

Viewpoint Paper ■

Accelerating U.S. EHR Adoption: How to Get There From Here. Recommendations Based on the 2004 ACMI Retreat

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Abstract Despite growing support for the adoption of electronic health records (EHR) to improve U.S. healthcare delivery, EHR adoption in the United States is slow to date due to a fundamental failure of the healthcare information technology marketplace. Reasons for the slow adoption of healthcare information technology include a misalignment of incentives, limited purchasing power among providers, variability in the viability of EHR products and companies, and limited demonstrated value of EHRs in practice. At the 2004 American College of Medical Informatics (ACMI) Retreat, attendees discussed the current state of EHR adoption in this country and identified steps that could be taken to stimulate adoption. In this paper, based upon the ACMI retreat, and building upon the experiences of the authors developing EHR in academic and commercial settings we identify a set of recommendations to stimulate adoption of EHR, including financial incentives, promotion of EHR standards, enabling policy, and educational, marketing, and supporting activities for both the provider community and healthcare consumers.

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The annual meeting of the American College of Medical Informatics (ACMI) in February 2004 focused on the status of electronic health records in the United States. Attendees at the meeting discussed three questions regarding the state of electronic health record (EHR) adoption in this country: Where have we come from? Where are we today and why? And with widespread adoption of EHR in the United States in mind—How do we get there from here? These discussions have been synthesized into three companion reports addressing each question in turn.^{1,2} In this report, building on the first two, we review discussions and recommendations that focus on the third question. This report represents the opinions of the authors, informed by the ACMI discussions, and does not represent a consensus statement from ACMI.

We believe that U.S. health care information technology adoption is stymied by a fundamental health care information technology* (HIT) market failure. The HIT market has failed because of misaligned incentives (asymmetric risk and reward) among key market players, the inability to achieve broad standards adoption and lack of definition of

basic product features, and the rapid cycle turnover of HIT companies to date. We identify four broad areas for action to stimulate U.S. EHR adoption. They are: (1) financial incentives to stimulate the EHR marketplace, (2) EHR functional and related informatics standards setting and adoption, (3) enabling policy for EHR adoption, and (4) educational, marketing, and supporting activities. Before we discuss each of these areas in turn, we start by first assessing the current market and business case for HIT in the United States.

Addressing a U.S. Health Care Information Technology Market Failure

We believe four principal reasons explain the U.S. HIT market failure. These issues must be overcome to facilitate rapid EHR adoption in this country.

HIT Value Proposition

While a great deal of work has been done demonstrating the impact of clinical information systems on clinical decision making and the quality of care, little work has been done that demonstrates the impact of health care information technology on economic outcomes. Several studies^{3,4,5,6,7} suggest that there should be a positive long-term return on investment for EHR in the ambulatory care environment and a business case for standardized interoperability between EHR implementations,⁸ but there is limited solid evidence demonstrating significantly improved financial outcomes resulting from HIT investments. In the absence of solid economic evidence for EHR adoption, most technology vendors make

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*We define “health care information technology” broadly as including in patient and out patient care settings clinical information management systems used by clinicians and ancillary staff for the purpose of clinical information management, order entry, documentation of care services, and decision support.

a business case focused on reduced costs associated with information management, potential quality of care impact, and, to a lesser degree, care process efficiency. For health care providers who heretofore have borne little risk for the quality of care provided, and who from their perspective are managing clinical practice well with a paper-based medical record, such arguments have largely fallen on deaf ears, perhaps appropriately so.

We believe that the research agenda should focus on the value proposition of EHR across the health care delivery spectrum. Solid evidence of economic impact of EHR will help make the business case for EHR and drive adoption.

Misaligned Incentives

In addition to the absence of solid evidence on the economic impact of EHR, certain analyses suggest that the HIT market is failing due to a fundamental misalignment of incentives between providers purchasing HIT and those who fund health care, such as public and private payers and employers.¹ The economic analysis suggests that the benefits of HIT do not accrue to those who must invest in these technologies. For example, many of the patient safety and quality effects of EHRs accrue benefit to the payer or employer—purchaser of health care services who is at greater risk for a patient's total health care costs given decreasing rates of provider reimbursement under capitation. Under fee-for-service reimbursement models, providers have little incentive to use EHRs unless they can contribute enough to practice efficiency or revenue cycle management to improve net revenue per time unit. Under mixed reimbursement models such as variable withholds, and newer pay-for-performance programs, EHRs may contribute to achieving performance or quality benchmarks that warrant increased reimbursement or increased return of withhold payments. We identify recommendations that may stimulate EHR adoption through reimbursement reform and improved capital availability for the provider sector.

