CHAPTER

1

CONNECTING THE STRATEGIC DOTS: DOES HIT MATTER?

Learning Objectives

1. List and define five major challenges facing healthcare delivery systems today.
2. Describe the complexity of these interrelated challenges for healthcare and healthcare information technology.
3. Illustrate the history, development, and current state of healthcare information systems.
4. Name and describe the four categories of healthcare information systems.
5. Analyze the key priorities of healthcare information systems today that will affect their future.

Healthcare Information Technology: The Future Is Now

Healthcare delivery continues to be an information-intensive set of processes. A series of Institute of Medicine (IOM 1999, 2001) studies suggests that high-quality patient care relies on careful documentation of each patient's medical history, health status, current medical conditions, and treatment plans. Financial information is essential for strategic planning and efficient operational support of the patient care process. Management of healthcare organizations requires reliable, accurate, current, secure, and relevant clinical and administrative information. A strong argument can be made that the healthcare field is one of the most information-intensive sectors of the US economy.

Information technology has advanced to a high level of sophistication. However, technology can only provide tools to aid in the accomplishment of a wider set of organizational goals. Analysis of information requirements in the broader organizational context should always take precedence over a rush to computerize. Information technology by itself is not the answer to management problems; technology must be part of a broader restructuring of the organization, including reengineering of business processes. Alignment

of information technology strategy with management goals of the healthcare organization is essential. Despite these cautions, effective design, implementation, and management of healthcare information technology (HIT) show great promise (De Angelo 2000; Glaser and Garets 2005; Kaushal, Barker, and Bates 2001; Smaltz et al. 2005a).

An essential element in a successful information systems implementation is carefully planned teamwork by clinicians, managers, and technical systems specialists. Information systems developed in isolation by technicians may be technically pure and elegant in design, but rarely will they pass the test of reality in meeting organizational requirements. On the other hand, very few managers and clinicians possess the equally important technical knowledge and skills of systems analysis and design, and the amateur analyst cannot hope to avoid the havoc that can result from a poorly designed system. A balanced effort is required: Operational personnel contribute ideas on system requirements and organizational realities, and technical personnel employ their skills in analysis and design.

This chapter sets the stage for what is discussed throughout the rest of the book. It begins with a brief overview of the current healthcare environment as a driver of healthcare information technology (HIT) and then presents the future trends in healthcare related to HIT. Next is a brief history of healthcare information systems and the state of healthcare priorities today. The last part of the chapter presents a framework of information systems categories.

The Current Challenges in the Healthcare Environment

While nothing is more dangerous than predicting the future, Goldsmith (1980) looked into the future of healthcare in the late 1980s. He foresaw a vastly different landscape for the delivery of care than existed at the time. He documented a number of demographic, secular, and organizational changes that would shape that future. Such changes included the growing elderly population, the decline of the hospital as the center of the healthcare delivery universe, the oversupply of physicians, the expanded role of government in financing healthcare, the shift of financial risk from payers to providers, the expansion of health maintenance organizations (HMOs) in various forms, and problems related to the uninsured. He observed that to address issues such as continuity, linkage, coordination, and accountability, changes in the organization of the healthcare delivery system would be required. One can question the accuracy of specific predictions made in Goldsmith's forecast, but most cannot deny that he was correct in the change in focus. Looking back, it is clear that these issues require added emphasis on improving the management of both healthcare information and its technology.

The complexity and challenges in healthcare delivery are many. To give a sense of this, consider that delivery systems today must provide high quality, timely care that attains full transparency regarding costs and quality; be mindful of growing privacy and security concerns of patients; utilize idiosyncratic, personalized medicine as appropriate; adhere to best-practice evidence; and adopt care coordination across settings and time (Wanless and Ludwig 2011). On top of this, with the accountable care organization model becoming supported through healthcare reform, delivery organizations may have more financial incentive to effectively implement disease prevention and wellness (CMS 2012a).

Consequently, we define five factors driving the current changes in the healthcare system: (1) healthcare costs, (2) medical errors and poor quality of care, (3) access and health disparities, (4) evidence-based medicine, and (5) broad organizational change.

Healthcare Costs

Healthcare costs continue to spiral upward continuing a trend of the last 45 years; this is examined in more detail in Chapter 2 in our discussion of the healthcare triangle. The concern about persistent cost increases, and more important the value of dollars spent on healthcare services, appears to drive changes. A common belief is that high healthcare costs make the US economy less competitive and have different effects on different segments of the national economy. These contentions can be debated, and few have clear strategies to control costs, but we have seen and will likely continue to see cost control being implemented by government, by private payers, and even by consumers.

The evidence that we can control costs has been made more apparent by some recent popular analyses that examine differences in the utilization of services and costs across communities in the United States. Gawande (2009), for example, demonstrates a nearly twofold difference in healthcare expenditures for the Medicare population in communities that are otherwise similar in demographics and objective need for services. If these differences exist broadly, then some of the cost of healthcare may reflect practice patterns or other factors that we cannot justify. It is clear that better data—aggregated and compared across regions—will enable us to investigate the differences further. HIT at the organizational level, shared with regional and national entities, will be called on to address these issues.

Medical Errors and Poor Quality of Care

According to the IOM's 1999 landmark report, *To Err Is Human*, medical errors are a leading cause of adverse health consequences in hospitals. The report estimated that at least 44,000 and as many as 98,000 individuals die

in hospitals per year as a result of preventable medical errors. Errors also resulted in greater direct and indirect costs borne by society as a whole. The report stated that "the total national cost associated with adverse effects [of medical errors] was approximately 4 percent of national health expenditures in 1996" (IOM 1999, 41). Further, in 2001 the IOM issued a blueprint, titled *Crossing the Quality Chasm,* designed to help organizations fix the delivery system.

