CHAPTER 7

Information technology in health care

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Information technology (IT) has the potential to improve the quality, safety, and efficiency of health care. Diffusion of IT in health care is generally low (varying, however, with the application and setting) but surveys indicate that providers plan to increase their investments. Drivers of investment in IT include the promise of quality and efficiency gains. Barriers include the cost and complexity of IT implementation, which often necessitates significant work process and cultural changes. Certain characteristics of the health care market—including payment policies that reward volume rather than quality, and a fragmented delivery system—can also pose barriers to IT adoption. Given IT's potential, both the private and public sectors have engaged in numerous efforts to promote its use within and across health care settings. Additional steps could include financial incentives (e.g., payment policy or loans) and expanded efforts to standardize records formats, nomenclature, and communication protocols to enhance interoperability. However, any policy to stimulate further investment must be carefully considered because of the possibility of unintended consequences.

By providing new ways for providers and their patients to readily access and use health information, information technology (IT) has the potential to improve the quality, safety, and efficiency of health care. However, relatively few health care providers have fully adopted IT. Low diffusion is due partly to the complexity of IT investment, which goes beyond acquiring technology to changing work processes and cultures, and ensuring that physicians, nurses, and other staff use it. In addition, certain aspects of the market—such as payment policies that reward volume rather than quality and the fragmentation of care delivery—do not promote IT investment, and may hinder it. Because of its potential, policymakers need to better understand how information technology is diffusing across providers, whether action to spur further adoption is needed, and if so, what steps might be taken. Any policy to stimulate further investment must be carefully considered because of possible unintended consequences—such as implementation failures due to organizations' inability to make the necessary cultural changes. This chapter is a first step in increasing our understanding of the current state of IT in the health care industry. The Commission will continue to work on this issue.

Despite considerable attention to the topic, much remains unknown about the role of IT in the health care setting. What types of IT are being used? What is the link between use of IT and quality improvements? How much investment have hospitals and physicians already made in information technology, and in what kinds? What factors drive IT investments (e.g., financial returns, quality improvement goals, other factors)? What factors hinder IT investments and implementation (e.g., work flow changes, lack of compatibility with other IT, costs)? What current steps are being taken by public and private entities to encourage further diffusion of IT? What additional actions might make sense?

Delivering quality health care requires providers and patients to integrate complex information from many different sources. Thus, increasing the ability of physicians, nurses, clinical technicians, and others to readily access and use the right information about their patients should improve care. The ability for patients to obtain information to better manage their condition and to communicate with the health system could also improve the efficiency and quality of care. This potential to improve care makes broader diffusion of IT desirable. However, further research is needed to better understand what types of IT applications are most useful for improving care in different settings and what circumstances are necessary to ensure successful implementation. Current studies show that some technologies lead to better care. However, the evidence base is narrow, coming primarily from select institutions that developed their own systems, and may not represent the average facility.

The health care system generally uses less IT than other industries, but surveys indicate that providers are increasing their investments. The extent of IT and the types of IT deployed vary by setting and institution. The prevalence of IT in any setting largely reflects the strength of the drivers and barriers to investment. For many organizations, quality and process improvements are primary drivers. For others, gains in efficiency motivate investment. Yet, the cost and the complexity of IT implementation, including necessary organizational and workflow redesign, pose considerable barriers, as does uncertainty regarding the stability of the IT industry.

The larger health care market poses additional barriers to investment in IT. Payment systems that tie reimbursement to the volume of services delivered, for example, may penalize providers who improve quality in ways that result in fewer units of service. To the extent that IT investments lead to reduced volume, many who make the investment will not reap all of the benefits. Systems that integrate care across settings tend to be more advanced users of IT because they are able to capture some of these efficiencies. In addition to barriers posed by payment systems, a fragmented delivery system leads to redundant investments by multiple providers who lose the benefit of economies of scale. Although this aspect of our delivery system is a barrier to adoption, widespread use of IT could help providers coordinate care across settings, overcoming some of the problems of fragmentation.

Both the private and public sectors have engaged in numerous efforts to promote use of IT within health care institutions and across care delivery settings. Activities include developing and promoting industry-wide standards; funding research to investigate the impact of IT on quality; providing incentives that encourage investment in IT; giving grants to those investing in IT; and developing strategies to improve the flow of information across providers. Additional activities to promote diffusion

could include changes to payment policy, institution of loan or grant funds, and requirements to adopt specific technologies.

What is health information technology?

In general, IT allows health care providers to collect, store, retrieve, and transfer information electronically. However, more specific discussion of IT in health care is challenging due to the lack of precise definitions, the volume of applications, and a rapid pace of change in technology.

Similar terms can be used to define different products, and the exact functions of a system will depend on the specifics of its implementation in a given setting. Both the terms and the functions also change over time. For example, computerized provider order entry (CPOE), which can minimize handwriting or other communication errors by having physicians or other providers enter orders into a computer system, can apply only to prescription drugs, or may also include additional physician orders, such as x-rays or other images, consultations, and transfers. For electronic health records (EHRs, also known as electronic medical records, automated medical records, and computer-based patient records, among other names), multiple definitions exist, depending on the constellation of functions that are included (Brailler and Tarasawa 2003).[1] They can be used simply as a passive tool to store patient information or can include multiple decision support functions, such as individualized patient reminders and prescribing alerts.

When purchasing IT, providers must consider multiple functions and literally hundreds of applications offered by numerous vendors. In general, the various IT applications fall into three categories:

- administrative and financial systems that facilitate billing, accounting, and other administrative tasks;
- clinical systems that facilitate or provide input into the care process; and
- infrastructure that supports both the administrative and clinical applications.

Table 7-1 provides examples of IT applications in hospitals and physicians' offices; the accompanying text box (p. 160) provides definitions for various clinical systems and other terms used in IT discussions.

TABLE 7-1

Examples of health information technology for hospitals and physicians

Type of information technology	Applications
Hospitals	
Administrative and financial	Billing
	General ledger
	Cost accounting systems
	Patient registration
	Personnel and payroll
	Electronic materials management
Clinical	Computerized provider order entry for drugs, lab tests, procedures
	Electronic health record
	Picture archiving and communication systems for filmless imaging
	Results reporting of laboratory and other tests
	Clinical decision support systems
	Prescription drug fulfillment, error-alert, transcriptions
	Electronic monitoring of patients in intensive care units
Infrastructure	Desktop, laptop, cart-based, and tablet computers
	Servers and networks
	Wireless networks
	Voice recognition systems for transcription, physician orders, and medical records
	Bar-coding technology for drugs, medical devices, and inventory control
	Information security systems
Physicians	
Administrative and financial	Billing
	Accounting
	Scheduling
	Personnel and payroll
Clinical	Online references (drug compendia and clinical guidelines)
	Receiving lab results and other clinical information online
	Electronic prescribing
	Computerized provider order entry
	Clinical decision support systems
	Electronic health record
	E-mail communication with patients
Infrastructure	Desktop and laptop computers
	Handheld technology
	Servers and network

Note: Applications listed are examples and not exhaustive.

What is health information technology?

The following technologies and terms are often included in discussions of information technology in health care:

- **Electronic health record (EHR):** EHRs were originally envisioned as an electronic file cabinet for patient data from various sources (eventually integrating text, voice, images, handwritten notes, etc.). Now they are generally viewed as part of an automated order-entry and patient-tracking system providing real-time access to patient data, as well as a continuous longitudinal record of their care.
- **Computerized provider order entry (CPOE):** CPOE in its basic form is typically a medication ordering and fulfillment system. More advanced CPOE will also include lab orders, radiology studies, procedures, discharges, transfers, and referrals.
- **Clinical decision support system (CDSS):** CDSS provides physicians and nurses with real-time diagnostic and treatment recommendations. The term covers a variety of technologies ranging from simple alerts and prescription drug interaction warnings to full clinical pathways and protocols. CDSS may be used as part of CPOE and EHR.
- **Picture archiving and communications system (PACS):** This technology captures and integrates diagnostic and radiological images from various devices (e.g., x-ray, MRI, computed tomography scan), stores them, and disseminates them to a medical record, a clinical data repository, or other points of care.
- **Bar coding:** Bar coding in a health care environment is similar to bar-code scanning in other environments: An optical scanner is used to electronically capture information encoded on a product. Initially, it will be used for medication (for example, matching drugs to patients by using bar codes on both the medications and patients' arm bracelets), but other applications may be pursued, such as medical devices, lab, and radiology.
- **Radio frequency identification (RFID):** This technology tracks patients throughout the hospital, and links lab and medication tracking through a wireless communications system. It is neither mature nor widely available, but may be an alternative to bar coding.
- **Automated dispensing machines (ADMs):** This technology distributes medication doses.
- **Electronic materials management (EMM):** Health care organizations use EMM to track and manage inventory of medical supplies, pharmaceuticals, and other materials. This technology is similar to enterprise resource planning systems used outside of health care.
- **Interoperability:** This concept refers to electronic communication among organizations so that the data in one IT system can be incorporated into another. Discussions of interoperability focus on development of standards for content and messaging, among other areas, and development of adequate security and privacy safeguards. ■

Source: Adapted from deliverable submitted to MedPAC by Abt Associates.

