaction with telemedicine applications appears to be declining. As computer technology pervades business and social environments, individuals may be more accepting of telemedicine and mHealth applications. Although age is sometimes identified as a barrier to technology acceptance, one nine-month study showed that frail elderly subjects were able to use a web-portal telehealth service to reduce their use of facility-based healthcare (Finkelstein et al. 2011). Subjects needed minimal training to use the web portal, and their self-ratings showed improvement in technology acceptance over the course of the study.

Research involving a US Department of Veterans Affairs cohort showed that patients rated service access and educational components of telehealth programs positively, but they reported frustration with equipment problems and slow responses to requests for assistance (Young et al. 2011). Incorporating routine monitoring of these elements of a telehealth service is pivotal to the long-term success of the service.

The ability to meet data-sharing requirements for telemedicine encounters are emerging as key factors in the sustainability of e-health systems (Ganguly et al. 2009). Telemedicine providers need access not only to clinical data, such as that extracted from an EHR, but also to research findings and other knowledge-based information. Thus, the data exchange protocol must address both standard format data and free-text formats.

Computer Applications in Medical Research and Education

Information systems and medical databases are used extensively to support biomedical education and research. Computerized patient records serve as the basis for epidemiological studies of a variety of diseases and their potential linkages to social and environmental factors. In addition, computers are used to support medical, dental, nursing, and allied health education, using such techniques as computer-aided instruction and patient-management simulation.

Computers are an integral component of most medical research projects. Effective project design requires close collaboration among clinicians, biostatisticians, and information systems specialists. Some research projects would not be possible without the high-speed computational capabilities and data storage capacity of large computer systems. An excellent example is the Human Genome Project, which mapped all the genes of the *Homo sapiens* species. One element of the map detailed all sequences of DNA chemical bases—an astounding three billion pairs. Analytical work of this magnitude is inconceivable without supercomputing capabilities.

Hospitals, medical libraries, and individual clinicians use personal computers to access references to the medical literature and full-text online documents. The most widely used bibliographic databases are available through the National Library of Medicine (www.nlm.nih.gov). Articles from thousands of biomedical journals are indexed, stored in computer files, and available for search and retrieval using standard medical subject headings and keyword searches. The internet is used extensively to retrieve clinical information from a wide variety of specialty databases and sponsored websites.

Computers are an important tool for the education of clinicians. Computer-based education for physicians and other health professionals engages the students actively in the learning process and builds foundational skills in preparation for clinical training. Learning activities range from presentation of information to students via the internet or course management systems to sophisticated simulations of clinical problems. Students are presented initial cues and additional information on request as they proceed through a diagnostic process. Final diagnosis, patient management, and follow-up plans selected by the students are entered, and the system responds with a comparison to the "ideal" solution and critiques the process followed.

Increasingly, computerized mannequins are used to teach clinical skills in a lab environment before health professions students are assigned to healthcare organizations for clinical practice. These mannequins also can be used in continuing medical education as a tool for testing new technologies or exploring procedure innovations.

Summary

Most healthcare organizations began using electronic data processing by developing or purchasing financial information systems. Financial applications remain essential, but from a broader perspective, healthcare organizations use computers and information systems to support not only financial activities but also all administrative operations, including human resources management, resource utilization and scheduling, supply chain management, facilities and project management, and office automation.

As healthcare is delivered frequently in outpatient and nonhospital settings, development of information systems that support the needs of these delivery sites was pivotal to achieving data sharing required for seamless patient care. Typical functions for ambulatory settings include patient scheduling and appointments, electronic medical records and medical management, patient and third-party billing, managed care contract management, and electronic communication with other providers in a network of care. LTC systems support census management, residential care documentation, pharmacy, and other areas of operation in skilled nursing facilities. Home health providers use laptop computers or other remote-access devices to document care at the location where it is provided and to access clinical data from previous encounters. Integration or connectivity between the hospital-based enterprise and these other care sites is pivotal to managing patient information across the continuum of care.

Applications developed to assist physicians and other providers in the delivery of high-quality care include CDSSs and evidence-based medicine programs. These tools aid in diagnosis and treatment planning and comparing treatment plans with established "best practices" using large databases.

Computers have become an integral component of medical equipment for instrument control, image enhancement, and medical data processing. These foundation applications evolved into sophisticated integration of computer and communications technology in telemedicine applications that support patient care at remote locations.

Information systems are used extensively to support biomedical education and research. Automated databases of patient records support epidemiological studies of disease linkage to social and environmental factors. Computer-assisted instruction and patient-management simulation programs support the education of physicians and other health professionals.

Simply stated, no aspect of healthcare delivery or health services management is untouched by computers and information systems. The computer, in its various forms, has become a ubiquitous tool used by clinicians and managers alike. Technological evolution has produced powerful machines whose functions are optimized through the judicious selection of software to meet business and care delivery needs.

Because the healthcare sector became technology-centric through a "natural, inevitable and necessary evolution" (Bowman 2016), many clinicians developed their computing skills through a combination of self-learning and focused training as systems were implemented in their organizations. Thus, a great deal of variability exists among hospital staff with regard to skill levels with the dynamic digital technologies used to manage patient care and operational activities.

Web Resources

A number of organizations (through their websites) provide more information on the topics discussed in this chapter:

- HIMSS (www.himss.org) is a global, not-for-profit organization of approximately 70,000 members that is "focused on better health through information and technology." It provides networking and collaboration forums, sector reports and surveys, as well as education programming and technology resources.
- *Healthcare Informatics* (www.healthcare-informatics.com) is a magazine that provides information about vendors of IT products and information systems management services.
- Healthcare Financial Management Association (HFMA) (www.hfma.org) is a member organization for healthcare finance and business leaders.
- KLAS Enterprises (www.healthcomputing.com/VendorDirectory) offers information about vendors of software, services, and medical equipment.
- The American Academy of Professional Coders (www.aapc.com) is a "training and credentialing organization for the business of healthcare" with special focus on medical billing and coding and clinical documentation.

Discussion Questions

1. Why are administrative systems more evolved than clinical systems?
2. What features of handheld devices make them inappropriate for some medical computing applications?
3. What are the key components of groupware as a resource to the management team?

4. What aspects of clinical applications support quality management and cost-control programs?
5. Describe various functionalities of a pharmacy information system that can aid in reducing medication errors.
6. Distinguish between the logic used in an expert CDSS and systems that employ probabilistic algorithms.
7. What are some ways that HIT contributes to patient satisfaction?
8. Why has HIT development in some segments of the healthcare field, such as long-term care, lagged behind other segments?
9. What challenges do legacy systems pose for enterprise system integration?
10. How are transaction-processing systems employed in financial information systems?
11. What is the purpose of the chargemaster?
12. What are the key functions of a human resources information system?
13. How can centralized scheduling systems contribute to the financial bottom line?
14. List some of the key drivers and some of the challenges of employing telemedicine applications in a healthcare organization.
15. What are the typical elements of a physician practice management system?
16. Describe the basic documentation requirements for an LTC information system. How do these requirements differ from those for the information system used in an inpatient facility?

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PART

III

STRATEGIC COMPETITIVE ADVANTAGE