Standards Adoption

Another component of the market failure we identify is delayed standards adoption. In the absence of a clear business case or value proposition, it is not surprising that voluntary U.S. standards-setting efforts have made slow progress in stimulating adoption of standards addressing HIT functionality, interoperability, content representation, and messaging. With the exception of recent U.S. federal efforts at standards acceleration and identification and endorsement of a select set of standards for use in federal programs,⁹ progress has been slow in the private sector among HIT vendor companies, with the notable exception of the recent effort of the Markle Foundation and the Connecting for Health Program¹⁰ and the Integrating the Healthcare Enterprise (IHE) efforts.¹¹ The absence of a solid business case for interoperability allows vendors to take a myopic view of the use of standards in their products and in installations of their technology in customer environments. Few HIT customers currently propose information exchange with clinical business partners as a requirement for their clinical systems. Commonly today, only messaging standards are applied to ensure information exchange between disparate systems within the context of a single health care entity, whether group practice, hospital, or multi-facility integrated delivery network (IDN).

Recent research suggests there is a considerable societal benefit—a U.S. savings potential of \$78 billion annually—that could be achieved with seamless, fully interoperable health care information exchange among key stakeholders in the health care delivery system.² At the local level, however, currently there is no financial reward for improved clinical information exchange among health care entities that regularly act as business partners providing care to a common set of patients—providers are not reimbursed for electronic information exchange. In one case of federally mandated interoperability standards, the Health Insurance Portability and Accountability Act (HIPAA) engendered cooperation among a set of diverse and potentially competing entities to improve reimbursement transactions and administrative information exchange¹² through collaboration to identify and implement a shared methodology for administrative transaction management. This idiosyncratic approach, however, is unlikely to lead to a coordinated set of standards adopted across the country.

In the current marketplace, in the absence of a similar shared and realizable gain for clinical information exchange, or other recognition of the value of collaboration, there is no incentive from the individual provider's perspective for the adoption and use of a common set of interoperability standards. Viewed from another perspective, by distributing the costs of poor information exchange and interoperability far and wide across all participants in the health care delivery system, each individual entity may be acting rationally from a local perspective, but no entity perceives the magnitude of the lost value in the aggregate (A. Milstein, personal communication, July 2004). This behavior precludes spending by individual providers or purchasers of HIT for a potential public good dependent upon the cooperation of other independent entities. When the vendors of HIT do not perceive their customers stating interoperability as a requirement of their systems, they act rationally and do not include these features in their products. Thus, there is an opportunity for a third party, such as the federal government and private payers, to introduce reimbursement or regulatory policy changes that would drive standards adoption.

Viable Companies and Products

The difficulties we have described prevent the development of a robust marketplace for HIT. While the academic literature has produced solid evidence on the impact of HIT on patient safety,¹³ the quality of care,^{14,15} care process efficiencies,¹⁶ and even revenue cycle management,¹⁷ the absence of a clear business case and fundamental misalignment of incentives has protracted the emergence of this market. To its credit, the venture capital community recognizes the potential value of HIT and has made considerable investments over the last decade; however, the market remains characterized by a few large vendors (typically with diversified product portfolios, not solely dependent upon their HIT product lines) selling to providers with sufficient operating margins and capital reserves to make considerable investments and stay the course, and a large number of small, highly unstable smaller EHR vendors with a relatively short mean lifespan. These same providers are typically at risk themselves, through self-insured or publicly funded health plans, for a percentage or all of their health care expenditures and thus experience the rewards of HIT investments themselves through internally aligned incentives (for example, Kaiser Permanente, Veteran's Health

Administration). The majority of physicians' office environments and small and midsize community hospital settings have yet to make significant HIT investments and in many cases do not believe they are in a financial position to do so.