Quality and health information technology

One of the primary motivators for adopting many clinical health IT applications is the belief that they improve the quality of patient care. Yet, further research is needed to better document and understand the link between IT and quality, including the types of quality problems information technology can be used to solve and implementation strategies to ensure that quality objectives are met.

Quality health care relies on physicians, nurses, patients and their families, and others having the right information at the right time and using it to make the right decisions.

Yet the health information needed to make these decisions changes frequently; the guidelines and clinical evidence continually evolve, as does knowledge about the condition of the patient. IT may provide a tool to store, integrate, and update this information base.

Beyond improving care in individual settings, health IT also has the potential to address the problems presented by a fragmented delivery system. Most patients receive care from many disparate providers. The primary means of coordination is often through discussion with the patients about what other services they have received and what the other providers thought about their conditions. Information technology used across settings could create a "virtual" integrated delivery system without requiring formal mergers or affiliations.

The Commission stated in its June 2003 report to the Congress that health IT was one of the more important system changes necessary to improve quality (MedPAC 2003). While the potential is clear, the evidence linking quality with various IT applications is less so.

In 2000, the Institute of Medicine (IOM) released a report focusing on patient safety estimating that 44,000 to 98,000 people die in U.S. hospitals annually as a result of medical errors. Many of these errors involve medications. In a subsequent report, the IOM identified IT as one of the four critical forces that could significantly improve health care quality and safety (IOM 2001). Partly in response to these reports, the Leapfrog Group, a group of large employers committed to patient safety improvements, made hospital adoption of CPOE a major goal for large employers and health plans. These influential external forces linking IT to improved quality and patient safety have contributed to a widespread belief that adoption of IT in health care will improve quality and safety.

In this section we present findings from a literature review done for MedPAC by Abt Associates on the relationship between health IT applications and quality. We find evidence that various forms of health IT improve or have the potential to improve quality. However, because many of these findings were based on the experiences of a few organizations without subsequent evaluation of the unique circumstances that may have led to their success, the results may not be generalizable to other organizations. Two large academic medical centers with a strong commitment to the use of health IT conducted many of the studies of CPOE. Each developed its own system. Studies have not critically analyzed how these systems were implemented. Implementation issues such as work flow disruption, physician involvement, and ease of use have tremendous impact on whether health IT is effective.

Some studies have shown that use of CPOE can reduce the frequency of medication errors. However, 9 out of the 11 formal analyses took place at one of two advanced institutions. CPOE significantly reduced (by 55 percent) serious medication errors (Bates et al. 1998). Of the 11 most rigorous studies, at least 1 study showed that CPOE improved quality and safety through one of the following actions:

- reducing medication errors, including adverse drug events;
- decreasing dosage errors;
- prescribing certain medicines more precisely; or
- prescribing with improved accuracy by faculty and residents (Oren et al. 2003).

Although more limited in the types of errors it can prevent, bar coding is probably the most proven technology of those we discuss. Bar coding prevents errors at the patient's bedside by averting the administration of the wrong drug when other levels of review have failed. Studies document that bar coding reduced ambulatory and inpatient medication error and the number of adverse drug events (Oren et al. 2003, Bates and Gawande 2003, GAO 2003). One study at a Department of Veterans Affairs hospital showed that bar coding of medications reduced the kind of medical errors bar coding could prevent by 85 percent (McVicar and Valdes 2003).

The types of computer-based clinical decision support systems (CDSS) vary widely—from preventive care reminders to notification of potential drug interactions. Therefore, the types of technology studied vary widely. A 1998 review of the literature on the impact of 68 computer-based clinical decision support systems showed a beneficial impact on processes of care in 43 out of 65 studies and a positive impact on patient outcomes in 6 out of 14 studies (Hunt et al. 1998).

Two studies of clinical decision support systems focused on aspects of the medication system. One found that computerized reminders improve by 100 percent the use of "corollary orders," that is, orders for other

pharmaceuticals or tests that would ensure appropriate dosage (Overhage et al. 1997). Another studied a broad range of CDSS and found improvements in types and doses of drugs (Teich et al. 2000). In a review of the evidence on CPOE and CDSS, researchers found that one important issue in ensuring successful implementation of either is that the threshold for alerts must be set so that physicians do not receive so many "false alarms" that the information is ignored (Kaushal and Bates 2001).

Electronic health records are often implemented with CPOE and decision support efforts; therefore, it is difficult to evaluate separately their impact on quality. However, an electronic health record has the potential to make health information more available to providers and patients when they need it. The availability of lab and radiology reports, patient-specific histories, and clinical reminders, along with other functions such as CPOE and bar coding, have the potential to improve quality.

The quality benefits of investment in IT are often achieved after tremendous efforts and some initiatives have failed. A recent study of the effect of computerized guidelines for managing heart disease in primary care found that sophisticated reminders from an EHR failed to improve adherence to accepted practice guidelines or outcomes for patients with heart disease (Tierney et al. 2003). A Department of Veterans Affairs hospital that is the test site for a new computer software program recently reported surgery delays and other problems with its new computer system (De La Garza 2004). Even when implemented, CDSS might not be used because of physician workload or limited training for rotating staff (Patterson et al. 2004). Other research has shown that automated systems are also subject to errors: U.S. Pharmacopeia reported that 10 percent of medication errors it studied resulted from computer-entry errors (Armstrong 2003).

IT can be a tool for improving quality and safety, but is not the only one and is often used by providers as part of a broader effort. In 2001, the Agency for Healthcare Research and Quality (AHRQ) determined that 14 safety practices had greater strength of evidence regarding their impact and effectiveness than any practice which relied on IT. They include such low-cost items as appropriate provision of nutrition, with a particular emphasis on early enteral nutrition in critically ill and surgical patients, and use of maximum sterile barriers while placing central intravenous catheters to prevent infections (AHRQ 2001). This is not to say that these practices are superior to IT; ideally, organizations would pursue them all.

Current status of health information technology

The degree of IT use varies by health care setting: Pharmacies are generally advanced users, while other settings such as physician offices or nursing homes are further behind. The kind of technology used also varies by setting. For example, in home health, the use of technology that allows patients to monitor their own vital signs from their home and communicate results to the agency could increase the ability to address a problem before a patient requires acute care. In both home health and nursing home settings, use of handheld computers to complete documentation and capture patient assessment information can increase efficiency and provide more information to care givers. IT and the Internet have also had a significant impact on consumers. Numerous websites have made health information more available to patients, thereby strengthening their role in care decisions. The Internet also helps consumers choose providers by allowing insurers and others (including Medicare) to post information on providers including, in some instances, comparative quality information.

This section provides detailed information on two settings—hospitals and physicians' offices—that have received considerable policy attention. Further MedPAC work may focus on other settings, such as post-acute care, as well as on the impact of IT and the Internet on consumers. This section also looks at linking health care providers through an information infrastructure, or "interoperable" systems that allow communication among the IT applications used by different providers.

Information technology in hospitals

Relatively little is known about the level of diffusion of IT in hospitals and strategies hospitals take when making IT investment decisions. Much of the existing information about IT diffusion comes from voluntary surveys, some of which are conducted on the Internet. Therefore, the results may not be representative and may be biased toward more advanced users of IT. Given the evolving state of the technology and limited availability of nationally representative surveys, varying estimates of IT diffusion exist. The following discussion draws on a literature review on hospital IT investments conducted for MedPAC by Abt Associates. It also draws on interviews Abt Associates conducted with hospitals that have made significant investments in IT, and some that have not, to

better understand IT investment decisions (Abt Associates 2004a and 2004b).

Diffusion of information technology in hospitals varies with the type of technology. Of the three major categories shown in Table 7-1 (p. 159), diffusion is greatest in administrative and financial applications such as patient registration, billing, and payroll. Clinical applications, such as computerized provider order entry for drugs or other items (e.g., lab work) and electronic health records, are less diffused. Infrastructure technologies build the base that other technologies work from, and include both widely diffused technologies, such as e-mail and telecommunications, and those that are less common, such as wireless connections and voice recognition. Infrastructure investments also include maintaining secure information systems that comply with federal security rules.

Estimates of the use of CPOE vary, but several studies report that 5 to 6 percent of hospitals currently have a system (Leapfrog Group 2004, Devers and Liu 2004). Others argue that these studies may have stringent definitions that lead to low estimates of CPOE use (iHealthBeat 2003). Estimates of the use of EHRs in hospitals are similarly low (Glaser 2002). Other types of clinical IT—such as picture archiving and communications systems (PACS) that allow digital storage and retrieval of x-rays, MRIs, and other images—have diffused more widely. About 15 percent of all hospitals were estimated to have PACS in 2002, with most academic and large hospitals having this technology. In a more recent survey of hospital executives, 49 percent indicated that they had PACS or were implementing it (Morrissey 2004).