More than ten years after the publications of the IOM reports, unnecessary deaths from medical errors (preventable and otherwise) and poor quality of care are still occurring at a high rate (Sternberg 2012). Estimation of the number of errors are difficult because no centralized reporting mechanism exists (Doheny 2009). We have seen the costs of poor quality and excessive medical errors, but the solutions to this complex problem are elusive.

Access and Health Disparities

The myriad problems arising from the failure of the US healthcare system to provide reasonable access to care have been well documented (Families USA 2012). While better information systems and exchange of information can address these challenges, they cannot directly solve all of them. Dealing with the uninsured will put a greater strain on the collection and reporting of clinical and administrative data at the organizational and system levels. The number of those uninsured is so large that the entire healthcare delivery system will be challenged as we implement policies to expand coverage. Data suggested that in 2010 just short of 50 million people were uninsured in the United States (DeNavas-Walt, Proctor, and Smith 2011). This estimate represented just more than 16 percent of the population and had been increasing since about 1980. However, according to recently released data, the number of uninsured dropped to 48.6 million (see Exhibit 1.1), representing 15.7 percent of the population, in 2011 (De-Navas-Walt, Proctor, and Smith 2012). This is a movement in the right direction, but the magnitude of the uninsured is still a current managerial challenge.

Evidence-Based Medicine

Evidence-based medicine grew in the late 1990s (Clancy and Eisenberg 1998) and has become mainstream, as indicated by the publication of at least one online evidence-based medicine journal (e.g., *Evidence-Based Medicine for Primary Care and Internal Medicine* launched in 1995). Landry and Sibbald (2001) define *evidence-based medicine* (EBM) as "an information management and learning strategy that seeks to integrate clinical expertise with the best evidence available to make effective clinical decisions that will ultimately improve patient care." It is a systematic approach to diagnosis

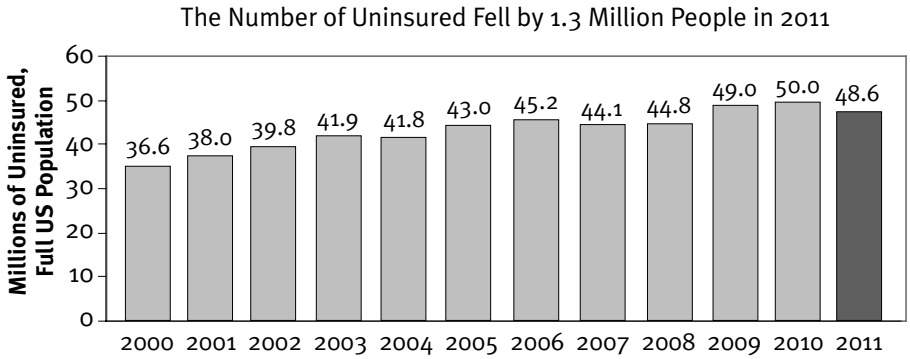

EXHIBIT 1.1
The Number of Uninsured, 2011

SOURCE: Reprinted from US Census Bureau (2012).

and treatment that encourages the physician to formulate questions and seek answers from the best available published evidence. EBM has gained momentum as an important mechanism for improving healthcare delivery. Some even suggested that EBM could become the new paradigm for organizations to follow in providing care; in fact, Moskowitz and Bodenheimer (2011) recently proposed the concept of "evidence-based health," which requires the involvement of patients and their community, to expand the EBM model. To successfully incorporate EBM into healthcare, participants in healthcare organizations (i.e., physicians, patients, managers) must agree to follow the evidence wherever it applies (Ellwood 2003). For balance, widespread implementation of EBM may have bumps. Some have begun to caution that the transition to "evidence" given the proliferation of information on the Internet may apply pressure on providers (Diamond and Kaul 2008).

The focus of this book lies between two extreme views of the managerial world. The creation, storage, and retrieval of evidence for health management decision making necessarily involve HIT. The use of HIT, however, is associated with both costs and benefits. These costs and benefits need to be assessed, and healthcare managers need to develop their skills in using internal health information intelligently and entering into health information exchanges to support their organization's strategic and operational goals (Johnston, Pan, and Middleton 2002; Sidorov 2006; Williams et al. 2012).

Broad Organizational Change

Healthcare markets continue to change as they face ongoing efforts to manage costs, quality, and access. As these markets—and the major delivery organizations in the markets—adapt, HIT will be required to accommodate

these changing needs accordingly. Market-driven healthcare reform and efforts to increase market competition, initiated in the 1990s, have evolved but still cannot be fully judged as to their effectiveness. Wilensky (2006) and Ginsburg (2005) provide interesting historical perspectives on the changing healthcare landscape. They demonstrate that in the mid-1990s, nearly 75 percent of people with employment-based insurance had some form of managed care, and HMOs constituted the largest component. Insurance companies and hospitals poured into this market because of the potential for profits.

As discussed earlier, the population of uninsured and underinsured US residents is still high, and disease prevention remains an elusive goal in most health plans today. This pressure will not subside in our opinion. Creating an organization and having the leadership in place to assist in meeting these and other challenges are essential. As we address in Chapter 4, the chief information officer (CIO) role will become even more essential in the future.