In the absence of a viable marketplace, and with little barrier to entry in the absence of a standards conformance requirement, the HIT industry is replete with hundreds of EHR vendors attempting to provide products to fulfill niche requirements from just a few customers, paying little attention to functional, data representation, or interoperability standards for EHR. While the EHR may be conceived as a "system of systems"¹⁸ the lack of clarity around basic product definition, relevant standards, and market segments, stifles demand from a wary customer.

Recommendations

We now discuss four areas in which we suggest action is warranted to help stimulate the adoption of EHRs in this country: market incentives; EHR and informatics standards; enabling policy; and educational, marketing, and supporting activities. We prioritize these in a manner that we believe will lead to the quickest response, and in several areas efforts are underway. However, some require additional effort, and we suggest these initiatives may proceed concurrently. This report represents the authors' opinions on these issues informed by the ACMI meeting held in February 2004, evidence in the literature, and experiences in both academic and commercial settings developing health care information technology.

Market Incentives

Given the heterogeneity of the U.S. delivery system and reimbursement mechanisms, we recommend the use of market mechanisms to stimulate HIT adoption. Such mechanisms take essentially one of two forms and can be expected to produce increased EHR adoption. We also suggest that an EHR certification process is called for to identify use of HIT that warrants one or both of these mechanisms. Finally, we suggest that open source technologies may have a role in lowering the price of HIT applications or components (particularly knowledge components), or pieces of the technology infrastructure for interoperability. We discuss these recommendations in turn.

Reimbursement Reform

The most direct way to stimulate any market is to increase demand. Such an increase would occur if users of HIT were directly or indirectly rewarded for using HIT. A direct reward could arise if, for example, payers required not only submission of administrative claims data electronically, but also submission of any attendant clinical information or other claims attachments in electronic form, and a differential payment was made to the provider supplying these data. This requirement would stimulate the adoption of HIT so that providers could supply both clinical and administrative data electronically. Secondary uses of these data for both individual provider performance assessment and secondary population health surveillance and public health management would produce secondary gains.

A more indirect mechanism would be to reward providers for attaining desired performance benchmarks across a variety of acute and chronic care conditions in both in-patient and out-patient care settings. While not a direct reward for the use of

HIT, this would have the likely effect of causing providers to adopt HIT to capture relevant performance measures and produce timely reports, warrant the bonus payment, or return withheld reimbursement from payers. The costs of producing such benchmark reports and gathering the requisite data without HIT would be greater than doing so with HIT. Such an approach imposes fewer constraints on the providers in terms of what constitutes acceptable HIT, and thus many secondary benefits may not as readily accrue—either to the providers or to society. Nevertheless, this may be the least invasive mechanism that could leverage much of the existing HIT and produce dramatic results. The Bridges to Excellence program¹⁹ and the Leapfrog Group standards²⁰ are notable examples of such efforts for out-patient and in-patient care settings, respectively, and several similar programs are in development or pilot stages around the country. Nevertheless, there is a paucity of evidence on what the effect of specific financial incentive mechanisms on EHR adoption is—this should be a research priority and tops our list of recommendations (Table 1).

Table 1 ■ Recommendations to Stimulate U.S. EHR Adoption

Expand the HIT Research Agenda

1. Increase funding to evaluate the impact of HIT in practice, with a focus on economic outcomes, costs and benefits.
2. Evaluate the utility of "open source" or public domain software for EHR and implementation and maintenance methods for such systems.

Financial Incentives to Stimulate EHR Marketplace

1. Reimbursement reform: Establish financial incentives for the use of EHR in practice.
2. Capital availability: Establish low-interest loans or a grant program to facilitate hardware and software adoption in health care settings.
3. EHR Certification and Accreditation: Establish a process to certify EHR products as having requisite functionality in accordance with accepted standards and an accreditation process for level of use of EHR in practice.

HIT Standard Setting

1. Coordinate existing efforts to specify essential standards for basic EHR functionality, data representation, and messaging.
2. Specify a minimal clinical data set covering a patient's demographics, medications, medical conditions, allergies, advance directives, and selected data pertinent to patient safety and health care quality.
3. Specify minimal functional standards for HIT systems in acute care and inpatient care settings, personal health records, and key functional components such as CPOE.