For each type of clinical IT, academic medical centers and large hospitals are more likely to be advanced users. Providers who are part of integrated systems delivering inpatient and outpatient services are also more likely to have the necessary financial support and a clearer need to ensure smooth flow of information across their systems. Those who are part of multiple hospital systems (about half of all hospitals according to the American Hospital Association Guide 2003–2004) probably benefit from IT support offered by the larger organization. They may also be motivated to adopt IT to facilitate information flow across system members.

Clinical applications, particularly CPOE and EHR, may not diffuse rapidly for a number of reasons. They are relatively new. They are costly, complex, and difficult to implement in stages. They require significant changes in work processes and culture for nurses, pharmacists, other allied health professionals, and physicians to be successfully implemented. Finally, achieving the benefits of these technologies for improvements in quality of care appears to hinge on the same factors that pose a risk to successful implementation. As discussed below, the financial return to investment for these technologies is uncertain.

Though not widely diffused now, many organizations are planning to implement clinical systems in the near future. The Healthcare Information and Management Systems Society (HIMSS) has conducted a survey in each of the past three years. The most recent web-based survey (conducted November 2003 through January 2004) included 307 respondents out of nearly 2,000 chief information officers or directors of information systems at health care facilities who were asked to participate. Most of the respondents work for health care systems and hospitals; some 86 percent came from an organization led by a hospital (HIMSS 2004a).

The HIMSS survey respondents reported that in the next year, upgrading security protocols and reducing medical errors and promoting patient safety will be priority issues for their IT departments (Figure 7-1, p. 164). Specific applications they think most important for the next two years include bar coding, EHR, and clinical information systems (Figure 7-1, p. 164).

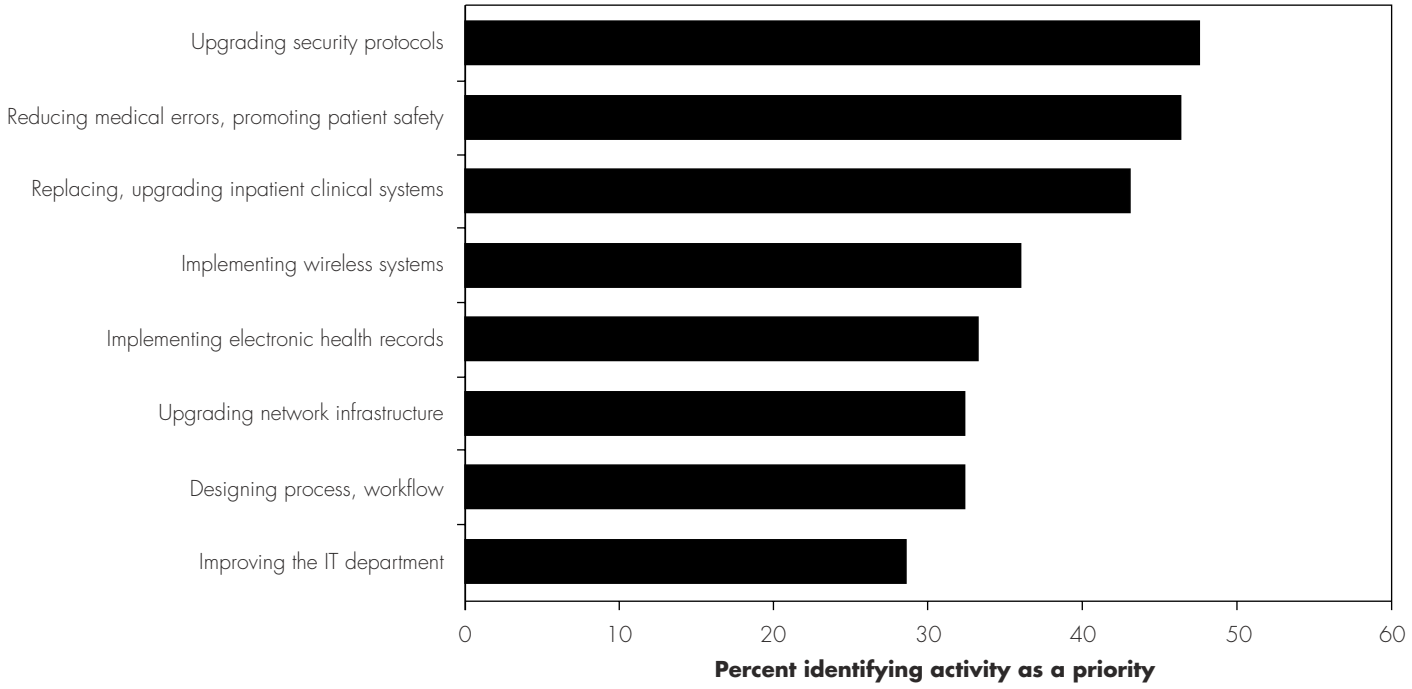
A recent survey of hospital investment priorities by the Health Care Financial Management Association indicated that IT is as high a priority as capital construction. Among IT applications, this survey suggested a different ordering of priorities than other surveys. The survey of 460 hospital and system chief financial officers showed that 72 percent anticipate investing in PACS, 64 percent in CPOE, and 61 percent in other major information technology. The same survey found that overall capital spending is expected to rise 14 percent annually for the next five years, compared with 1 percent annual increases from 1997 to 2001 (HFMA 2004).

Many systems and hospitals have recently announced IT plans. For example, Kaiser Permanente, an integrated system, is investing $1.8 billion to put in place a fully operational EHR. Catholic Health West recently announced its intention to implement various forms of health IT for all of its 41 hospitals.

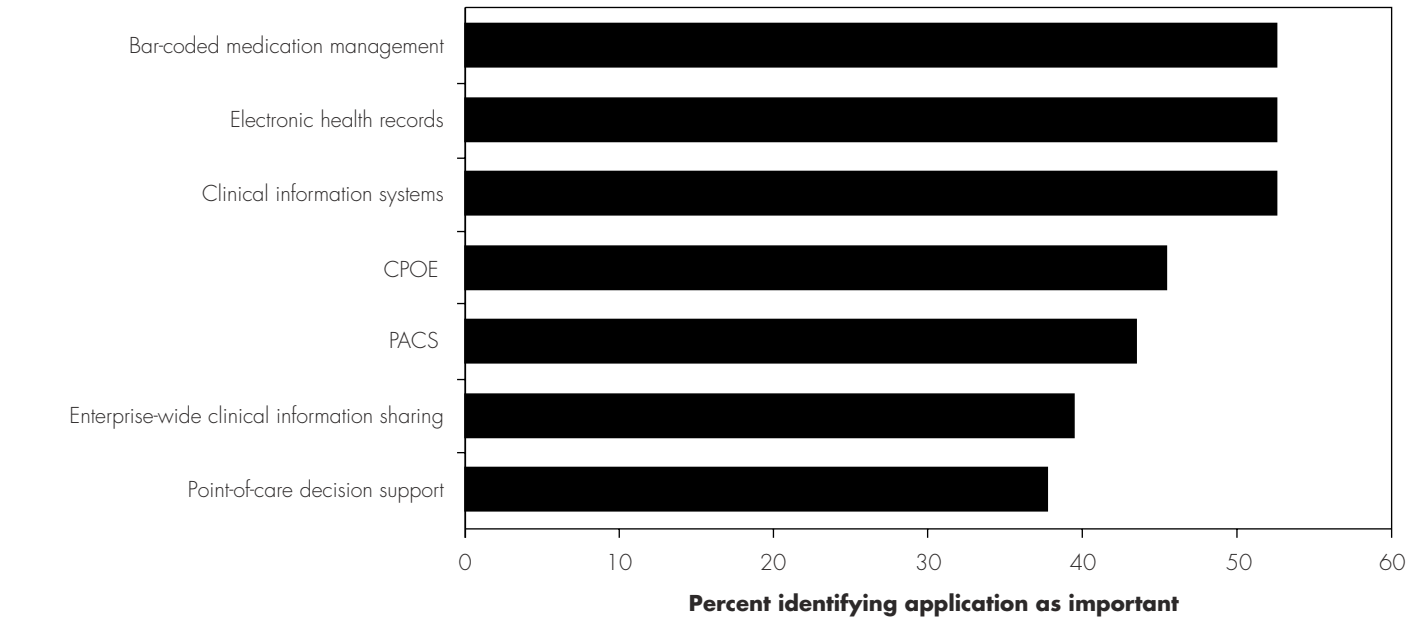
FIGURE 7-1

Information technology priorities for hospitals

Hospital and health care executives name security and safety as top priorities for 2004



Hospital and health care executives name bar coding and other clinical applications as most important for 2004–2005



Note: CPOE (computerized provider order entry), PACS (picture archiving and communications system).

