Using Electronic Health Records to Help Coordinate Care

LYNDA C. BURTON, GERARD F. ANDERSON,
and IRVIN W. KUES

Johns Hopkins University

The use of electronic health records that can securely transmit patient data among physicians will help coordinate the care of 60 million Americans with multiple chronic conditions. This article summarizes the different organizations in the United States that are developing this technology. It discusses some of the problems encountered and the current initiatives to resolve them. The article concludes with three recommendations for enhancing care coordination: (1) a common health record, such as the Continuity of Care Record, to facilitate the exchange of clinical information among health providers; (2) regional governance structures to encourage the exchange of clinical data; and (3) payment by purchasers of care, both public and private, to physicians for using electronic health records.

APPROPRIATE MEDICAL CARE FOR PEOPLE WITH multiple chronic conditions requires that clinicians be able to communicate with one another about their patients. Unfortunately, in today's medical care system, many clinicians are unable to communicate easily and efficiently with their colleagues. In a series of reports, the Institute of Medicine (IOM) named ineffective care coordination as a cause of poor care and initiated a series of reports recommending electronic health records as one way of improving its quality (Institute of Medicine 2003b; Institute of Medicine, Board on Science Technology 2001). The greatest burden stemming from this

Address correspondence to: Lynda C. Burton, Johns Hopkins University, Bloomberg School of Public Health, 624 N. Broadway, Baltimore, MD 21205 (e-mail: lburton@jhsph.edu).

The Milbank Quarterly, Vol. 82, No. 3, 2004 (pp. 457–81)
© 2004 Milbank Memorial Fund. Published by Blackwell Publishing.

lack of easy and effective care coordination is for the 60 million Americans with multiple chronic conditions (Anderson and Knickman 2002).

Studies have found that people with multiple chronic conditions are more likely to be hospitalized, see a variety of physicians, take several prescription drugs, and be visited at home by health workers. For example, Medicare beneficiaries with five or more chronic conditions fill an average of 48 prescriptions, see 15 different doctors, and receive almost 16 home health visits during one year (Partnership for Solutions: Better Lives for People with Chronic Conditions 2002a). Furthermore, the poor coordination of care has been associated with poor clinical outcomes such as unnecessary hospitalization, duplicate tests, conflicting clinical advice, and adverse drug reactions. One study showed that Medicare beneficiaries with four or more chronic conditions were 99 times more likely to have an unnecessary hospitalization during the year than was a beneficiary without a chronic condition (Wolff, Starfield, and Anderson 2002). All this suggests a need for better care coordination and information sharing among clinicians. The growing evidence attests to the value of electronic clinical data systems in bringing better care to persons with multiple chronic conditions (Casalino et al. 2003).

A major step in promoting care coordination is the electronic health record (EHR). The EHR enables clinicians treating people in a variety of settings to exchange and continuously update a patient's clinical data and then present that information in logical clinical groupings that other clinicians can access easily. The key functions of an electronic health record system outlined by an Institute of Medicine committee are health information and data storage, results management, order entry and management, decision support, electronic communication connectivity, patient support, administrative processing, and reporting and population health management (Institute of Medicine 2003a). Such an integrated system allows a physician to enter a patient's record number and view a menu showing his or her current medications, problem list, history of recent visits to health providers with submenus for notes from those visits, images and reports of diagnostic procedures, a functional status assessment and social service eligibility report, schedule of preventive services, allergies, contact information for all persons caring for the patient, names and contact information for family caregivers, guidelines for appropriate care, and clinical decision support.

Problems with the Current Paper-Based System

Participants at a joint IOM–Kaiser Permanente Institute for Health Policy conference in 1992 agreed that the paper-based information systems still used by most clinicians are not well suited to good-quality care, especially for persons with multiple chronic conditions (Raymond and Dold 2002). The conference concluded that paper-based systems supporting clinical care are limited as information storage and retrieval systems and have high rates of failure in retrieval and illegibility; that human memory–based medicine is increasingly unreliable; that the capture of clinical data has become necessary for billing, appointment scheduling, prescription refills, and results reporting; and that consumers' expectations for improved care and service are rising. Their proposed solution was the creation of electronic clinical information systems.

Increasingly, the medical care field is recognizing that it is far behind most other industries in using electronic data (Shortell et al. 1996). At one end of the continuum is the highly visible and advanced use of technology such as the remote sensing of bodily functions and the revolution in radiology and surgery based on the ability to digitize and communicate information (McDonald et al. 1999). At the other end of the continuum are the communication methods used by the majority of U.S. clinicians, who rely on paper medical records and coordinate care by “playing phone tag” with other clinicians and social service providers caring for the patient.

Some provider groups recognized the benefits of better communication years ago and developed a prototype EHR. The Computer-Stored Ambulatory Record (COSTAR), one of the first EHRs, was created in the early 1970s at Massachusetts General Hospital (Smithline and Christenson 2002). Some settings, primarily highly integrated networks, have realized the benefits of EHRs. Unfortunately, the level of EHR use among ambulatory care physicians still is low, with estimates in 2002 ranging from 10 to 14 percent of family physicians and 22 percent of all physicians operating as solo practitioners or in small groups (Loomis et al. 2002).