Future Challenges for Healthcare Information Systems

The factors that drive healthcare change today—costs, quality, access, evidence-based management, and organizational change—will not disappear in the foreseeable future because we have not solved the challenges associated with them. They also represent our future challenges. Look a little further out and see some other forces likely to alter the delivery of care. We have observed how technology has transformed banking, communications, retailing, and other industries. It seems, however, that healthcare and education are yet to fully absorb technology's ability to alter their respective landscape. We have identified five broad forces that will drive future change and potentially have profound impacts on information technology systems in and across organizations: (1) healthcare system change, (2) consumer empowerment, (3) connectivity, (4) transparency, and (5) tourism.

Healthcare System Change

The fundamental shift in thinking, partially expressed in the Patient Protection and Affordable Care Act of 2010 (discussed in Chapter 3), was largely overshadowed by the immediate emphasis on providing access to care for the uninsured population in the United States. Within that massive legislation were the seeds of experiments designed to identify other ways of operating the healthcare delivery system. Elements such as bundled payments, payment for outcomes, accountable care organizations, patient-centered medical

homes, and comparative effectiveness research all challenge the conventional fee-for-service payment and focus on the care of an individual patient. These changes will alter the sources of data that information management professionals will be required to identify, collect, store, analyze, and report. All of the challenges we face today will expand with the addition of sources of information and legitimate users of information outside of the normal organizational boundaries.

In the coming years, payment will be more oriented toward the outcomes generated and will cover the costs of a full range of services necessary to treat the patient. Already we are bundling Medicare payments for surgery and postsurgical care. Even broader ranges of clinical services—from presurgical assessments and testing to postsurgical clinical management and rehabilitation—are likely to be paid to a single provider. This expanded episode-of-illness system will fundamentally enlarge the sources of vital data that an organization must process. Because these data cross organizational lines, the episode-of-illness systems complicate how the data are linked and aggregated for reporting purposes. Starting in 2012, hospitals are penalized for excessive 30-day readmission rates, so leadership is demanding more information and intervention to make sure that patients are ready to be discharged and that essential follow-up care is provided.

Similarly, our responsibility for providing reasonable cost, high quality, and good access will shift from individual patients to populations. Monitoring and designing interventions to keep people healthy before they show up at the healthcare provider's door require a different type of thinking about data needs. For example, how do providers capture and assist the patient with uncontrolled diabetes living in the community but not yet showing up with out-of-control blood sugar?

Finally, as the government gets more directly involved in changing the system, it will fund research aimed at identification of positive changes. IOM (2009) identified the top 100 funding priorities as a means of guiding government research support. Brief descriptions of the ten priorities from the top quartile are as follows (IOM 2009, 107):

1. Compare the effectiveness of treatment strategies for atrial fibrillation, including surgery, catheter ablation, and pharmacologic treatment.
2. Compare the effectiveness of the different treatments (e.g., assistive listening devices, cochlear implants, electric-acoustic devices, habilitation and rehabilitation methods) for hearing loss in children and adults, especially individuals with diverse cultural, language, medical, and developmental backgrounds.

3. Compare the effectiveness of primary prevention methods, such as exercise and balance training, versus clinical treatments in preventing falls in older adults.
4. Compare the effectiveness of upper endoscopy utilization and frequency for patients with gastroesophageal reflux disease on morbidity, quality of life, and diagnosis of esophageal adenocarcinoma.
5. Compare the effectiveness of dissemination and translation techniques to facilitate the use of Comparative Effectiveness Research by patients, clinicians, payers, and others.
6. Compare the effectiveness of comprehensive care coordination programs, such as the medical home, and usual care in managing children and adults with severe chronic disease.
7. Compare the effectiveness of different strategies of introducing biologics into the treatment algorithm for inflammatory diseases, including Crohn's disease, ulcerative colitis, rheumatoid arthritis, and psoriatic arthritis.
8. Compare the effectiveness of various screening, prophylaxis, and treatment interventions in eradicating methicillin resistant Staphylococcus aureus (MRSA) in communities, institutions, and hospitals.
9. Compare the effectiveness of strategies (e.g., bio-patches, reducing central line entry, chlorhexidine for all line entries, antibiotic impregnated catheters, treating all line entries via a sterile field) for reducing healthcare-associated infections (HAI), including catheter-associated bloodstream infection, ventilator-associated pneumonia, and surgical-site infections in children and adults.
10. Compare the effectiveness of management strategies for localized prostate cancer (e.g., active surveillance, radical prostatectomy [conventional, robotic, and laparoscopic], and radiotherapy [conformal, brachytherapy, proton-beam, and intensity-modulated radiotherapy]) on survival, recurrence, side effects, quality of life, and costs.

Clearly, these are comprehensive assessments that will strain even the best data collection, reporting, and analysis systems for healthcare.

Consumer Empowerment

Related in some ways to the reform of the delivery system is that consumers have become increasingly sophisticated in their selection and use of healthcare services. Empowered by the Internet, consumers are seeking medical information and joining together in support groups as they interact with physicians and other healthcare providers. Goldsmith stated that "the patient is in charge of the process. . . . The Internet has enabled patients to aggregate their collective experiences across disease entities" (Reece 2000).