Source: Healthcare CIO Results: Final Report, Leadership Survey, Healthcare Information and Management Systems Society, February 23, 2004.

Drivers of adoption

Hospitals consider both financial return on investment and nonfinancial benefits when making IT investment decisions. Return on investment varies by the type of IT. Technologies that pay for themselves tend to diffuse more widely. Studies dating back to the 1980s have shown that electronic billing and claims submission rapidly pay for themselves and generate additional savings by decreasing the costs of creating bills and speeding reimbursement. These technologies are practically universal. Hospitals have also been quick to adopt other kinds of technology that produce revenues, such as imaging equipment.

Little economic literature addresses the question of the impact of IT on hospital financial performance. One study offers preliminary results indicating that investment in IT leads to increased volume in nonprofit hospitals and reduced length of stay in for-profit hospitals. The same study found that the longer the health IT investment, the greater the effect (Parente and Van Horn 2002). Some reports suggest returns on investment or anticipated savings for several specific clinical applications. Voice recognition software can pay for itself by lowering transcription costs. PACS can lower costs for acquiring and storing films by storing digitized radiology images, and may reduce the workload among radiology staff (Wiley 2003). One study suggests an 18-month payback period (Baldwin 2002).

Most of the hospitals with advanced IT systems interviewed by Abt used PACS: Of the 12 total, 10 had it in place, 1 was implementing it, and the last had put out a request for proposals. Most of the hospitals had performed return on investment calculations and predicted positive returns, which most realized. Recent diffusion estimates suggest that PACS, at least, is becoming more common, perhaps in part because the financial return is evident. However, one of the smaller hospitals interviewed that was less advanced in its use of IT purchased PACS despite predicting a negative return on investment. The projected lack of return was due primarily to a low volume of imaging in the facility.

The literature provides scant evidence of return on investment calculations for CPOE and EHR and we see lower diffusion of these technologies. Regarding CPOE, six of the interviewed hospitals have the system or are implementing it, five plan to have it within one to three years, and only one had no plans to pursue it. In general, hospitals reported that patient safety and quality of care, rather than financial returns, motivate their investments in CPOE and EHR. None of these hospitals had conducted or planned to study return on investment for CPOE.

Calculating return on investment for clinical IT can be challenging. The costs of CPOE and EHR can be difficult to measure because they require investment not only in the technologies themselves, but also in changing work processes, significant staff training, and ongoing system support (Darves 2004). Quantifying some of the benefits for these applications, such as improved care processes and workflow, can be difficult. Reductions in costs stemming from reduced medical errors, shorter stays, or efficiencies in care delivery can also be hard to measure.

Furthermore, the financial returns from some quality improvements may accrue not to the hospital investing in the technology, but to other parties. For example, a hospital might invest in CPOE and, through successful implementation, prevent an adverse drug event that would have resulted in another hospital admission. The hospital loses revenue from the avoided admission, and the purchaser of care gains. In this example, the hospital improves care and the patient is clearly better off.

Closed systems of care, in which a single entity serves as both the insurer and the provider of care, will reap all of the financial benefits from health IT. This may explain why closed systems, such as the Veterans Health Administration or staff model HMOs, are generally more advanced users of IT systems. One national health system, the National Health Service (NHS) in England, has recently committed to a large-scale implementation of IT (see text box, p. 166). The head of that effort recently noted that the NHS is able to do some things, such as negotiate big discounts from IT vendors, that could not be easily duplicated in the United States (AHA News Now 2004).

The nonfinancial benefits hospitals consider when making IT investment decisions include clinical efficiencies and improved quality, patient and provider satisfaction, image and public relations, and employee morale. A focus on improved quality of care by the Institute of Medicine, the Leapfrog Group, and others has fueled interest in CPOE, in particular, as well as EHRs, other pharmacy systems, and lab systems. Those hospitals interviewed by Abt that had more advanced IT systems indicated that patient care and safety were major drivers for adopting clinical IT. Consumer expectations and possible discounts on

England plans for national information technology system

England's government has begun contracting with information technology (IT) firms to implement a National Programme for IT (NPfIT) within the National Health Service (NHS), the public agency that provides health care. The program consists of four parts:

- electronic patient records, which will include a central data repository of patient information available to all health care providers;
- electronic scheduling of appointments for consultations and hospitalizations that will be available to referring general practitioners and, eventually, patients;
- e-prescribing, which will allow electronic prescriptions filled by physicians to flow to both the pharmacy and the Prescription Pricing Authority that manages payments; and
- improved broadband communications networks to facilitate communication across the National Health Service.

The NPfIT has an ambitious agenda that seeks to implement the world's largest health care IT system by the year 2010. Because the health system in England is closed, with the government employing staff, it can implement a system that covers all patients and providers. However, implementation will require coordination among the national health authority, regional health authorities, and local health care providers, some of whom have already invested in their own IT systems.

The NHS plans for the first element, electronic scheduling, to be available in some locations by the summer of 2004, with full implementation by the end of 2005. The NHS will phase in the national database of electronic patient records by 2010. The NHS targets having 50 percent of prescriptions handled electronically by 2005 and 100 percent by 2007.

Funding for the NPfIT includes $17 billion from the national government, with additional funds coming from local health authorities. The central funding currently covers only the cost of the technology, and not the training and work process changes that will be needed to implement health IT at the local level.

Supporters of the system predict significant improvements in efficiency and quality of care, as patient information will be accessible to all providers at any time. The system will also include decision-support functions, such as clinical guidelines or prompts for drug allergies. Supporters also claim that significant discounts can be obtained from IT contractors because of the size of the endeavor and the centralized procurement process. Others have noted the need for greater attention to the availability of local funds for implementation and training. Additional concerns include the need to involve stakeholders during design, ensure data quality, and implement adequate security and privacy safeguards. ■

Sources: Parliamentary Office of Science and Technology 2004, NHS 2004, Naik 2003, Dodge 2004.

malpractice insurance premiums for reduced medical error rates have been cited as drivers of adoption (Scalet 2003). In addition, declining prices for IT technologies should facilitate IT use.

Standards and regulations set by state and federal governments or accrediting agencies can also spur investment in IT. Electronic transaction standards put in place through the Health Insurance Portability and Accountability Act of 1996 (HIPAA) should facilitate adoption of IT by removing some innovation barriers and providing guidance for future investments, steering hospitals away from applications that will not meet the standards. Currently, hospitals are working to comply with HIPAA requirements to ensure the security of their information systems (HIMSS 2004a). The recent

requirement by the Food and Drug Administration (FDA) for pharmaceutical companies to include bar codes on their products within two years is likely to stimulate investment in bar coding in the near future (FDA 2004).[2] However, the adoption of bar coding in hospitals may depend on the extent to which manufacturers put bar codes on single doses of their medications, rather than putting them on a package containing multiple doses (Hawryluk 2004).

Barriers to adoption

While many factors push hospitals to invest in IT, others pose barriers. Investment in IT is costly and must compete with other priorities, including investment in bricks and mortar, as well as in technologies with more direct application to clinical care and greater certainty for increased revenues, such as new imaging equipment (Morrissey 2004). The availability of capital for investment in IT depends, of course, on hospitals' ability to access capital in general, which may be easier for some hospitals (e.g., those with good financial performance, for-profits, members of chains) than others. Recent estimates of the percentage of hospital operating budgets spent on operating IT systems indicate that 2 to 3 percent is the industry average (Morrisey 2004, HIMSS 2004a). Capital expenditures on IT generally consume a larger share of capital budgets, although the percentage varies with each hospital's investment cycle.

Cost poses another barrier to adoption. The costs of implementation and ongoing maintenance vary by the size of the hospital, as well as by the functions to be installed. A full clinical IT system that includes CPOE and an EHR will cost tens of millions of dollars; CPOE on its own was estimated to cost about $8 million for a 500-bed hospital (First Consulting Group 2003). Installing bar coding is expected to cost around $1 million for the average hospital (Hawryluk 2004). In addition to the costs of IT, hospitals may perceive lack of reimbursement for specific IT investments as a barrier.

The costs of implementing IT go beyond purchasing the technology to providing training and systems support, which case studies indicate are crucial for success. Deriving benefit from IT generally requires changing work processes, which can be more challenging than the purchase and installation of the technology itself (Darves 2004, First Consulting Group 2003). New applications must also integrate with existing systems, which makes implementation more complex and can further increase costs. For example, applications providing considerable depth of support for a given department, such as PACS for radiology, may not communicate easily with an existing patient registration system.