Enabling Policy

1. Promulgate Medicare Modernization Act relaxations to Social Security Act, Sec. 1877 (Stark).
2. Establish federal policy on clinical data ownership and stewardship.
3. Establish policy framework for Regional Health Care Information Authorities.
4. Establish U.S. national licensure in the health professions.

Educational, Marketing, and Supporting Activities.

1. Establish educational and marketing campaign for the public—"Got EHR?"
2. Establish educational campaign for health professionals.
3. Establish educational campaign for health care management.
4. Create a National Health Care Information Technology Resource Center.

Capital Availability

We believe that reimbursement reform is only one part of what will necessarily be a two-part approach to market incentives. While reimbursement reform may cause an increase in operating revenue for providers adopting HIT, it does not address the fundamental capital barrier that providers face in making the initial investment and capital outlay in expensive HIT software, hardware, support services, and the lost revenue typically associated with HIT adoption in the early phase of implementation. Many experts have described and proposed a variety of mechanisms to increase capital availability to small office environments, community hospitals, and other care settings, that lack sufficient capital reserves or credit to access capital markets. We suggest that what has occurred in many other countries should occur in the United States: low interest loans or even one-time grants to providers adopting HIT are in the nation's and the payers' interest to catalyze HIT adoption. Whatever the approach to providing initial hardware and software it must include a workable plan to both sustain and update those systems. We need to recognize that commitment to HIT is not a one-time expense.

EHR Certification Process

We believe that an EHR certification process is called for to attest to the appropriate functionality of EHRs, and an accreditation program is called for to attest to the level of use of an EHR in practice. HIT purchasers need assurance that their technology purchases will warrant incremental payments from payers. Payers need to be assured that their incentives are going to physicians who are using more than a spreadsheet as their EHR—it must meet minimal functional standards. In addition, they need to have assurance that the system is being used appropriately to achieve patient safety and quality gains; for example, that each clinician is using an electronic prescribing module for every prescription. While this may be viewed by some as something that raises the bar for entry into the HIT marketplace, this concern pales in comparison to fears HIT purchasers have that their investments will be for naught or concerns of the payer community, who fears being asked to comply with one or more of the reimbursement mechanisms we have described with no means to ensure compliance with HIT adoption or adequacy of the HIT itself.

Open Source EHR and Related Technologies

Finally, another market mechanism to stimulate market demand for a desired product is to lower the price. Many pundits have written about so-called "open source" software systems in health care, and many providers describe their willingness to pay for HIT at a price-point that is far below current prices for EHR.²¹ While it may be debated whether the open source model may ever truly apply to EHR applications given their complexity, rich knowledge content for decision support, and mission-critical nature, what is clear is that for many providers, one of the main barriers to adoption is the cost of current technology. However, it is important to note what has been successful using the open source process. Most successes have been with tools and technology components rather than large applications.

The question of open-source software and component technologies warrants critical analysis and may be addressed at many levels: perhaps it is not the EHR application before

the end user that should be open source, but rather the enabling technology and knowledge infrastructure underlying and supporting the end-user application. Much like the U.S. interstate highway system was viewed as a critical infrastructure for any form of transportation, public or private, we suggest that there are analogous critical information infrastructure components undergirding local HIT applications used in offices and hospitals that will enable the National Healthcare Information Infrastructure (NHII). These may include regional transaction hubs or information exchanges, secure networks and patient-matching infrastructure, public-interest organizational structures to manage regional information exchanges and broker communitywide investment and serve as a local certification authority, and so on. In addition, currently, each provider organization wrestles with the task of implementing and maintaining knowledge-based rules and alerts in its HIT applications. This time-consuming and difficult task could be ameliorated if there were an accessible library of such knowledge in the public domain. If such component tools and technologies were open source and readily available in the public domain, it could have a profound impact on vendors building HIT technologies as it would reduce their internal development costs and mitigate risks of adopting standards.