Although providers express legitimate concerns about misusing and misunderstanding information obtained from the Internet, they realize that the trend of Internet use by healthcare consumers is clear and irreversible. Oravec (2001) suggested that the healthcare system should help develop approaches to empower consumers to use the Internet effectively as one part of a total healthcare strategy, rather than simply warn them about the potential hazards of using inaccurate or misunderstood medical or healthcare information. Further, Ellwood (2003) outlined a comprehensive set of recommendations that arose from a health reform meeting held in Jackson Hole, Wyoming, in 2002. The Jackson Hole Group looked to Congress to set up a "uniform, national information infrastructure and a process for its further development and implementation" (Ellwood 2003). The proposal called for four infrastructure-related developments, which include electronic health records; evidence-based clinical practices; public disclosure, analysis, and feedback of quality performance information; and genuine patient power and responsibility.

Evidence shows that the consumer empowerment/involvement movement is growing and is highly integrated with the need for information management in healthcare. For a comprehensive overview of the history of social networking and social media not applied to healthcare per se, see Boyd and Ellison (2007). PricewaterhouseCoopers Health Research Institute (2012) has published results of a consumer participation survey related to healthcare. The findings reveal that age matters in who trusts and shares information (younger patients are more likely to trust and share). However, young people in poor health are also more likely to engage in health-related social media. Consumers in general are likely to share through social media any (positive and negative) information on the care received, on experiences with medication/treatment, and on specific physician or provider. Interestingly, a posting on social media raises the expectations for responses to consumers' request for appointment, information, and complaint. Consumers appear willing to seek a second opinion and choose a hospital/facility, physician, or health plan on the basis of the information they found on social media. All of this suggests that consumer preferences and managing the information of consumers will be vital to provider survival and raise the demand on HIT professionals to help address these needs. The concerns of rising consumer populism as opposed to consumer empowerment have already been raised as systems struggle to meet rising consumer expectations (Simborg 2010).

Connectivity

Related to the rise of the consumers and their connectivity is how providers and payers will change the healthcare delivery system and HIT needs as a result. Social media needs a series of hosts for transmitting connected

information. Not long ago, people relied heavily on the phone to communicate, but that technology is being supplanted by e-mail, text, tweet, and other mechanisms. This change is central for consumers, especially younger consumers, and is certainly worthy of significant study. As a brief overview, each year many bloggers post the top new technologies related to consumer connectivity and technology. For example, Swayze (2011) indicated the following nine trends, many of which occurred by 2012: "(1) Android invasion, (2) tablets galore, (3) Internet TV, (4) faster phones, (5) 3-D, (6) watching TV on the go, (7) cameras you can afford, (8) faster laptops with better graphics, and (9) techie cars."

The push toward connectivity has begun to permeate the health provider system as well. A good gauge of how this connectivity will proceed can be seen in a report from the Federal Communications Commission (2012). The Federal Communications Commission chair asked industry leaders to evaluate the "opportunities and challenges" arising from the widespread adoption of wireless health technologies. The result was the formation of the mHealth Task Force, which examined how patient care can be improved and made more efficient by the use of mobile health, wireless health, and e-Care technologies. The task force aims to make these technologies best practices by 2017; to this end, it identifies five broad goals (FCC 2012, 1):

> Goal 1: FCC should continue to play a leadership role in advancing mobile health adoption.
>
> Goal 2: Federal agencies should increase collaboration to promote innovation, protect patient safety, and avoid regulatory duplication.
>
> Goal 3: The FCC should build on existing programs and link programs when possible in order to expand broadband access for healthcare.
>
> Goal 4: The FCC should continue efforts to increase capacity, reliability, interoperability, and RF safety of mHealth technologies.
>
> Goal 5: Industry should support continued investment, innovation, and job creation in the growing mobile health sector.

The scope was broad in that the task force examined nine aspects of mobile technology (mHealth), as seen in Exhibit 1.2.

The types of challenges in adopting this technology are the subject of study for government and private specialists. For example, the National Institute of Standards and Technology (2010) has been convening a number of integrative forums to address such innovations as cloud computing. These often have strong proponents but also focus on the challenges that new technology presents to cybersecurity.

EXHIBIT 1.2
Nine Aspects of mHealth Activities Evaluated by FCC mHealth Task Force

- Medical devices that act as remote patient monitors used in clinical, home, mobile, and other environments
- Mobile medical and general health software applications that allow patients to upload or download health information at any time
- Medical body area network sensors that capture and wirelessly forward physiological data for further analysis
- Medical implant devices that allow neuromuscular microsimulation techniques to restore sensation, mobility, and other functions to paralyzed limbs and organs
- Medical device data systems that allow for the transfer, storage, conversion, or display of medical data through wired or wireless hubs, smart phones, or broadband-enabled products
- Mobile diagnostic imaging applications that allow doctors the flexibility to send or review medical images from virtually any place and at any time
- Patient care portals that can be accessed anywhere for self-reporting and self-management
- Accessible clinical decision support tools that allow doctors to help patients in real time with diagnosis, treatment options, and necessary medical calculations at the point of care
- Broadband-enabled HIT infrastructure that allows healthcare providers to share rich electronic health information with other providers, regardless of their provider organization and geographic area

SOURCE: Data from Federal Communications Commission (2012).

Transparency

The movement to greater transparency has been around for some time (Collins and Davis 2006), but it got a big national push with the federal government's Value-Driven Health Care initiative. An Executive Order signed by President Bush (2006) established value-driven care consisting of four cornerstones: (1) interoperable HIT, (2) public reporting of provider quality information, (3) public reporting of cost information, and (4) incentives for value comparisons. This government support added to the growing evidence that the system could improve in a number of ways if consumers, providers, and payers had better information on which to base their decisions. Early efforts in this regard concentrated on price transparency (Deloitte Center for Health Solutions 2007), but a Commonwealth Fund report suggested that price transparency was not in itself an answer to cost problems but could enable the development of the following (Collins and Davis 2006):

- Valid benchmarks of provider performance
- Quality and efficiency reward programs by payers
- Informed choices by patients

The report pointed out, however, that without transparency in outcomes and information on the "total cost" of care, price transparency could not enable consumers to make better choices. As discussed earlier, some broader changes are coming in the future. In any case, increasing transparency puts added pressure on healthcare's data systems to report more data and ensure all information is accurate and timely.

