

HEALTH POLICY REPORT

Information Technology Comes to Medicine

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Judging from the excited rhetoric of some of its enthusiasts, health information technology (HIT) has the power to transport us to almost a dream-like world of health care perfection in which the work of doctors and the care of patients proceed with barely imaginable quality and efficiency. For many physicians, however, especially those in solo or small practices, HIT conjures a very different image — that of a waiting room full to bursting, a crashed computer, and a frantic clinician on hold with IT support in Bangalore.

With these two starkly different fantasies animating so much discussion about HIT, the real implications of HIT for doctors, patients, and the health care system are often hard to understand, as are the likely pace and extent of adoption of HIT. One central, often unspoken question is whether HIT is best viewed as one more in the long list of technologies that modern medicine has effectively accommodated over the years without great disruption or whether it is something fundamentally different, a potentially transformative force that ultimately will bring about a radical redesign of the processes by which care is delivered. This latter view suggests that adoption of HIT could fundamentally change the practice of medicine and the relationship between doctors and patients for decades or even centuries to come.

In this report, we seek to clarify some of the issues that are central to current discussions about HIT, focusing on topics critical to physicians, patients, policymakers, and managers. For HIT experts, however, a word of caution is in order. This report is intended for an audience of general physicians who have, as yet, little or no direct experience with the marvels and, yes, frustrations, of HIT as it affects their daily work. HIT cognoscenti, therefore, will find that many topics are not pursued here in detail. To reach its intended audience, the report also adopts a purposely detached tone toward the benefits and

risks associated with HIT. To some of its advocates, this tone may seem to deny what many regard as its indisputable value. That is not our intent. Rather, we recognize that the benefits and costs of HIT are multiple and complex and that the evidence supporting them is evolving.

The report addresses five questions: What exactly is HIT? What do we know of its benefits and risks? How prevalent is its use at the current time? What are policymakers doing to encourage or manage its dissemination? And what does the future hold for HIT in U.S. medicine?

WHAT IS HEALTH INFORMATION TECHNOLOGY?

HIT consists of an enormously diverse set of technologies for transmitting and managing health information for use by consumers, providers, payers, insurers, and all the other groups with an interest in health and health care. For reasons of space, we focus here on technologies that are particularly relevant to storing and processing data about patients. Even these technologies encompass a diverse array of systems ranging from those that are relatively straightforward with which physicians are widely familiar, such as the computerized storage and reporting of laboratory results, to more novel systems that permit clinicians to share information about patients across institutional and geographic boundaries (a sharing that is often called “connectivity” or “interconnectivity” and requires systems that can talk to each other — that are “interoperable”).

Many types of HIT are important, but three deserve particular attention because of their potential significance for the day-to-day delivery of health care services: the electronic health record (EHR), the personal health record (PHR), and clinical data exchanges. The EHR is the technology likely to have the most profound effect on the daily work of physicians and other health

care providers. According to the Institute of Medicine, an EHR is a system that can do eight things electronically (or in the terminology of informatics, has eight functionalities) (Table 1).¹ This past year, an advisory panel to the government's HIT Adoption Initiative (which is tracking the spread of EHRs for the Department of Health and Human Services) concluded that the first four of these eight functionalities constitute the core of an EHR. Thus defined, an EHR is able electronically to collect and store data about patients, supply that information to providers on request, permit physicians to enter patient care orders on the computer (known as computerized physician-order entry, or CPOE), and provide health professionals with advice for making health care decisions about individual patients (known as computerized decision support).

Although the greatest effect of EHRs will be on the work of providers, PHRs have the potential to affect the daily lives of patients the most and, particularly, to involve patients much more actively than ever before in managing their own health. PHRs are at an earlier stage of development than EHRs and take more varied forms.^{2,3} At this point, PHRs most commonly consist of systems that give patients access to EHRs maintained by health care providers. Often called patient portals or gateways, these computer applications permit patients to view (and in some cases, to annotate) data in their EHR online, to e-mail their health professionals, and to accomplish numerous other health care tasks electronically, including getting referrals, scheduling appointments, and obtaining medication refills.⁴

Some insurance companies have begun to offer their own versions of PHRs.⁵ Insurance-based PHRs provide insurers' clients with online access to reports derived from their claims data, includ-

ing lists of medical problems and medications and reminders about pending preventive care services.