EHR and Informatics Standards

A great deal of activity in recent years brought considerable attention to the issue of standards development and acceleration of this process.^{4,8,22} Yet, from either a public or private perspective, adoption of even a minimal set of standards remains rare with a few notable exceptions.^{23,24} The standards development organizations have focused primarily on specific standards such as messaging and have assumed that other groups would develop the additional necessary standards for complete interoperability including terminology standards and a reference information model. More recently, HL-7, for example, has begun to develop standards for broader areas, addressing the complete set of standards that is necessary for interoperable data exchange. Lack of awareness regarding existing standards, confusion about which standard is the right standard, and lack of proof of the value of standards has severely limited the adoption and implementation of standards.

We believe that specification of a minimal set of essential standards that have the property of supporting interoperability (the ability to exchange clinical information reliably) is critical to rapid adoption of HIT—and a key component in deriving value from HIT.⁷ It is beyond the scope of this report to recommend specific standards, but we suggest that efforts underway in the Consolidated Healthcare Informatics initiative, the newly created Commission on Systemic Interoperability, and private sector efforts at HL-7 and ASTM, be coordinated to ensure successful definition of essential standards for clinical information content representation and messaging.²⁵

Beyond the specification of standards for clinical information content and messaging, additional work is needed in specifying a variety of uniform clinical information data sets to facilitate interoperability between EHR implementations. The Continuity of Care Record effort²⁶ is a notable example in which a set of information is defined to facilitate transfer of patients between health care entities for care and is a useful

intermediate step toward seamless health care information exchange and interoperability. We believe such instruments should be based upon a minimal set of patient care information that includes patient demographics, insurance coverage, allergies, medications, current medical problems and conditions, and the patient's advance directives. Such a core data set serves as a means by which clinicians may quickly become familiar with a patient and serves as a foundation for clinical decision support in electronic health records. Availability of a common core set of laboratory data, and such ancillary information as prior electrocardiogram, would also be useful to promote patient safety and health care quality, and reduce redundant utilization.

Another area requiring definition and clarity is in the area of functionality of clinical information systems. Not only is this useful from the business perspectives described above, it also is critical for enabling the interoperability of an essential minimal care data set and is essential for certification purposes that will warrant additional payments or other incentives to providers from payers when the use of an EHR can be documented and attested to. The HL-7 functional model of the EHR is an excellent start, and the draft standard is now available for trial use.²⁷ It is clear, however, that much more work needs to be done on functional standards for personal health records that interact with EHR systems, inpatient clinical information systems, and additional detail and specification regarding critical functional modules such as provider order entry and clinical decision support.

Enabling Policy

We identify four areas in which national policy could have a profound impact on the adoption of HIT: modification of Stark antitrust regulations, policies to guide clinical data ownership and stewardship, mechanisms to support creation of regional health care information authorities, and lastly, and with a longer view of clinical practice in this country, establishing means for national professional licensure in the health care professions. We discuss these in turn.

The Medicare Modernization Act²² (MMA) supports provider adoption of electronic prescribing technology and provides for some relaxation of the Stark regulations in the Social Security Act (Section 1877). It is critical that these regulations be supported in practice from two perspectives. First, physicians in distinct organizational entities (different businesses) must be allowed to form purchasing cooperatives to allow economies of scale to accrue in HIT purchasing decisions. This would allow providers to experience considerable savings when participating in volume purchase agreements with vendors. Secondly, larger hospitals and integrated delivery networks must be allowed to improve the ability of physicians using their office technology to interact with that hospital or IDN clinical information systems for review of patient care data. In addition, health care data from the provider offices should be made available to the hospital systems. In situations in which community providers have affiliations with multiple inpatient care facilities, this ability is particularly important for patient safety and quality of care—they must have a complete view of their patients' health care data from wherever care is provided. The MMA requirement that the hospital or IDN data be made available to any provider in the community may only be made possible through a community health information exchange.