Tourism

Medical tourism is an important element of the future that will affect HIT. The prospect of US healthcare organizations losing patients to providers in third-world countries on the basis of price for select procedures or therapies could pose a major challenge. In addition to system effects, the information technology world would be made more complicated because these patients would want information about their medical history, tests, and prior procedures to be sent overseas. In addition, when the patients come back home, their surgical case information would have to be returned and then integrated into existing records of any follow-up care. There are many reasons, however, that traditional international medical tourism may not make as big an impact as first thought. The inability of average patients to afford long-distance travel to seek care for most clinical problems puts a limit on medical tourism's scale and scope. Further, despite quality assertions and some review by Joint Commission International, the lingering hesitancy by many people to try this trend may keep this at bay for years to come.

However, if the notion of medical tourism were expanded to include regional or cross-border travel within the United States as opposed to seeking only international providers, the issue takes on a whole new level of importance. Reports are still incomplete and the evaluation scale is not clear, but in 2012 Wal-Mart joined a number of large US employers that are contracting with select national delivery systems (known as centers of excellence) to provide specialty services to employees and their dependents (Diamond 2012). Lowe's and Boeing are also mentioned in this context, contracting with healthcare organizations with a national name recognition, such as Cleveland Clinic, Geisinger Medical Center, Scott & White Memorial Hospital, Virginia Mason Medical Center, and Mercy Hospital Springfield. The services include spine care, transplants, and heart procedures (Elliott 2012; Zeltner 2012).

Historical Overview of Healthcare Information Systems

The evolution of HIT will fill a text by itself, but a brief overview will help you understand where the system began and where it is likely heading. Many fine, classic summaries (e.g., Collen 1995) can help in this process along

with newly developed tutorials that effectively tell the history of healthcare information systems in the United States (e.g., National Training and Dissemination Center 2012). Exhibit 1.3 presents a list of the specific section of the Health IT Workforce Curriculum Components (a tutorial) that discusses the comprehensive history of HIT. It enables interested readers to absorb a broad perspective. Especially important to note in these historical presentations is how the medical education community and professional organizations grew and supported the infusion of HIT into the research and practice communities. For complete information on this and other courses, visit www.onc-ntdc.org.

The first computer systems in healthcare date back to the early 1960s, when a small number of hospitals began to automate selected administrative operations, usually beginning with payroll and patient accounting functions. These systems were developed by analysts and computer programmers hired by the hospitals, and they were run on large, expensive, and centralized computers referred to as "mainframes" (see Exhibit 1.4). Little attention was given to the development of clinical information systems to support patient care, and the paper medical record was the legal and clinical record of the treatment experience. The growth of medicine as a science that could benefit from systematic collection and analysis of information spurred analysts to expand computer applications to clinical medicine.

EXHIBIT 1.3 Detail of HIT Curriculum Component 5

Component 5: History of Health Information Technology in the U.S.

Unit 1. Evolution of Health IT: The Early Years
Unit 2. Evolution of Health IT: The Modern Era
Unit 3. Evolution of Health IT: The HITECH Act
Unit 4. Evolution of Public Health Informatics
Unit 5. Evolution of Nursing Informatics and HIT Tools Used by Nursing
Unit 6. History of Electronic Health Records (EHRs)
Unit 7. History of Clinical Decision Support Systems
Unit 8. History of CPOE and E-Prescribing
Unit 9. History of Health Information Exchange
Unit 10. History of Privacy and Security Legislation
Unit 11. Software Certification and Regulation
Unit 12. History of Mobile Computing
Unit 13. History of Telemedicine
Unit 14. History of Quality Improvement and Patient Safety
Unit 15. Payment-Related Issues and the Role of HIT
Unit 16. History of Health IT Organizations

SOURCE: Reprinted from National Training and Dissemination Center (2012).

EXHIBIT 1.4
Mainframe Computer

SOURCE*:* Courtesy of International Business Machines Corporation. Unauthorized use not permitted.

The medical record was still a relatively new concept, and standards for the paper version were established and widely adopted only in the 1960s. A few systems were developed for the electronic storage and retrieval of abstracts of inpatient medical records, but these systems contained limited information and were operated on a postdischarge, retrospective basis. The early "computer-based medical record" systems, such as COSTAR and RMRS, were attempts to capture the patients' experience in an easily retrievable manner.

Advances in technology during the 1970s expanded the use of information systems throughout all industries, and hospitals were no exception. These systems eventually became part of other healthcare settings such as clinics, physician office practices, and long-term-care facilities. Computers became smaller and less expensive, and some vendors began to develop "applications software packages"—generalized computer programs that could be used by any hospital, clinic, or physician's office that purchased the system. Most of these early software packages supported administrative operations, such as patient accounting, general accounting, materials management, scheduling, and practice management. Eventually, clinical systems

were developed as well, particularly for hospital clinical laboratories, radiology departments, and pharmacies (for a description of current applications, see chapters 9 and 10).