Nearly every study of clinical IT implementation and adoption cites physician reluctance as a major hurdle to broader investment and overcoming it as a key to project success. A number of large-scale investments, including the one at Cedars-Sinai Medical Center in Los Angeles, have failed due to a lack of physician acceptance. With the exception of pharmacy settings, there is little consistent evidence that IT systems save time for providers. In some instances, the literature suggests the reverse: Systems such as CPOE add to clinicians' workloads because information must now be entered into a computer. EHRs require even greater levels of physician acceptance than CPOE (Darves 2004, GAO 2003). The need for changes in work process and culture suggest that hospitals may not be able to move quickly when making IT investments because they can manage only a limited amount of change at a time. The need to maintain full operations while undertaking systems changes provides an additional challenge. Given the importance of culture and physician acceptance for implementation of clinical IT, hospitals that employ a large share of their physicians may find it easier to implement because they have more control over how their physicians work.

Earlier we noted that federal and state regulations like HIPAA can drive investment in IT. They may also slow adoption of some types of IT, however, if IT funds and the attention of hospital executives must be directed to specific technologies over others. The HIPAA transaction rules require investments in IT supporting transactions, potentially at the expense of other investments. The HIPAA privacy and security requirements may also increase the complexity of the design of IT systems that share patient information.

In the latest HIMSS survey, respondents were asked to identify the most significant barrier to implementing IT. Lack of financial support was cited most often; however, it was chosen by fewer than one in four respondents (23 percent). Respondents also considered the following to be significant barriers:

- vendors' inability to deliver products effectively (14 percent);
- difficulty in providing quantifiable benefits or return on investment from IT (13 percent); and

- difficulty achieving end-user acceptance (11 percent), among others.

Very few respondents (3 percent) considered lack of common data standards to be a significant barrier (HIMSS 2004a). The hospitals interviewed by Abt highlighted the following as possible barriers to successful implementation of IT: cost, physician culture or reluctance, the need for concomitant changes in workflow and processes, retraining, poor quality of vendor offerings, and integration with existing systems.

Information technology in physicians' practices

Like hospitals, physicians are more likely to use IT for administrative functions (such as billing, claims submission, and scheduling) than for clinical functions (such as electronic health records, clinical decision support, access to formularies or other references, or computerized provider order entry). Physicians must also invest in infrastructure to support their IT applications.

Data on the use of IT by physicians and their staffs are limited. This section reports the results of three surveys of the current and planned use of IT in physicians' offices. For clinical IT, estimates of physicians' use of EHRs in their offices vary across surveys. Brailer and Terasawa (2003) suggest that 20 to 25 percent is a reasonable estimate of current diffusion. This estimate is higher than those generally quoted for hospitals, perhaps because the EHR is only one of many technologies hospitals are pursuing. A longitudinal record of patients' care may be more relevant in an outpatient clinic or office setting, where physicians coordinate care across settings.

The Center for Studying Health System Change (HSC) included questions on use of IT in its latest physician survey. Although the information is somewhat dated—it was conducted in 2000 and 2001—it is nationally representative of all physicians. HSC asked about use of IT in the practice, not by the physician himself or herself. In addition, HSC did not gather information on the frequency or intensity of IT use. The survey found that adoption of IT varied by the application:

- 77 percent of physicians accessed the Internet,
- 53 percent obtained information on treatment alternatives and clinical guidelines,
- 32 percent obtained information on formularies, and
- 11 percent used IT to write prescriptions (Reed 2004).

This survey compares IT use by practice and personal characteristics of the physician. Physicians in group and staff model HMOs, practices with 50 or more physicians, and medical schools were most likely to use IT. Those in solo or small group practice were less likely to do so. By specialty, surgeons were less likely to be in practices that use IT than primary care physicians or those in medical specialties (Reed 2004). Some very large physician group practices, such as Harvard Vanguard Medical Associates in Boston, the Marshfield Clinic in Wisconsin, and Geisinger Healthcare in Pennsylvania, have developed and operated EHRs for 10 years or more.

The Healthcare Information Management Systems Society surveyed physician and practice managers and executives in 2003 on the use of IT in ambulatory settings. Only 16 percent of the respondents (compared with about 35 percent of physicians nationwide) were in a practice with 1 or 2 physicians. Given that physicians in larger groups are more likely to use IT, respondents likely represent physicians that use IT more than the national average (HIMSS 2004b).

The survey found widespread use of handheld technology, but significantly lower use of EHRs and e-mail for communicating with patients. The majority of survey respondents indicated that physicians have personal digital assistants or some other form of handheld technology (71 percent), used most commonly as a portable drug reference. Less common uses include scheduling, e-prescribing, better documenting care to facilitate billing ("charge capture"), dictating, and accessing information in an EHR. Sixty-two percent reported that they did not have an EHR, while small shares indicated that one was present in all departments within their organization (24 percent), or in some departments (15 percent). Only 17 percent indicated that they or physicians in their organization communicate with patients about clinical issues via e-mail. Reasons for not doing so included legal concerns, HIPAA privacy concerns, and, to a much lesser extent, lack of reimbursement.

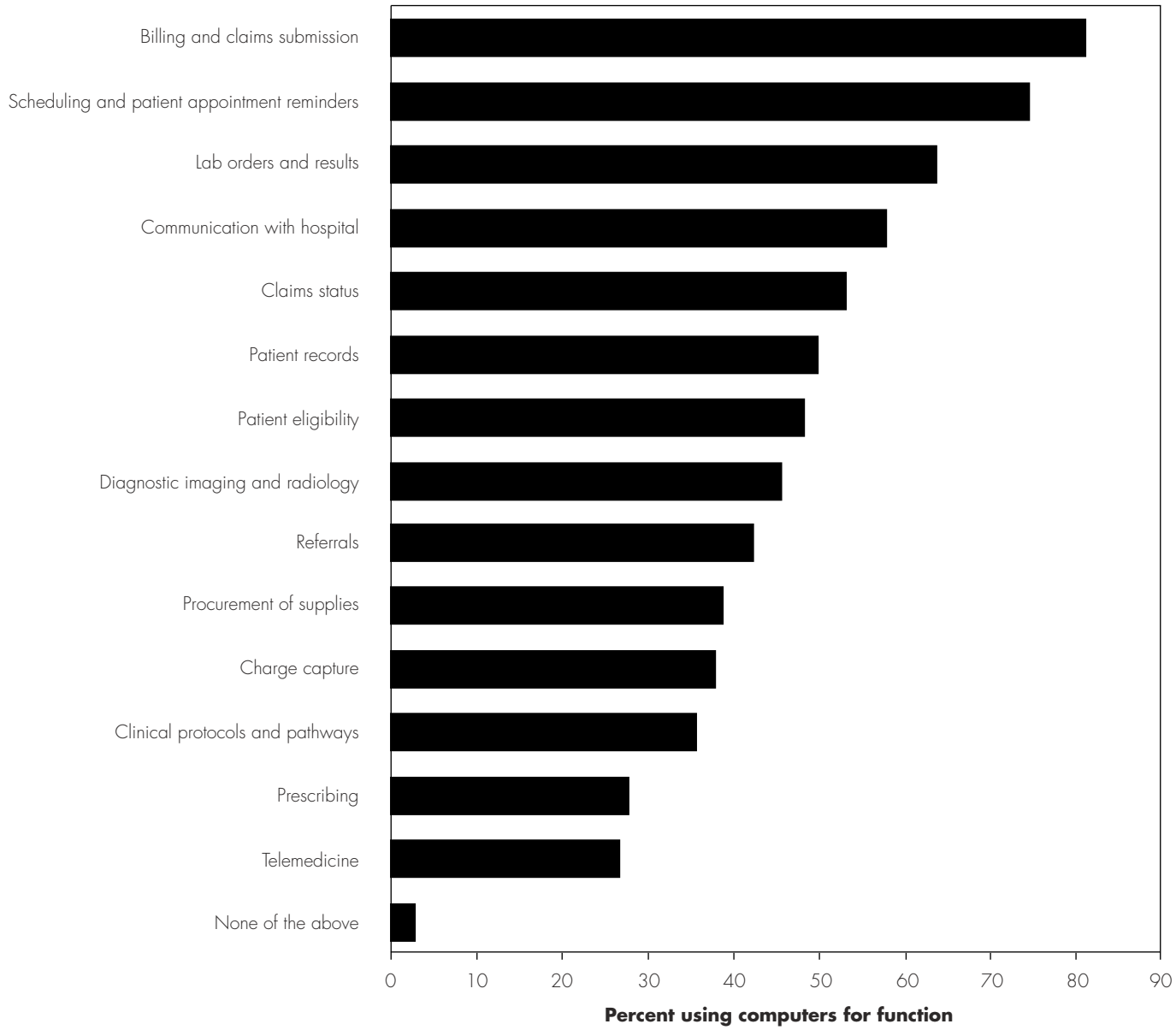
A recent survey by Modern Physician/Pricewaterhouse Coopers (436 respondents) suggests increases in the use of IT by physicians. The survey was conducted online, however, which may bias the results toward users of IT. Forty-one percent of respondents indicated that their organizations have invested in an EHR, with investment

more likely in hospital-affiliated practices (61 percent) than in independent group practices (37 percent) (Versel 2003). This echoes the findings by HSC, where practice type was a predictor of IT use.