The clinical data exchange is the most abstract of the three forms of HIT highlighted here, and as its name suggests, it may not, strictly speaking, be a technology. In most cases, the clinical data exchange is established and managed by a regional health information organization, or RHIO. These organizations consist of local groups — including hospitals, insurance companies, employers, pharmacies, consumer groups, and government officials — that are brought together to connect the HIT systems maintained by the separate health care providers and insurers in a given geographic area (Fig. 1). If successful, regional health information organizations will allow clinicians, no matter where they are or for whom they work, to share information electronically about common patients. Only a handful of functioning regional health information organizations exist,⁶ though more than 100 are in the planning stage.⁷ They are currently mostly voluntary in nature, are funded haphazardly through philanthropy and modest state grants, and appear to be financially shaky.⁸

Although it is helpful to be familiar with the types of HIT, the implications of the technologies for doctors and patients really depend on nontechnical considerations. Sophisticated observers and advocates of computerizing medical information view the adoption of HIT as the opening wedge into, indeed a fundamental catalyst of, widespread change in the practice of medicine.⁹ With HIT, it is hoped, doctors will have the information they need to make good decisions at the exact time and place they need it, and computerized decision support will ensure that they use that information to make and implement correct decisions. Missed diagnoses, incorrect clinical choices, errors, and unnecessary tests and procedures will be dramatically reduced. Moreover, by using their PHRs, patients will become partners in maintaining their health and treating their own illnesses. They will monitor their clinical values — such as daily weights for patients with congestive heart failure — and using new forms of decision support, will make wise decisions regarding how to manage their health problems without always having to contact a doctor or a nurse. With all these changes, quality and efficiency will soar.

Table 1. Functionalities of an Electronic Health Record System, According to the Institute of Medicine.

Core Functionalities*	Other Functionalities
Health information and data	Electronic communication and connectivity
Results management	Patient support
Order entry and support	Administrative support
Decision support	Reporting and population health management

* These categories were determined by an advisory panel to the federal government's HIT Adoption Initiative to be the core functionalities of an electronic health record.