Before discussing regional information exchange, however, it is useful to address clinical information ownership and stewardship. Many physicians express concern about adopting HIT when they cannot be assured that the information will be made available to them should they elect to switch EHR vendors. In addition, de-identified, aggregated clinical data may be viewed as a critical public good in light of bioterrorism and protecting the public health—biosurveillance and epidemiology research would be well served through access to anonymous clinical data arising from EHRs. The regulations implementing the HIPAA provide guidance for managing information security and privacy. These guidelines have been used effectively to facilitate the most notable demonstration of clinical information exchange to date—the Indiana Network for Patient Care (INPC). In this case, clinical information is shared broadly across the greater Indianapolis metropolitan area. Stewardship for the data is provided by the Regenstrief Institute, which is well versed in clinical information management and has the leadership, technical capacity, and political capital to help establish policies and procedures for the INPC. The lessons learned from this demonstration and others^{5,28} should be collected and elevated to the national policy level so that other communities wishing to create similar regional health care information exchanges could readily adopt policies and procedures that work.

While the HIPAA legislation, including the Privacy Rule, established protections for the security and confidentiality of personally identifiable health care information, it does not address fundamental issues of data ownership. Clarification of the rights of both the providers who gather and collect patient data, and the patient as source of the data, would be useful to help establish the value of these data and appropriate uses of the data in exchange for compensation in research and marketing purposes. Clarification of these rights and privileges will help define the methods to obtain patient consent and grant access to or exchange of personally identifiable health care information by authorized individuals. Such policy could allow explicit recognition of the multiple uses of medical record data within health care institutions and providers' offices for billing, documentation, decision support, and quality analysis, as well as the patient's rights with respect to secondary uses of the data beyond health care operations.

To derive value from HIT in clinical settings, two things must happen simultaneously: functionally rich EHRs supporting comprehensive patient data management, decision support, and health care workflow must be adopted in acute and chronic care settings,³ and these systems must share data with one another. That is, clinical information systems in disparate health care business entities must exchange clinical information on common patients for treatment purposes.² Given the rational but myopic business perspective of most health care providers, we believe that to achieve regional health care information exchange, an appropriate regional authority must be established to guide development and implementation of data sharing policies and procedures among providers and patients, legal frameworks, enabling technologies (e.g., patient matching algorithms), and management of shared expenses and financial benefits in a coherent and sustainable business model. Such regional health care information exchanges are under development in several areas,^{10,21,28}

and several legislative efforts support this notion,²⁹ but it would be useful to have in place federal guidelines, and seed money, that could be applied locally and regionally to ensure their success.

Finally, with the advent of “wired” clinical care environments and their emerging interconnectivity, and an increasingly mobile patient, we suggest that soon it will be advantageous for providers and their patients to have licensure in the health professions be provided at the federal level. Providers should be able to act on behalf of their patients even remotely; for example, when a patient is in another state, experiences a medical problem, and communicates electronically with his or her provider at home (who has access to both the local and remote health care data). Short of national licensure per se, relaxation of state regulations to facilitate reciprocity of professional licensure between state agencies is a worthy first step. Broadening the geographic scope of licensure in the health professions will allow the development of regional health care information exchanges that truly reflect “medical marketplaces” that may span across state boundaries. With national licensure or improved reciprocity between states, providers would be able to physically practice more readily in more than one state. More importantly, however, as health care becomes more “wired,” providers will be able to seamlessly collaborate across state lines, rendering opinions remotely from the patient care site or remotely performing critical interpretive duties such as reading radiology, nuclear, electrocardiographic, sonographic, and other image modalities and interpreting biomedical signals, which do not require physical proximity to the patient.

Educational, Marketing, and Supporting Activities

Achieving President Bush’s vision—that most Americans would have an electronic health record within ten years—will require an extraordinary effort. In addition to the recommendations above, we feel there is need for an educational and marketing campaign not dissimilar to the public announcements and efforts surrounding smoking cessation, drug abuse, obesity, accident prevention, and other campaigns in the interest of the public’s health. At the 2004 ACMI Retreat, Kevin Johnson of Vanderbilt University suggested a campaign: “Got EHR?”