Physicians also reported using computers more for administrative functions than for clinical functions (Figure 7-2). The most common uses included billing or claims submission and scheduling or patient appointment reminders. Placing lab orders or getting results by computer was also common. Small shares of respondents reported that physicians used computer-based systems to access clinical protocols or pathways, write prescriptions, or conduct telemedicine.

FIGURE 7-2

Physicians use computers more for administrative than clinical functions



Note: The survey asked, "What do your physicians use computer-based systems for?" Charge capture means better documenting care to facilitate billing.

Source: Modern Physician/PricewaterhouseCoopers survey of executive opinions on key information systems issues, Modern Physician, November 2003.

Drivers of adoption

As is the case with hospitals, a variety of motives influence physicians' use of IT. Financial returns are certainly one consideration. We found few studies, however, on the return on investment for physician use of IT. One might conclude that the widespread use of IT for administrative and financial functions (e.g., billing and accounting) indicates that these systems do bear a financial return, or are at least useful for practice management.

The evidence of a link between larger practice size and greater use of clinical IT suggests that having a larger revenue base or more complex practice with greater management capabilities allows larger groups to better support the sizeable investments needed to implement information systems. In addition, economies of scale reduce the per physician cost of investing for larger groups. Finally, larger groups may also have more need for IT to communicate within the practice.

Although clinical systems require up-front financial investment, some argue that physicians can benefit financially from the increased documentation of care, leading to fewer rejected claims and enhanced revenues (CITL 2003, Versel 2003). For EHRs, savings also accrue from reduced transcription and medical records management costs, as physicians enter information directly into the EHR and can retrieve information more efficiently (Miller and Sim 2004).

A qualitative study of 30 physician organizations that had EHRs found that the financial returns were uncertain, and depended on the extent to which physicians used the EHR (Miller and Sim 2004). The study found that "the path to quality improvement and financial benefits lies in getting the greatest number of physicians to use the [EHR] (and not paper) for as many of their daily tasks as possible." Some of the practices realized no financial gains, but a few realized gains of more than $20,000 per physician per year. Physicians rarely used all the capabilities of the EHR, and most combined paper processes with the EHR.

A recent study looked at the value of CPOE in ambulatory settings and estimated that nationwide adoption could improve patient outcomes and save money for the health care system as a whole by avoiding adverse drug events and related hospitalizations, and by suggesting cost-effective use of medications, lab tests, and radiology (CITL 2003). These savings will not all accrue to the providers implementing the system. However, the study projected that physicians could increase revenues through the use of IT by reducing the cost of rejected claims by at least $10 per outpatient visit.

Both financial and nonfinancial incentives encourage physician use of IT. In a recent survey, physicians indicated that improving business performance, improving the clinical quality of care, and managing growth in the size of the physician practice motivated the adoption of IT (Versel 2003). Moving to an EHR can decrease storage costs for medical records; increase access, security, and efficiency of medical records; and improve documentation. Rooms previously used for storing paper records may be converted to patient exam rooms. In addition, some insurers are providing discounts on malpractice when physicians have IT systems because they provide better documentation of the care provided (Scalet 2003).

Advances in technology or financing arrangements may further spur use. Open source software that has no licensing requirements can lower the cost of technology. In addition, some specialty organizations have negotiated discounts from vendors for their members. Alternatively, application service providers have begun to promote arrangements in which they own and maintain the software and store data for physicians, who pay a monthly access fee (Chin 2004).

Barriers to adoption

Many barriers slow physician adoption of IT. The costs of investing in IT can be significant, the financial return is not certain, and any financial benefits will not necessarily all accrue to the physician practice bearing the costs. Most current payment policies do not include incentives for use of IT. The small size of many practices makes the start-up and maintenance costs of IT systems difficult to manage. Costs vary tremendously with the characteristics of the practice and the applications involved. In one study, the average cost of an EHR varied from $16,000 to $36,000 per physician (Miller and Sim 2004). Even if cost is not an issue, the complexity of the technology, limitations in the products currently on the market, and the time it takes to complete implementation pose barriers. Implementing and supporting IT applications requires skills that have not traditionally been part of a medical practice. In addition, physicians must make significant changes to both office and physician workflow and take time away from seeing

patients to learn how to use IT (Brailer and Terasawa 2003, Miller and Sim 2004).

Beyond the financial and technological concerns, the use of electronic systems for clinical reminders may not agree with some physicians' clinical practice styles, which may rely primarily on their knowledge and experience. In addition, use of computers may be seen as interrupting the physician-patient relationship by drawing away from the personal interaction. These systems may add to a physician's workload, rather than alleviating it, particularly in the initial implementation (Brailer and Terasawa 2003, Miller and Sim 2004).

Linking health care providers through information technology

For information technology to become widespread, individual providers must adopt it. Once that happens, connecting them electronically could bring additional benefits. Health care today involves considerable sharing of information among providers such as physicians' offices, hospitals, imaging centers, and clinical laboratories, as well as among providers and payers. A health care information infrastructure would provide the networks and standards to allow providers within a community to share information electronically. In addition, patients could use it to access their medical records or other health care information from all providers. A primary focus of those advocating a health care information infrastructure is development of standards for messaging so that one IT system can communicate with another.

Few systems allow communication among providers today, although some cities are sharing information across emergency departments. Two communities have moved to have a more comprehensive ability to share information. In Indianapolis, an intranet connecting some hospitals to facilitate sharing of clinical information is under development. In California, Santa Barbara County has a central system collecting radiology, pharmacy, and lab reports that can be accessed by providers, payers, and laboratories (Broder 2004).

Some see a health care information infrastructure as a key building block to encourage investment by providers and increase its value. The goal is interoperability—the ability for information to flow among settings of care. The information infrastructure would consist of standards and networks that allow electronic communication among providers, so that, for example, the electronic record created during a hospital stay is accessible to the primary care physician, or even becomes part of the electronic record maintained by the primary care physician. Interoperability could increase the usefulness of implementing IT and decrease the risk of investing in a system that might quickly become obsolete. The health care information infrastructure has been a major focus of the Department of Health and Human Services (HHS) and a number of private initiatives, such as the eHealth Initiative and projects at the Markle Foundation.

A study to be released in 2004 suggests that standardized health care information exchange could reduce national health care spending by automating how providers share data (CITL 2004). Currently, telephone, fax, and mail are most often used for communication among health care providers. Patients themselves also serve as a conduit of information among providers. Electronic communication could reduce repeat tests and expenses for administrative tasks. However, the low diffusion and riskiness of investment in IT suggest that interoperability is many years off. If providers do not have IT systems in place, an information infrastructure will have limited use. However, having an infrastructure in place may provide an incentive for further adoption.

Efforts to encourage faster diffusion

In the previous sections, we find that current levels of clinical IT diffusion are relatively low but increasing, and that rates of adoption vary by type of provider and technology. Barriers to adoption are multifaceted and complex, making investment in health IT a risky proposition for many providers. A primary driver of adoption of IT, the need to improve quality is compelling. We find potential for IT to improve quality and patient safety, but further evidence is needed. The question is not whether to push for further adoption, but how, and how fast. The implementation experience of those providers who have adopted various forms of IT suggest that caution is warranted to ensure effective, broad implementation.

Market forces that inhibit faster diffusion of health information technology

Research comparing diffusion of IT in different industries has identified two key criteria for broad diffusion: 1) the external market must reward the product of IT, and 2) the

organization must be capable of sustaining its commitment to IT and continually respond to changing needs of the users of the IT (Givens 2003). Certain attributes of the health care market may impede faster diffusion:

- Quality, a main reason for investing in IT, is not rewarded. While awareness of the problem is growing, payments for health care do not distinguish between providers who furnish a higher quality product and those who produce a lower quality product. Rather than rewarding higher quality, most fee-for-service payment systems emphasize volume of services. The current system rewards volume by paying every time a procedure or service is provided, regardless of its quality. This approach encourages adoption of technology that supports provision of a billable service, such as an MRI, over technology that might improve the quality of many services. This approach also leads providers to try to see as many patients as possible rather than ensuring that every patient receives the best care possible. Clinical IT applications sometimes add time to patient interactions with physicians, thus causing physician resistance to using IT, even though giving orders or having information available electronically could lead to higher quality care.
- The financial rewards may bypass the purchaser of IT. If a physician group invests in an IT system to better manage the care of their patients with chronic conditions, lower levels of hospitalization can result. But unless the change results in additional office visits, only the payer benefits financially; the physician group does not. If a hospital invests in CPOE to reduce adverse drug events, it could lead to fewer complications and readmissions—leading to cost savings for the payer, but lower payment for the hospital. Integrated delivery systems that combine insurance and service delivery functions are capable of capturing savings from the use of IT and tend to be more sophisticated users.
- The fragmented nature of health delivery also impedes further adoption. Without organized delivery systems, it is difficult for individual providers to adopt health IT applications capable of communicating across systems of care.