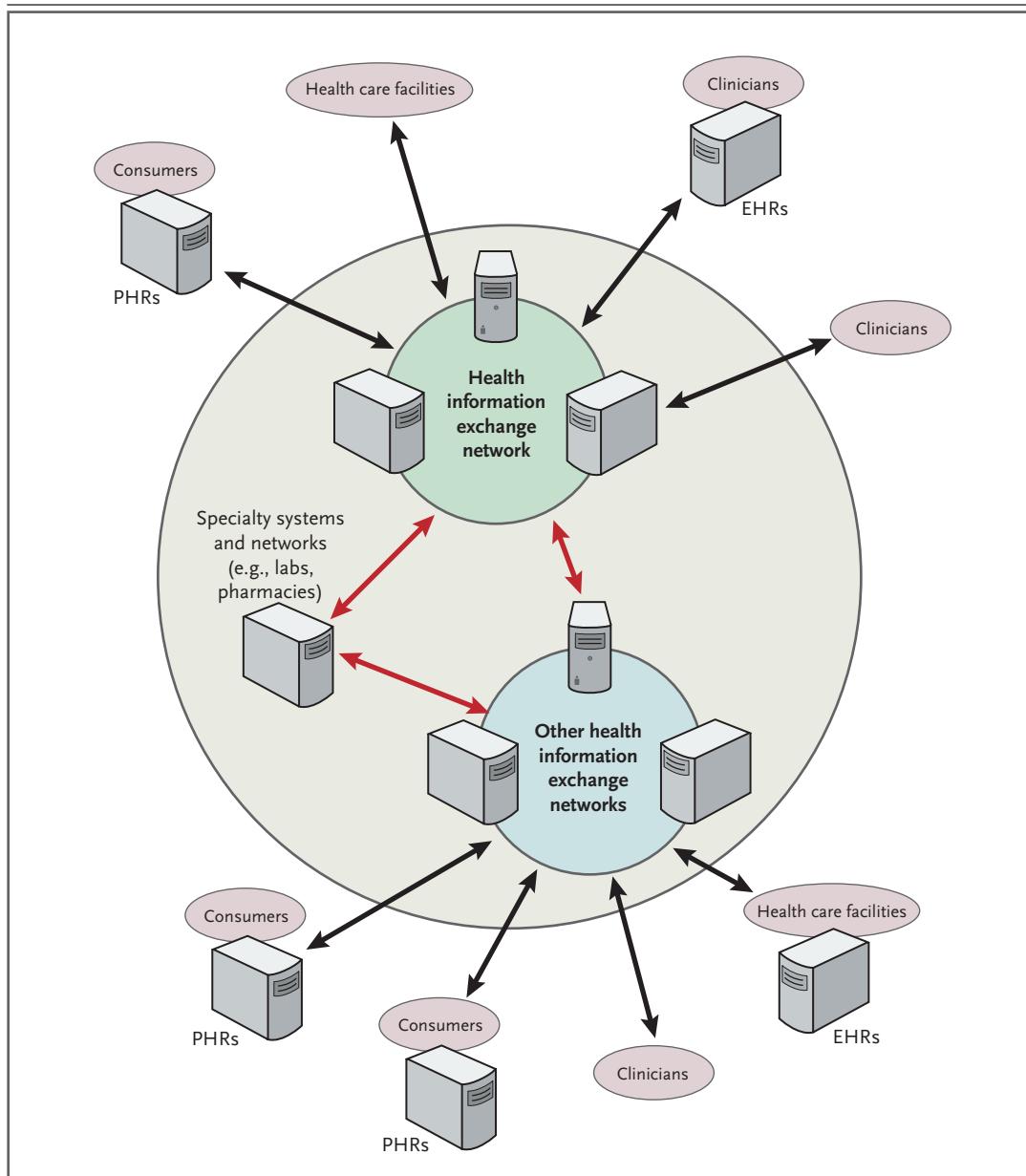


Figure 1. A Regional Health Information Organization (RHIO).

Clinical data exchange allows clinicians and patients to share clinical information across institutional and geographic boundaries. RHIOs facilitate this exchange by bringing together the groups that must participate in it to make the exchange effective. RHIOs may also provide ongoing governance of the process of data sharing. Data exchange occurs through the information-exchange networks that provide the technical means of exchanging data between the records and databases maintained by clinicians, health care institutions, and individual consumers. A given region, overseen by a given RHIO, may have multiple networks of this kind that communicate with one another. Health care facilities include hospitals, long-term care facilities, home-health agencies, nursing homes, and rehabilitation hospitals. PHRs denotes personal health records, and EHRs electronic health records.

This vision, however, is dependent on much more than putting new technology on physicians' desks or in patients' pockets or laptops. To realize the full potential of the information revolution in health care, clinicians will probably have to change the way their offices and days are organized, how they enter and retrieve patient information, the process by which they make medical decisions, and the ways in which they relate to colleagues and consultants and interact with their patients. Patients will have to find ways to understand and manage huge amounts of health care information that had previously been largely inaccessible to them. In other words, effective use of HIT depends as much on managing change as it does on information management, and change has never been easy for our nation's health care system.

The capacity of HIT to realize this transformational vision will also depend on something else: whether the systems installed are designed to produce the information required to make possible the quality and cost reforms that are sought. It is one thing to digitize the current medical record, so that the information clinicians now collect is available to them in electronic form. It is another thing to make certain that all the data needed for the purposes of improving quality and efficiency are collected and to install new software applications that can retrieve these data, organize them, apply decision algorithms, and provide the result to clinicians and managers when and where they need it. The HIT products now being sold are intended to meet the present needs of clinicians — as would any product be that is aimed at attracting buyers in a well-functioning market. Health care reformers, however, imagine a world in which HIT meets needs that most physicians and hospitals do not now think they have. How to meet future needs, and how to persuade providers to invest in such innovative systems, is a nut waiting to be cracked.

BENEFITS AND RISKS OF HIT

Whether HIT can or will catalyze these huge changes remains uncertain — and extremely difficult to evaluate in the short term. However, it is possible, if still challenging, to assess the benefits and risks associated with some types of HIT. Since data about the effects of PHRs and clinical

data exchanges are scarce, we focus here on what is known about the benefits and risks of EHRs.