We suggest a three-pronged marketing and educational campaign directed at consumers, health care professionals, and the executive suites of our provider organizations across the country. The public has heard the news from the IOM reports that made the front pages of local newspapers, describing medical error,³⁰ poor quality of care, and the role of HIT,³¹ but they do not yet generally perceive the risks of receiving care from providers and hospitals that do not have HIT with clinical decision support in place. It is often mistakenly believed that HIT is already in use.³² Just as a consumer buying a car today would never think of selecting one without seatbelts, airbags, or other safety features, American consumers should ask whether their personal physician and their hospital have CPOE and EHR systems in place and in use. Secondly, health care professionals may be increasingly aware of the potential benefits of HIT, but they have not yet adopted these technologies to any significant degree. In conjunction with alignment of incentives and reimbursement reforms we have described, an education campaign needs to be directed toward health care professionals to help them under-

stand the potential of HIT, its use, and its limitations. This may begin by expanding the curriculum devoted to clinical informatics in the health professions schools. Finally, an educational campaign should also be directed at the executive suites of our health care enterprises, both large and small, where the strategic and investment decisions are made about the business of health care. Without leadership and commitment, whether it is the small office environment or the largest IDN, adoption of HIT will not proceed.

Even if every physician, nurse, and hospital were committed to adopting HIT, however, to facilitate rapid adoption, it is critical that we engineer adoption strategies that scale. That is, every clinic and hospital environment must not be forced to rediscover best practices for implementing HIT; there should be a National Resource Center for HIT that can be a repository of best practices and expertise for HIT implementation to accelerate the process. The recently announced requests for proposals from the AHRQ appear to be well targeted to meet this need. In addition, we believe there should be a national repository that would make available clinical knowledge required for HIT adoption, be readable, and be encoded in a standardized manner, including items such as appropriate controlled terminology, standard code sets, care rules, alerts and reminders, order sets, documentation templates, and forms, so that each clinic and hospital does not have to rediscover the best clinical knowledge for implementation within their chosen clinical systems. We believe the absence of such a resource protracts the implementation of HIT, and in some settings, the absence of the appropriate resources will make sophisticated decision support in clinical systems an unattainable goal. These resources should be public-private collaboratives that serve the interests of the HIT marketplace as well as the public and private purchasers of health care.

Conclusion

There is growing support for the widespread adoption of EHR as a fundamental strategy to improve U.S. health care delivery, efficiency, quality, and safety. Despite considerable evidence to support adoption of EHR, progress has been slow to date. We suggest that the current HIT marketplace has failed because of several factors, including misalignment of financial incentives, absence of a clear business case for EHR adoption and for interoperability between EHR implementations, and incomplete specification and adoption of relevant standards. To accelerate EHR adoption we believe a variety of stimuli are needed to align incentives, provide new incentives for adoption of interoperable EHRs, coordinate and promote relevant standards, and educate the health care community and consumers. This report describes our recommendations (summarized in Table 1) in all of these areas.

References ■

1. Berner E, Detmer DE, Simborg D. Will the wave finally break? A brief view of the adoption of electronic medical records in the United States. *J Am Med Inform Assoc.* 2005;12:3–7.
2. Ash JS, Bates DW. Factors and forces impacting EHR system adoption: report of a 2004 ACMI discussion. *J Am Med Inform Assoc.* 2005;12:8–12.
3. Johnston J, Pan E, Walker JD, Bates DW, Middleton B. The Value of Computerized Provider Order Entry in Ambulatory Settings.