These broader market factors operate on top of the barriers to adoption noted previously, including the complexity of implementation. The IOM recognized these complexities in its Crossing the Quality Chasm report.

> "The challenge of applying information technology to health care should not be underestimated. Health care is undoubtedly one of the most, if not the most, complex sectors of the economy. The number of different types of transactions (i.e. patient needs, interactions, and services) is very large. Sizable capital investments and multi-year commitments to building systems will be required. Widespread adoption of many information technology applications will require behavioral adaptations on the part of large numbers of patients, clinicians, and organizations."

The complexity and implementation costs are further exacerbated by the impression that vendors' products do not necessarily perform as anticipated. On the recent HIMSS survey, the second most important reason given for not investing in IT was "vendors' inability to effectively deliver products."

Over time, the market may naturally ease some of these barriers. Development of improved products could reduce the hesitation to invest. Physician acceptance may accelerate with more user-friendly versions and experience. In the long term, adoption of uniform standards also should help providers share information across settings of care and make investment decisions less risky.

However, market barriers such as fragmentation and misaligned payment systems are fundamental problems. Current public and private efforts are attempting to correct for many of these, but more changes may be needed to create conditions necessary for health IT to become broadly available to providers and the patients they treat.

Public and private efforts

The initiatives described in this section, in one form or another, attempt to either strengthen the drivers of health IT or lower the barriers. Numerous public and private initiatives have generally focused on one or more of the following (Table 7-2):

- developing or adopting standards,
- providing incentives for providers to use health IT, or
- giving grants for research and implementation.

TABLE 7-2 **Public and private health information technology initiatives**

Standards	Incentives	Grants
Public		
• Transactions, privacy, security, and provider, plan, and employer identifiers (HIPAA) • HHS adoption of standards for federal agencies and EHR functionality initiative • E-prescribing standards (MMA) • IOM work to encourage use of IT in health care • Commission on Systemic Interoperability (MMA)	• Physician incentives through Medicare demonstration and Medicare Advantage plans (MMA) • FDA requirement for manufacturers to barcode pharmaceuticals	• Matching grants for e-prescribing (MMA) • AHRQ research on value of IT and implementation strategies
Private		
• Health Level 7 efforts to create functional model of EHR • Numerous private sector standards development efforts for administrative functions, prescriptions, labs, and clinical terminology • Physicians' and standard-setting groups' development of standard definitions and terminology for a continuity of care record.	• Leapfrog efforts to encourage CPOE • Plan and purchaser inclusion of physician use of IT as a quality measure • AAFP effort to create affordable open-source architecture for small practices	• Markle Foundation grants to eHealth Initiative • Regenstrief and Santa Barbara community grants

Note: HIPAA (Health Insurance Portability and Accountability Act of 1996), HHS (Department of Health and Human Services), EHR (electronic health record), IOM (Institute of Medicine), IT (information technology), MMA (Medicare Prescription Drug, Improvement, and Modernization Act of 2003), FDA (Food and Drug Administration), AHRQ (Agency for Healthcare Research and Quality), CPOE (computerized provider order entry), AAFP (American Academy of Family Physicians).

Several organizations, both public and private, are also attempting to coordinate the various stakeholders to ensure as focused an effort as possible. HHS is leading the National Health Information Infrastructure (NHII) initiative to coordinate public and private efforts to create a national infrastructure.

Private sector organizations, such as the eHealth Initiative and its affiliate, Connecting for Health (a group made up of a broad set of public and private sector stakeholders), and the National Alliance for Health Information Technology (a group made up of leaders from all health care sectors) are also funding strategic collaboration.

Standards development and adoption

Developing and adopting standards can help ensure a smooth flow of health information across providers.[3] The Congress and HHS have focused on this need in the past few years.

Through HIPAA, the Congress required HHS to develop standards for transactions, such as billing and claims attachments, and required a standard policy related to the privacy and security of health information. These efforts created a base for standardizing health data more broadly. The privacy and security rules, for example, made discussions of broad sharing of patient information possible. However, while HIPAA required the development of standard ways to move administrative data, it did not address standardization of clinical data.[4]

Current HHS efforts are focused on adopting standardized clinical messaging mechanisms and terminology. In this arena, the public sector has been a catalyst to stimulate development and adoption, and the private sector has, for the most part, developed the standards.

The Department of Health and Human Services has taken a lead role to ensure that standards are adopted within the federal agencies and more broadly. Working with numerous private sector organizations and with other

federal agencies such as CMS, the Department of Veterans Affairs (VA), AHRQ, and the Department of Defense, it has broadly defined its goal as developing the NHII. The initiative is defined as "the technologies, standards, systems, values, and laws that enable health information to be appropriately and safely shared among all relevant health decision-makers to promote improvements in health and healthcare." HHS's goals include faster adoption of clinical IT in provider settings, and across providers and government agencies.

These goals require standard terms and messaging formats. HHS initiatives include:

- Giving providers the rights to use the Systemized Nomenclature of Medicine (SNOMED). HHS has obtained the rights to the comprehensive standard medical vocabulary of SNOMED and will make it available at no charge. Prior to this policy, providers had to pay for the rights to use this system for classifying clinical information.
- Working with the Health Level 7 (HL7) group, a private sector standards development organization, to define the functions of an electronic health record. As a first step, HHS asked the IOM to define the key capabilities of an EHR. The IOM defined five primary and five secondary uses of an electronic health record system upon which HL7 is basing its work.
- Adopting standards for use in electronic interactions within the federal government. Through the Consolidated Health Informatics (CHI) initiative, HHS is working with other federal agencies to adopt certain private sector standards for government agencies, such as CMS, the VA, DoD, and the Centers for Disease Control and Prevention (CDC). Through this effort, the federal government is hoping to prompt the private sector to standardize clinical and messaging terminology and logic. The CHI initiative set out to identify all aspects of health care delivery that may need to have standards and seek private sector organizations that already developed standards. CHI initiative staff analyze the standards' utility with advice from private sector experts. The CHI initiative is focused on 24 clinical domains. Five standards were adopted by the federal government in March of 2003 (Table 7-3). On May 6, 2004, the Secretary announced that HHS had adopted 15 more standards for the electronic exchange of information across agencies.

TABLE 7-3

Standards adopted by the Consolidated Health Informatics initiative

Source of standard	Type of information
Health Level 7	Order entry, scheduling, admitting, discharge, and transfer
Joint Committee of the ACR and NEMA	Imaging information (DICOM)
National Council on Prescription Drug Programs	Drug ordering between retail pharmacies and health care providers
Institute of Electrical and Electronics Engineers	Information exchange between medical devices and the computer systems that receive the information (IEEE 1073)
Regenstrief Institute	Lab test result names (LOINC)

Note: ACR (American College of Radiology), NEMA (National Electrical Manufacturers Association), DICOM (Digital Imaging and Communications in Medicine), LOINC (Logical Observation Identifiers Names and Codes).

The MMA calls for further adoption of standards. To encourage use of e-prescribing in the new Medicare prescription drug benefit, the MMA required the Secretary to adopt standards for such transactions. The MMA also established a Commission on Systemic Interoperability. This commission is to study the best strategy, including a "timeline and prioritization for such adoption and implementation," to create a nationwide system of interoperability of IT. The provision requires the commission to consider the costs and benefits of standards, both financial and qualitative; the current demand on industry resources to implement the MMA and other electronic standards, including those in HIPAA; and cost-effective and efficient ways for industry to implement the standards.

External incentives for use of health information technology

The primary driver of adoption—the relationship between IT and quality improvement—may be strengthened by grants for research on the value of health IT, but also by purchaser and plan expectations and incentives for high

quality care. The concept the Commission adopted in its June 2003 and March 2004 reports to include incentives for quality improvement in the Medicare payment system is one approach to encouraging use of IT. By rewarding a quality product, Medicare, in its purchaser role, could provide incentives for providers to adopt the technology necessary to improve quality. Other strategies include increased payment for use of certain forms of health IT and increased reporting on quality measures. Many organizations find that reporting on quality measures requires an information system to track and report data.

Our research found a variety of private sector models in which incentives for quality either directly or indirectly encouraged further diffusion of health IT. CMS has begun to explore some of these models through demonstrations. The MMA also included incentives for e-prescribing. These types of incentives are aimed at strengthening the drivers of health IT adoption by creating an external incentive for investment.