Information on EHRs and their effects comes in at least two forms: studies of the effect of EHRs, or of the tasks that they can perform (the separate functionalities), on the quality and efficiency of care and cost-benefit analyses that, on the basis of these smaller studies, project the effects of EHRs on the health care system as a whole.

Chaudhry and colleagues¹⁰ recently reviewed the literature on the effects of HIT, including EHRs and their separate functionalities, on the quality and efficiency of care. On the basis of studies of what these authors called “multifunctional systems” of HIT, some of which consisted of full EHRs whereas others involved multiple EHR functionalities, they found evidence that implementing a multifunctional EHR system could increase the delivery of care that would adhere to guidelines and protocols, enhance the capacity of the providers of health care to perform surveillance and monitoring for disease conditions and care delivery, reduce rates of medication errors, and decrease utilization of care. Effects on the efficiency of care and the productivity of physicians were mixed.

The major limitation of the literature on EHRs, in the authors' view, was that most of the key studies originated at four institutions that had pioneered the use of HIT and had developed their own EHRs incrementally over time. Since providers are likely to purchase off-the-shelf EHRs, the relevance of these studies to the probable experience of most doctors and hospitals is uncertain.

Although some of the other studies that examined the effects of commercial systems purchased by health care institutions also suggested significant benefits, others hinted at potential risks. One study of the introduction of a computerized physician-order-entry system at the Hospital of the University of Pennsylvania showed an increase in certain types of medication error associated with the introduction of this technology.¹¹ Another study actually showed an increase in mortality in a pediatric intensive care unit when the hospital introduced an EHR,¹² a finding that was contradicted by a subsequent investigation at another institution.¹³ In addition to these cautionary studies on the effects on patients' health of the use of EHRs, there are indica-

tions that the transition to their use slows down physicians and may result in a 10 to 20% reduction in productivity for a period of months or more.¹⁴

In general, the empirical literature on EHRs at this point raises a question that is commonly encountered when considering new health care technologies: how to translate evidence of efficacy into estimates of effectiveness. In the settings in which EHRs have been evaluated, empirical evidence of efficacy seems strong, though accompanied by cautionary notes about unintended consequences in the form of new errors and economic dislocations. If EHRs were drugs under review by the Food and Drug Administration, they would probably be approved for marketing but with requirements for some postmarketing surveillance.

Using data from reported studies, several groups have attempted cost-benefit projections of the effects of widespread implementation of various forms of HIT, including EHRs, on the U.S. health care system. The study that addressed the effects of EHRs most directly was conducted by the RAND Corporation, with support from industry sources. The investigators estimated that achieving a 90% rate of adoption of EHRs in hospitals and physician practices would entail capital expenditures of \$121 billion over a period of 15 years but would yield net savings of \$531 billion over the same period.¹⁵

PREVALENCE OF ADOPTION OF HIT

Given the evidence, however imperfect, of the efficacy and cost-saving potential of HIT, adoption has been slower than many expected. According to the best estimates, as of 2005, about 23% of physicians in ambulatory practice used some form of EHR and about 9% had an EHR with capabilities approximating those defined by the HIT Adoption Initiative (Fig. 2).¹⁶⁻¹⁸ Rates of adoption were significantly higher among groups of 11 or more physicians: about 20% for the more fully capable form of EHRs. For hospitals, good data on the prevalence of EHR use are almost nonexistent. The best data are on use of computerized physician-order entry, which was available in about 5% of U.S. facilities in 2004.^{17,18}

These modest rates of adoption raise the obvious question of why EHRs and other forms of HIT have not spread more rapidly in the U.S.