- Boston, MA: Center for Information Technology Leadership; 2003.
4. Pan E, Johnston D, Walker JD, Adler-Milstein J, Bates DW, Middleton B. The Value of Healthcare Information Exchange and Interoperability. Boston, MA: Center for Information Technology Leadership; 2004.
 5. Wang SJ, Middleton B, Prosser LA, et al. A cost-benefit analysis of electronic medical records in primary care. *Am J Med.* 2003; 114(5):397-403.
 6. Birkmeyer CM, Lee J, Bates DW, Birkmeyer JD. Will electronic order entry reduce health care costs? *Eff Clin Pract.* 2002;5(2): 67-74.
 7. Zdon L, Middleton B. Ambulatory electronic records implementation cost benefit: an enterprise case study. *Proc Hlth Infor Mgmt Sys Soc* 1999;4:97-117.
 8. Brailer DJ, Augustinos N, Evans LM, et al. Moving Toward Electronic Health Information Exchange: Interim Report on the Santa Barbara County Data Exchange. Sacramento: California Healthcare Foundation; 2003.
 9. Consolidated Health Informatics. US Federal Government G2B Portfolio. Available at: http://www.whitehouse.gov/omb/egov/gtob/health_informatics.htm. Accessed July 30, 2004.
 10. Overhage JM, Rischel W. Executive Summary. Technical Panel Recommendations: Achieving Electronic Connectivity in Healthcare. New York, NY: Connecting for Health, Markle Foundation; 2004.
 11. Radiological Society of North America, and the Healthcare Information Management and Systems Society. Integrating the Healthcare Enterprise. Available at: <http://www.himss.org/asp/issuesbytopic.asp?TopicID=11>. Accessed August 2, 2004.
 12. Glaser JP, DeBor G, Stuntz L. The New England Healthcare EDI Network. *J Healthc Inf Manag.* 2003;17(4):42-50.
 13. Bates DW, Gawande AA. Improving safety with information technology. *N Engl J Med.* 2003;348:2526-34.
 14. Bates DW, Pappius E, Kuperman GJ, et al. Using information systems to measure and improve quality. *Int J Med Inf.* 1999; 53(2-3):115-24.
 15. Henry SB, Lenert L, Middleton B, Partridge R. Linking process and outcome with an integrated clinical information management system knowledge systems. *Proc HIMSS.* 1993:57-81.
 16. Poon EG, Wald J, Bates DW, et al. Supporting patient care beyond the clinical encounter: three informatics innovations from partners healthcare. *Proc AMIA Symp.* 2003:1072.
 17. Welsh F. Informatics: a physician's view. *J Health Care Finance.* 1997;23(3):37-43.
 18. Steen EB, Detmer D (eds). *The Computer-based Patient Record: An Essential Technology for Healthcare.* Washington DC: Institute of Medicine, National Academy Press; 1991.
 19. de Brantes F. Bridges to excellence: a program to start closing the quality chasm in healthcare. *J Healthc Qual.* 2003;25(2):2-11.
 20. Birkmeyer JD, Dimick JB. Potential benefits of the new Leapfrog standards: effect of process and outcomes measures. *Surgery.* 2004;135(6):569-75.
 21. Valdes I, Kibbe DC, Tolleson G. Barriers to proliferation of electronic medical records. *Inform Prim Care.* 2004;12(1):3-9.
 22. Commission on Systemic Interoperability. Medicare Modernization Act of 2004 (S.2343.IS). Available at: <http://www.cms.hhs.gov/medicarerereform/>. Accessed August 2, 2004.
 23. Department of Veterans Affairs Office of Information. VISTA Monograph: Veterans Health Information Systems and Technology Architecture (VISTA). Available at: http://www1.va.gov/vista_monograph/. Accessed August 2, 2004.
 24. McDonald CJ, Overhage JM, Tierney WM. The Regenstrief Medical Record System: a quarter century experience. *Int J Med Inf.* 1999;54(3):225-53.
 25. Middleton B. Comments to the NCVHS on patient medical record information standards. Available at: <http://ncvhs.hhs.gov/991014tr.htm>. Accessed August 2, 2004.
 26. Tessier C, Waegemann CP. The continuity of care record. Organizations unite to create a portable, electronic record for use at transfer points in patients' care. *Healthc Inform.* 2003;20(10):54-6.
 27. HL7. Electronic health record functional model and standard. Available at <http://www.hl7.org/ehr/>. Accessed August 2, 2004.
 28. Patient Safety Institute. Economic value of a community clinical information sharing network. Available at <http://www.ptsafety.org/resources/PSI_cost_savings.pdf>. Accessed August 2, 2004.
 29. Kennedy P. Quality, efficiency, safety, and technology for healthcare transformation act. Available at <<http://thomas.loc.gov/cgi-bin/query/D?r108:1::/temp/~r108gweoxT>>. Accessed August 2, 2004.
 30. Kohn LT. *To Err is Human: Building a Safer Health System.* Washington, DC: National Academy Press; 2000.
 31. Committee on Quality of Health Care in America. *Crossing the Quality Chasm: A New Health System for the 21st Century.* Washington, D.C.: National Academy Press; 2001.
 32. Work Group on Policies for Electronic Information Sharing Between Doctors and Patients. *Connecting Americans to Their Healthcare.* New York, NY: Connecting for Health, Markle Foundation; 2004.



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