One way in which purchasers and plans are encouraging health IT use is by including measures of provider IT adoption in the quality indicators they use to reward providers. For example, the Leapfrog Group, an organization made up of large purchasers, has included the adoption of CPOE as one of its key patient safety goals. As a result, hospital adoption of CPOE has become a priority for some health plans. One health plan—Empire Blue Cross Blue Shield—in concert with several large employers gave direct bonuses to hospitals for implementing the Leapfrog goals, including CPOE. In Seattle, Boeing is charging employees no copay for using hospitals that meet Leapfrog Group standards, including use of CPOE. In other hospitals, patients will have to pay 5 percent of their bill (Freudenheim 2004). The Bridges to Excellence initiative by several large employers has physician use of certain IT tools as one measure of physician quality. CMS is also considering such an approach in its Doctors Office Quality project.

A less direct approach to encouraging diffusion is to reward the outcome of implementing health IT, for example, higher quality. The relationship between rewarding providers for higher quality and implementation of IT is not proven. However, collecting and analyzing the data necessary to measure quality performance, and implementing process improvement, is easier with IT. Further, because an IT system can track patients and send physicians automatic reminders, physicians with IT can identify patients who need certain diagnostic or preventive services.

Some private sector organizations are giving IT to providers. Anthem Blue Cross Blue Shield and Wellpoint are purchasing computers and certain software for many of the physicians in their networks. These plans expect to benefit from the purchase. While this practice does not appear widespread, a recent regulatory clarification may make it easier in the future. CMS recently issued a final rule implementing certain provisions of the Stark II Law which allows doctors to receive "technology items or services" to encourage them to participate in community-wide health information systems.

Mandating use of a specific technology is yet another approach. This has not been done directly. However, the FDA's recent regulation requiring pharmaceutical manufacturers to place bar codes on their products points in this direction. While the rule does not require hospitals to purchase and use the technology necessary to read the codes on the pharmaceutical products, the FDA hopes the availability of the coding will encourage hospitals to do so. In addition, the Joint Commission on Accreditation of Healthcare Organizations recently proposed adding a requirement for bar coding in future hospital accreditation standards.

Grants for research and implementation

Public and private sector grants are funding research on the value of IT and implementation models for community-wide or provider-setting adoption. The Agency for Healthcare Research and Quality is allotting $10 million in fiscal year 2004 to create a better research base on the value of implementing IT. The request for applications seeks information to allow stakeholders to make more informed decisions regarding adopting and using IT. AHRQ also has $7 million available for assisting health care systems in planning successful health IT implementation and $24 million for organizational and community-wide implementation.

The President's budget request for 2005 calls for $50 million more for hospital information technology grants through AHRQ. In addition, the MMA authorized $50 million in 2007 and such sums as necessary in 2008 and 2009 for matching grants for physicians to purchase the software and hardware necessary to e-prescribe.[5]

The private sector has also used grants to fund efforts to encourage further diffusion. Some of these efforts are national collaborations around diffusion and community-level initiatives. The Markle Foundation has identified diffusion of health IT as a priority and funded a variety of efforts to identify strategies to encourage diffusion. In 2002, the Foundation convened and funded Connecting for Health, a group of more than 100 public and private stakeholders to work on data standards, privacy, and security issues, and to spur national efforts to create a national health information infrastructure. In 2004, the Robert Wood Johnson Foundation is acting as a partner with the Markle Foundation to fund Phase II, which will look at community-wide exchange of information, information sharing with patients, and adoption of data exchange standards.

The Healthcare Collaborative Network (HCN) is supported by Connecting for Health, the eHealth Initiative, and IBM. The HCN is a national demonstration project designed to show the feasibility of an electronic infrastructure. It involves the electronic exchange of lab results, prescriptions, and clinical procedures among several major delivery systems, including New York Presbyterian, Vanderbilt University Medical Center, and Wishard Memorial Hospital. Several government agencies—CDC, FDA, and CMS—are also involved.

To support community-level projects to exchange information electronically, the Foundation for the e-Health Initiative, with $3.86 million in funding from the Health Resources and Services Administration's office for Advancement of Telehealth, will be giving grants to several communities for seed funding and other support for individual communities who are using IT to drive quality improvements.

In addition to these national efforts, local private sector groups have provided funding for two of the most well-known community-level initiatives. The Regenstrief Institute worked with hospitals in Indianapolis to create a secure platform to share patient information and is currently expanding its efforts to a broader group of providers. In Santa Barbara, the California Healthcare Foundation provided seed money to create a system for sharing patient information among a variety of providers and public health organizations.

Potential additional action

Over time, these efforts may speed adoption of health IT. Providers who have already implemented IT successfully did so over a lengthy time period and used a step-by-step approach. But significant barriers remain for many providers, and the market forces encouraging adoption are weak. Current efforts may need to be expanded or new strategies developed to stimulate broader diffusion of health IT.

Several legislative proposals, information technology experts, and research groups, such as the IOM, have suggested other ways to encourage faster adoption of IT.[6] Options include:

- Payment policy. Purchasers and plans can encourage the adoption of IT by: 1) paying more to providers who adopt certain forms of information technology or 2) paying more for the quality product that may result when information technology is used. The private sector is using some of these payment options. However, as yet, the government has not chosen to adopt them.

- Loan funds. To provide the necessary investment funds, some have suggested establishing a health technology loan fund or regional funds. The concept, outlined in a paper written by The Health Technology Center, and widely discussed, described a revolving fund that would be administered at the state level with matching state and federal dollars (The Health Technology Center 2003). These types of funds could also be funded by private foundations. The state-level affiliates would decide how the loans would be distributed, including the types of information technology appropriate for support and the amounts and terms of the loans. These loans could also be used to leverage investment from capital markets.

  While loans would address the cost barrier, it would be important to ensure that those who qualified for the loans had the capacity to implement and continue to support the health IT. We found through our analysis that organizations often took a step-by-step approach to implementation, beginning with limited applications, and broadening the functions used over a period of several years. To do so required strong leadership, clear strategies for retraining all levels of personnel, and a commitment to redesigning the care

process without disrupting clinical care. Loan recipients will need this level of commitment and infrastructure for implementing health IT. Without such an infrastructure, the IT projects funded may fail, thus leading to further concern that implementing health IT is too risky. Because of the need to learn more about successful implementation strategies, loans might need to be tied to some evaluation strategy.

Loans would also need to be well targeted to organizations that cannot afford health IT on their own. As our analysis shows, health organizations of all types are beginning to adopt a wide variety of IT applications. In addition, some applications may be encouraged over others to ensure a step-by-step approach.

- Grants. The federal government and private foundations are already using grants to spur further diffusion, but these efforts could be expanded. Federal grants could encourage further private sector investment. The proposal discussed above for establishing loan funds also envisions some grants. In designing grant programs, strong criteria for evaluation would allow learning from the grantees' lessons that could be applied more broadly. In addition, the projects should be designed so that once the grant funding ends, the project can be self-sustaining. In the long term, health IT must be sustained through market forces. It would also be important to target funds to those who are unable to invest on their own.

- Requirements to adopt specific technology. The Medicare program or private payers could also require providers to adopt certain types of technology, such as CPOE for hospitals. Alternatively, the government or other payers could require organizations to perform the types of functions for which IT is often used. For example, CMS could require physicians to keep track of preventive services given to diabetic patients through electronic patient registries or paper records. Over time, the provider may find adoption of IT to track patients more efficient.

Our review shows that IT use in health care is growing, but providers do experience barriers. Implementation is difficult, making the risk of investment high. Many public and private organizations support increased use of health IT, but more may be necessary. MedPAC will continue to monitor diffusion efforts, including assessing diffusion in settings other than hospitals and physician offices and looking at the impact of IT on consumers. We will also analyze in more depth potential public actions to encourage diffusion, including efforts within the Medicare program. ■

Endnotes

1 The Institute of Medicine identified the following core care delivery-related capabilities as necessary for an EHR that promotes patient safety: patient health information and data, results management, order entry, decision support, electronic communication and connectivity, patient support, administrative processes, and reporting and population health management. Few, if any, EHRs currently in use have all of these capabilities (IOM 2003).

2 The two-year implementation period allows for some exceptions.

3 While standards adoption is critical in the long run, in the short term, standards adoption could create switchover costs for some providers and slow purchasing decisions that are dependent on standards yet to be introduced.

4 HIPAA did require the National Committee on Vital and Health Statistics (NCVHS) to make recommendations on some forms of clinical coding. NCVHS has discussed whether to move from ICD–9–CM coding to ICD–10–CM. HIPAA also required and the Secretary adopted standards for pharmacy information.

5 For these funds to be used, the Congress will need to appropriate them in this year's budget.

6 The IOM has published a variety of reports on encouraging diffusion of health IT and the importance of health IT to quality delivery of health care. One specific proposal included in a report on graduate medical education was to base some of the distribution of indirect medical education funds on hospital adoption of IT.

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