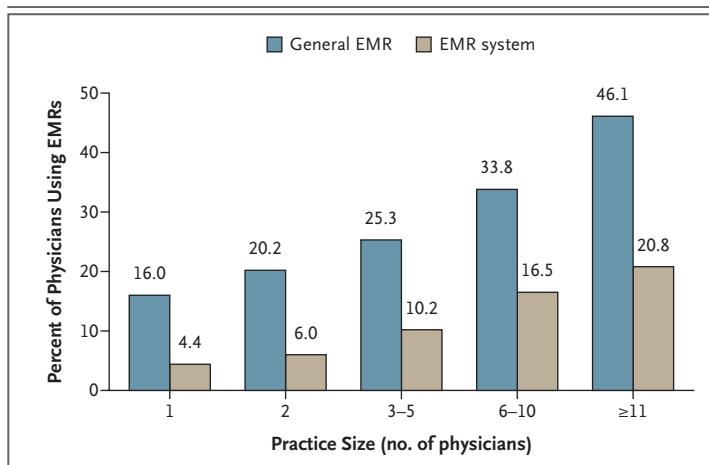


Figure 2. Percentage of Physicians Using Electronic Medical Records (EMRs) According to Practice Size, in 2005.

The trends toward physicians' increasing use of EMRs (also known as EHRs) individually and according to practice size were significant ($P < 0.05$). In the National Ambulatory Medical Care Survey, the general EMR represented a positive response to a question concerning whether physicians participated in the full or partial use of EMRs. An EMR system had the core functionalities of an EHR: health information and data, results management, order entry and support, and decision support. The survey included non-federal, office-based physicians who see patients in the office setting and excluded radiologists, anesthesiologists, and pathologists. The data are from Burt et al.¹⁶ and Jha et al.¹⁷ Adapted from Burt et al.¹⁶ and Blumenthal et al.¹⁸

health care system. A number of explanations seem pertinent. The introduction of such systems into doctors' offices can be costly and disruptive in the short term. Estimates of the cost of purchasing and installing an electronic health record range from \$15,000 to \$50,000 per physician.¹⁹⁻²¹ These costs, along with those of system support, pose a substantial financial hurdle for solo physicians and small group practices that lack the necessary capital.

Like physicians, hospitals are discouraged by the cost of new systems and the pace of technological change, but they also confront the difficulty of implementing such systems across large organizations and the presence of bits and pieces of HIT systems (in their laboratories or pharmacies) that must be abandoned or reconciled with new EHRs.^{22,23} In addition, hospitals must contend with the prospect of physicians' opposition if the implementation makes their work more difficult. In one famous episode, the Cedars-Sinai Hospital in Los Angeles was forced to abandon installation of a computerized order-entry system when its physicians rebelled.²⁴ Thus, though some

hospitals are adopting HIT systems, their investments in this technology pale by comparison with recent explosive spending on new physical plants.²⁵ This situation suggests that even when capital is available, some hospitals shy away from HIT investments in favor of capital projects that are less controversial or have more immediate returns to the bottom line.

These barriers to adopting HIT are to some degree symptomatic of underlying issues. Convinced that HIT will actually save money for the health care system, advocates of health information systems contend that the real problem is that distortions in health care payment systems prevent those who will bear the costs of implementing HIT — the providers of care — from sharing in the resulting economic gains. Put another way, providers may have a professional responsibility to adopt HIT, but there is no “business case” for them to do so.²⁶ Another critical obstacle to adoption of HIT is that, as noted, it would require physicians to change many things about their work. Especially for older physicians, the case for jettisoning familiar practices has to be truly compelling. So far, this case has evidently not been made.

PROMOTING ADOPTION OF HIT

Whatever uncertainties surround the net benefits of HIT, its potential is sufficiently compelling — and its pace of adoption sufficiently slow — to have generated a flurry of interest and activity among public and private health care groups aimed at promoting the dissemination of the technology. The Bush administration has made promotion of HIT one of its highest health care priorities. In April 2004, President George W. Bush declared that most physicians should have an EHR system by 2014. He also established a new administrative entity, the Office of the National Coordinator of Health Information Technology, in the Department of Health and Human Services, to lead federal efforts to accomplish this objective.²⁷