As the scientific knowledge base of medicine expanded during this period with funding from the federal government, effectively diagnosing and developing treatment for patients began to tax the capacity of providers. Clinical decision support systems, such as MYCIN and HELP, were introduced to assist providers to apply the rules for diagnosis and treatment. While computers helped with retrieval of information, providers found that specialization became essential. Consequently, the collection, storage, analysis, and reporting of the expanding body of healthcare information required professional specialization of the HIT community as well. Organizations for medical records professionals (e.g., American Medical Records Association, which later became American Health Information Management Association), informaticists and researchers (e.g., American Medical Informatics Association), and HIT practitioners (e.g., Hospital Management Systems Society, which later became Healthcare Information Management Systems Society) supported the professionalization and specialization of the HIT workforce.

A virtual revolution in computing occurred in the 1980s with the development of powerful and inexpensive personal computers (PCs)—desktop devices with computing power and storage capacity that equaled or exceeded the large mainframe systems of the 1960s and 1970s. A second major advance in this period was the development of electronic data networks, whereby PCs and larger computing systems could be linked together to share information on a decentralized basis. An increasing number of vendors entered the healthcare software business, and a much larger array of products became available for both administrative and clinical support functions. The use of PCs in physicians' offices, particularly for practice management, became commonplace. This ad hoc proliferation of systems and applications to meet specific clinical and administrative needs contributed to the system-integration challenges providers face today.

The 1990s witnessed even more dramatic changes in the healthcare environment with the advent of market-driven healthcare reform and expansion of managed care. Much greater attention was given to the development of clinical information systems and strategic decision support systems to assist providers in achieving a critical balance between costs and quality in the delivery of care. These changes were supported by advances in technology, through the use of laptop computers and, today, notebook computers or the iPad. This portable hardware expanded the ability of clinicians and other caregivers to take the data-collection tool with them, access information from virtually anywhere, and communicate with others in the care team quickly.

At the same time, electronic data interchange and networking were used to link components of integrated healthcare delivery organizations and support enterprisewide information systems. As a result, healthcare organizations now employ Internet technology to support internal communications and external connections with patients and business partners. Similarly, telemedicine applications can link primary care providers at remote locations with clinical specialists at centralized medical centers. These technologies provide potentially better access to high-quality care at reasonable costs.

As an example, the Electronic Health Network (EHN), operated under the direction of Dr. Glenn Hammack at the University of Texas Medical Branch (UTMB) at Galveston, uses cutting-edge video, digital, audio, and telecommunications technology to deliver care (Blanchet 2005). While this major commitment to telemedicine has many components, the major activity is EHN's Correctional Managed Care Program, which has provided "prison health" to individuals incarcerated in Texas prisons since 1993. Today, the program is a full risk-capitated delivery system. In 2004, it had $330 million in revenue, covered 166,000 lives, and employed 3,700 workers. Texas is a large state geographically, and the technology enables UTMB to effectively connect clinical care in more than 100 locations for the Texas Department of Criminal Justice, Texas Youth Commission, Dallas County Jails, and Federal Board of Prisons in Beaumont.

The electronic medical record (EMR) used in the EHN is its key component. The EMR is a security encrypted, full-time web-enabled record that gives the physician access to medical records regardless of patient location. It contains a pharmacy system for identifying drug interactions, and clinical laboratory and radiology services can input data and images directly into the system. UTMB finds that the expanded capacity to reliably, remotely deliver quality care for less cost makes sense for the organization.

While hardware and software continued to emerge and to be implemented widely, many began to realize that information systems were being developed in partial isolation. The ability of products to seamlessly connect and transfer information was being impeded by the lack of rigorously defined standards. Consequently, many in the industry began to call for industry and, ultimately, government standards. Some of the standard-setting organizations today include the following:

- International Organization for Standardization (ISO) (www.iso.ch)
- American National Standards Institute (ANSI) (www.ansi.org)
- Health Level 7 or (HL7) (www.hl7.org)
- Healthcare Information Technology Standards Panel (HITSP) (www.hitsp.org)

- Current Procedural Terminology (specifically CPT-4) of the American Medical Association (www.ama-assn.org)
- Health IT Standards Committee (www.healthit.gov)

As addressed in Chapter 3, government got heavily involved in the setting of standards after 2000. For an outstanding review and history of HIT standards, see Amatayakul (2007).

Categories of Healthcare Information Systems

Computerized information systems in healthcare fall into four categories: (1) clinical information, (2) operational management, (3) strategic decision support, and (4) electronic networking and e-health applications.

Clinical information systems support patient care and provide information for use in strategic planning and management. Examples include computerized patient records systems; clinical department systems for pharmacy, laboratory, radiology, and other units; automated medical instrumentation; clinical decision support systems (computer-aided diagnosis and treatment planning); and information systems that support clinical research and education.

Operational management systems support non–patient-care activities in the healthcare organization. Examples include financial information systems, payroll, purchasing and inventory control, outpatient clinic scheduling, and office automation.

Strategic decision support systems assist the senior management team in strategic planning, managerial control, performance monitoring, and outcomes assessment. Strategic information systems must draw data from internal clinical and management systems as well as from external information on community health, market-area demography, and activities of competitors. Consequently, information system integration—the ability of organizational information systems to communicate electronically with one another—becomes very important.

Healthcare organizations also engage in *electronic networking,* which supports data interchange with external organizations and business partners for such activities as insurance billing and claims processing, accessing clinical information from regional and national databases, communicating among providers in an integrated delivery system, and communicating with patients and health plan members. Many of these applications are web-based, *e-health applications.* Computer applications in healthcare organizations are described in detail in chapters 9 and 10 of this book.