Consistent with the administration’s suspicion of government and its belief in the ability of markets and the private sector to accomplish key policy objectives, federal authorities have operated on a very modest budget, have used the bully pulpit heavily, and have focused on strengthening private markets for HIT adoption. The Office of National Coordinator has undertaken a series of relatively low-cost but potentially valuable studies

and projects designed to reduce barriers to adoption by physicians and hospitals.²⁸ The government has also reduced an important legal barrier to hospital–physician cooperation in the adoption of EHRs. Until recently, federal regulations made it illegal for hospitals to give doctors not in their employ any assistance in acquiring HIT. The government feared that such assistance would be used as an inducement for physicians to make referrals or to bind physicians to particular hospitals. The secretary of Health and Human Services recently issued regulations softening those restrictions.²⁹ In still another executive action, last summer President Bush signed an executive order requiring that all providers of care doing business with the federal government (including providers of care to Medicare beneficiaries) make certain cost and quality data publicly available by January 2007, a requirement that might spur adoption of HIT.³⁰ Not to be outdone, both houses of Congress passed legislation to promote HIT adoption, but the two bills differed significantly, failed to emerge from conference during the recent lame-duck session, and will probably be re-drafted by the current Democratically controlled Congress.³¹

State governments have also embraced the spread of HIT. According to one recent survey, 28 states are planning or engaging in efforts to promote adoption of HIT within their borders.³² A number of private health care actors, such as health care insurers, have become major promoters of HIT use as well.

THE FUTURE OF HIT

The frenzied interest in HIT throughout our government and our health care system creates the strong impression that its widespread adoption is inevitable. As an instrument of reform, HIT has attributes that ensure its attractiveness to many groups in a politically and economically divided health care system that is struggling with seemingly insurmountable problems of cost and quality.

However, the apparent certainty of the adoption of HIT needs to be constantly reexamined. Several difficult questions remain. One is whether the Bush administration’s current decentralized, market-based approach to promoting its spread will prove effective in realizing the promise of HIT. Relying on private organizations and state and local governments to implement HIT solu-

tions will almost certainly result in varying patterns and rates of adoption across the United States and the development of systems that differ in capability and performance from institution to institution, practice to practice, and region to region. Characteristically, other Western countries, such as the United Kingdom, are adopting more top-down approaches to implementing HIT systems. Although the United Kingdom is currently encountering some problems of implementation, a recent cross-national study of HIT adoption by physicians showed that the United States was lagging behind several other Western countries that have adopted a more centralized approach to spurring adoption.³³ In the present U.S. political context, a bottom-up strategy for spreading HIT may be the only viable option, but it would be unfortunate if this approach hardwired into our health information system the administrative inefficiencies that plague other parts of our health care system.

A second question is whether, if the apparent benefits of HIT materialize, its spread will perpetuate and perhaps even enhance disparities in care received by different population groups and in different geographic regions of the country. If we rely on the private sector to fund acquisition of HIT — at a likely cost of hundreds of billions of dollars over several decades — providers that are financially strong will have an advantage over weaker ones. If history is a guide, organizations that disproportionately serve underrepresented minorities and the uninsured will lag and their patients will suffer.

A third unanswered question is how, exactly, the HIT revolution will recruit the 75% of U.S. physicians who still practice alone or in groups of five or fewer. As yet, no national strategy has evolved for assisting these physicians with the costs of acquiring, installing, and maintaining EHRs or other forms of HIT or for convincing them that they can effectively function within the new practice regimes that HIT may engender.

Perhaps the biggest uncertainty, however, concerning HIT is whether it will accomplish dramatic, transformational improvement in the functioning of our health care system. Managers of organizations at the vanguard of the HIT revolution are already grappling with the fact that implementing HIT nationwide will require changing, quite dramatically, the work of millions of

health professionals and tens of thousands of institutions throughout our \$2 trillion health care system. In the face of this challenge, the will to improve will be primary, the technology itself secondary, and patience critical. Creating an economic and policy environment in which hospitals and doctors find quality improvement and cost reduction essential to accomplishing their financial and professional goals will be necessary to widespread adoption of HIT and to assessing its transformative potential.

The U.S. health care system is prone to undertaking huge risks without ever explicitly acknowledging that it is doing so. The health care system's current embrace of HIT and its decision to allow markets to guide the dissemination of this promising but incompletely tested set of technologies constitute just the latest in a series of health care somersaults into uncharted waters. Collectively, health care providers and consumers can take some comfort in the thought that HIT is a surer bet than many previous ventures, and one likely to do much more good than harm.

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