Healthcare Information System Priorities Today

Healthcare organizations and their leaders operating in this environment of change must understand the history and evolution of HIT. They also must keep an eye on how the future will likely unfold if they want long-term success. Most important, however, is that they must provide valid, reliable, and secure clinical and administrative information to assist healthcare leaders in making optimal clinical, operational, and strategic decisions today. To this end, organizations are developing sophisticated information systems to support clinical and administrative operations and strategic management.

This book is designed to meet the needs of a variety of healthcare information professionals as they strive to support their private and/or their organizational missions. As a result, the chapters that follow address both focused, detailed information needs and broader corporate information needs. We hope that this format is useful to those with clinical backgrounds, technical backgrounds, and business backgrounds. Because individuals with these three types of backgrounds must learn to work together to achieve common goals, it is vital for each not only to gain knowledge to support their own domain but also to gain a deeper understanding of other's perspectives.

The book addresses the priorities of today by embedding one priority in each chapter:

- *Chapter 2: External environment.* The strategic direction of any healthcare organization is influenced by the world outside its walls. Gaining a deep understanding of the fundamental forces of change and the ability to observe and anticipate that change is essential to the long-term success of the healthcare information professional. In this chapter, we explore the healthcare triangle of cost, quality, and access because these challenges prompt government and market changes that must be addressed by any organization. We also examine evidence-based medicine and management because this will likely be the mechanism of change in the delivery of healthcare services. Finally, the chapter compares domestic with international systems because the many aspects of the US healthcare world are and will continue to be influenced by developments in other countries.
- *Chapter 3: Government policy and healthcare reform.* The US delivery systems are being buffeted by government regulations and other interventions that affect cost, quality, and access. This chapter examines recent government interventions that change the HIT landscape. Our discussion starts with the appropriate role of government and quickly turns its focus on the healthcare reform legislation—the Patient Protection and Affordable Care Act of 2010. Related challenges and

government programs are discussed as well, such as the HITECH Act, meaningful use of information technology, privacy and security, and healthcare information exchanges.

- *Chapter 4: Leadership*. Here, we examine the case of the healthcare chief information officer (CIO). To better manage the healthcare information enterprise, organizations need an appropriate structure. The roles of senior HIT managers are different today from those in the recent past, and thus their place within the organization must change as well. Senior-level HIT managers must become a part of the corporate strategy—both to understand organizational direction and to provide advice on the challenges that direction might impose from the information technology perspective. Similarly, HIT professionals must have a different set of skills to maneuver in the new organizational structure. CIOs must have leadership expertise and analytical/strategic thinking skills as well as be clinically savvy and technologically sound.
- *Chapter 5: HIT governance and decision rights*. To take advantage of the revised organizational structure and CIO leadership skills, HIT units must incorporate appropriate and effective governance structure. These are the necessary how-to components for ensuring that HIT infrastructure and operations reliably accomplish goals. The growing scale and scope of the information technology reach within the delivery system present major challenges to these assurances; thus, the importance of appropriate HIT governance expands accordingly.
- *Chapter 6: HIT architecture and infrastructure*. While leading successful HIT systems does not require an in-depth working knowledge of computer and communication technologies, a basic understanding of the physical and logical structure of information systems and their components is essential. This chapter offers an essential core lesson, clarifying the differences between hardware and software; providing examples of computer network structures; differentiating operating systems, utility programs, and application software; and exploring telecommunication concepts such as wireless technologies.
- *Chapter 7: HIT service management*. Operation of an HIT department has evolved and now consists of managing a complex set of interdependent elements. Unlike the other components of a healthcare delivery organization, all of HIT components must coordinate and communicate effectively, accurately, and securely. Consequently, service delivery and support services are vital to effective functioning. This chapter outlines the challenges of unplanned work and the necessity of implementing a process improvement framework for an organization. It also introduces the concept of an Information Technology Infrastructure Library and its components to assist HIT operations.

- *Chapter 8: Systems selection and contract management.* In the past, delivery organizations on the frontier of HIT development created their own information systems because integrated options from vendors were not available or adequate. Now, organizations purchase complex, integrated, and expensive HIT systems from a vast array of vendors. The selection of these systems constitutes a major financial, clinical, and administrative investment by an organization's leadership. The need to identify system requirements and ensure that vendors deliver those specifications in a timely manner requires a systematic approach to selection and contract management.
- *Chapter 9: Electronic health records.* In previous editions, the application chapter was small and primarily emphasized administrative/financial functions. This edition features two application chapters—Chapter 9 is devoted to the electronic health record (EHR) and Chapter 10 to management/administrative systems. Chapter 9 outlines the importance of EHR to the present and future of healthcare organizations. It discusses key capabilities, organizational benefits, costs of adoption, and methods of adoption/implementation. It follows up on meaningful use in the context of the EHR, the EMR, and the personal health record. In addition, it discusses related concepts such as the computerized physician order entry and constraints such as interoperability.
- *Chapter 10: Management/administrative and financial systems.* This chapter addresses the many conventional uses of HIT to support the overall goal of a delivery organization. The enterprise system applications include resource planning, financial management, scheduling, decision support, and research/medical education.
- *Chapter 11: HIT project portfolio management.* Successful HIT operations require conventional project management expertise. This chapter expands that necessary project management content to include HIT program and portfolio management techniques. The ultimate goal is to reach the synchronized stage of portfolio management. At this level, HIT leadership should regularly evaluate the portfolio with operational unit leaders. The evaluations should include both the risks and returns of the complete HIT portfolio.
- *Chapter 12: Knowledge-enabled organization.* Moving from operational effectiveness to achievement of strategic competitive advantage with HIT involves a transformation into a knowledge-enabled organization. The purpose of applying knowledge management is for it to become an integral part of the organization, thereby ensuring organizational success today and in the future. The chapter places a great emphasis on "baking in" the knowledge into workflows.

- *Chapter 13: HIT value analysis.* A formal, comprehensive valuation of a HIT system's direct and indirect costs will help organizations move to the next level of operational excellence. Too often, HIT decisions are based on partial assessments of both costs and benefits, a strategy that may spell doom in cost-competitive future scenarios. State-of-the-art valuation processes from other industries provide a full social benefit and cost assessment tool that will become part of our collective HIT future.

Summary

The management of healthcare organizations can be improved through the intelligent use of information. This requires systematic planning and management of information resources to develop information systems that support patient care, administrative operations, and strategic management. Change is occurring rapidly and persistently in the healthcare industry. Major forces of change that have a direct impact on the application of information technology include (1) continued pressure for healthcare cost containment, (2) concerns about medical errors and poor quality of care, (3) challenges from limited access to care and health disparities, (4) growth in the use of evidence-based medicine, and (5) need for broad organizational change. The US healthcare system is in the middle of fundamental change, and HIT plays a role in solving all its challenges.

As we look to the future, we see these five challenges remaining, so we need to consider the following: (1) healthcare system change, (2) consumer empowerment, (3) connectivity, (4) transparency, and (5) tourism. These, too, pose challenges and opportunities for HIT and healthcare leadership.

Healthcare information systems fall into four categories: (1) clinical information, (2) operational management, (3) strategic decision support, and (4) electronic networking and e-health applications. Clinical information systems support patient care and provide information for strategic planning and management. Operational management systems support non–patient-care activities, such as financial management, human resources management, materials management, scheduling, and office automation. Strategic decision support systems assist managers in planning, marketing, management control of operations, performance evaluation, and outcomes assessment. E-health network applications support electronic data interchange with external organizations and business partners, communication among providers in an integrated delivery system, and communication with patients and health plan members.

These environmental trends have resulted in a reordering of the information system priorities of healthcare organizations. To meet current and future challenges, HIT leadership needs a comprehensive view of healthcare information by considering external strategic alignment, internal strategic alignment, operational effectiveness, and achievement of strategic competitive advantage. The chapters that follow guide the reader through these four stages.

Web Resources

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

- Agency for Healthcare Research and Quality (www.ahrq.gov) is the health services research arm of the US Department of Health & Human Services that complements the biomedical research mission of its sister agency, the National Institutes of Health. It is home to research centers that specialize in major areas of healthcare and is a major source of funding and technical assistance for health services research and research training at leading US universities and other institutions.
- Bureau of Labor Statistics (www.bls.gov) has many components that report varied data regarding the US economy. Particularly, it presents detailed information on consumer prices at the national and state levels.
- Care Continuum Alliance (www.carecontinuumalliance.org/index.asp) is an organization dedicated to the improvement of population health.
- Centers for Medicare & Medicaid Services (www.cms.gov) offers access to a vast array of healthcare-related information regarding Medicare, Medicaid, research and statistics, and regulations.
- Institute for Healthcare Improvement (IHI) (www.ihi.org) is a not-for-profit organization leading the improvement of healthcare throughout the world. IHI's work is funded primarily through its fee-based program offerings and services as well as through support from foundations, companies, and individuals.
- National Association for Healthcare Quality (www.nahq.org) empowers healthcare quality professionals from every specialty by providing vital research, education, networking, certification, professional practice resources, and a strong voice for healthcare quality.
- National Committee for Quality Assurance (NCQA) (www.ncqa.org) is a private, 501(c)(3) not-for-profit organization dedicated to improving

healthcare quality. NCQA has been a central figure in driving improvement throughout the healthcare system, helping to elevate the issue of healthcare quality to the top of the US political agenda. Its mission is to improve the quality of healthcare with a vision to transform healthcare quality through measurement, transparency, and accountability.

- Office of the National Coordinator (ONC) for Health Information Technology (www.healthit.gov) is the primary federal agency responsible for coordinating efforts to promote and develop HIT infrastructure. The ONC was created in 2004 via an Executive Order and codified by the HITECH Act. Its aims are to improve quality of care while reducing cost, enhance coordination of care, encourage health information exchanges, and ensure a secure personal health record for the US population.

Discussion Questions

Because most developers are not clinicians and most clinicians are not developers, what measures are necessary to ensure the development of an effective healthcare information system?

1. What are the five most important challenges faced by HIT today, and why?
2. What are the five most important future challenges that will face HIT, and why?
3. In what ways may improved HIT assist in continuity, communication, coordination, and accountability of patient care? [Hint: Consider Goldsmith's discussion.]
4. How can HIT assist organizations in responding to the drivers of information technology changes?
5. Define and describe evidence-based medicine. Are there positive or negative aspects of this concept for the healthcare field?
6. Why is the improvement of clinical information systems a high priority to most healthcare organizations?
7. Order the following types of healthcare information systems from most important to least important to a healthcare organization, and discuss why you chose this order.
    a. Clinical information
    b. Operational management
    c. Strategic decision support
    d. Electronic networking and e-health applications