It is technically feasible to digitally connect stand-alone electronic data systems so that an office-based physician can have quick access to results of diagnostic tests, electronic prescribing, images, and dictated reports of visits or consultations from any other site (Smithline and Christenson 2002). A common method to achieve interconnectivity

is to make data available through secure Web-based interfaces. Another option is a smart card, a wallet-size card carried by the patient that contains health information or security codes permitting access to a shared system (McDonald et al. 1999). Advantages of the smart card are that the information is portable, accessible, and secure. It has not been adopted widely because of such disadvantages as a card reader being needed at every site of care, cards being lost, and cards not being updated at each provider visit (Aubert and Hamel 2001). Other health care delivery organizations are testing credit card or ATM-style technology to transmit essential clinical information (Patient Safety Institute 2001).

Barriers to the Widespread Adoption of Electronic Health Records

Five of the most important barriers to the widespread adoption of EHRs that would allow clinicians to share information about patients easily and effectively are (1) no common format or standard for recording clinical information, (2) the high costs of implementation and maintenance, (3) no demonstrated clinical and/or financial benefits for ambulatory care physicians participating in shared information systems, (4) patients' concerns about information sharing and possible loss of privacy, and (5) physicians' concerns about legal liability.

Standardization of Clinical Information

The need for a common standard to record and transmit clinical information is widely recognized, with solutions currently being developed by both public and private entities. The Institute of Medicine has addressed the importance of standardization in several reports and cited the standardization and use of EHRs as a priority (Institute of Medicine, Board on Science Technology 2001; Institute of Medicine 2003b). The National Health Information Infrastructure, a new federal office within the U.S. Department of Health and Human Services, has been established to provide advice and assistance to the department and serves as a forum for interacting with the private sector. Federal health information interoperability standards have been proposed by the federal government's Consolidated Health Informatics Initiative and the National Committee on Vital and Health Statistics and were adopted by the secretary of Health and Human Services for messaging, electronic

exchange of clinical laboratory results, standards for retail pharmacy transactions, standards allowing health care providers to plug medical devices into information and computer systems, and standards enabling the retrieval and transfer of images and associate diagnostic information (National Committee on Vital and Health Statistics 2003). The secretary announced the use of these common standards by the Centers for Medicare & Medicaid Services (CMS), the Veterans Administration, and the U.S. Department of Defense as well as an agreement to make Systematized Nomenclature of Medicine—Clinical Terms (SNOMED) a universal health care terminology, available to U.S. users at no cost through the National Library of Medicine (U.S. Secretary of Health and Human Services 2003). Private foundations have helped develop these standards by involving vendors and leaders in the academic fields of clinical data sharing (ehealth Initiative 2002). While these steps are significant, the widespread adoption of these standards will require the willingness of the current owners of EHR systems to find the money to make conversions where necessary and to design EHRs that will attract buyers.

To achieve the coordination of care described earlier, standards will be needed to organize and make transportable basic patient information, consisting of the most relevant and timely facts about a patient's condition (Barthell et al. 2002; Dolin 1999). An example is the Continuity of Care Record (CCR), which is intended as a national standard for all relevant information necessary for continuity of care (ASTM International 2004). The CCR is a minimum data set that includes provider information, insurance information, patient's health status (e.g., allergies, medications, vital signs, diagnoses, problem list, and recent procedures), recent care provided, as well as recommendations for a care plan and the reason for the referral or transfer. Data on the CCR are a subset of the full patient record residing on an EHR. The data necessary for the CCR can be electronically transferred from an EHR and then transported by e-mail or given to the patient or family member in paper form and/or on a computer disk to take to the next visit. The CCR will enable the next provider seen by the patient to access the information at the beginning of a first encounter and easily update the information when the patient returns to the referring physician or goes to another provider.

This common record has been under development for a number of years, led by the Massachusetts Medical Society, the Medical Records Institute, and the American Academy of Family Physicians. More recently,

the CCR has been endorsed by the American Medical Association; the Healthcare Information and Management Systems Society (HIMSS 2003); the Patient Safety Institute (2001), a nonprofit organization that promotes real-time access to clinical information for patients and providers; the American Academy of Pediatrics; and others. The developers are promoting the widespread acceptance and use of the CCR by clinicians through a consensus-building effort that is under way with ASTM International (2004), a standards approval organization.

Cost of Implementation and Maintenance

Transferring to an electronic data system where none exists is a major undertaking, requiring a change in work flow, finding a reliable EHR vendor, investing capital in hardware and software, converting records, and training staff. The financial and time costs vary, depending on the extent of the clinical and administrative functions to be managed by the system. Costs also are based on whether the system is purchased outright, leased, or rented. The time that the physician spends entering data at each patient encounter also must be considered. This may be only two or three minutes per patient but may be a major obstacle to the widespread implementation of the system, given most clinicians' tight time schedules.

An important issue related to cost is determining the primary beneficiary of a technology that can lead to better care. Many people now believe that much of the financial benefit from using an EHR goes to health plans, not physicians (Goldsmith, Blumenthal, and Rishel 2003). Health plans have a strong interest in reducing the number—and thus the cost—of unnecessary hospitalizations, repeat tests, and adverse drug reactions.

Because public and private insurers are likely to be the principal financial beneficiaries of widespread adoption, they are the most likely sources to pay physicians to use an EHR. So far most insurers have been unwilling to pay physicians to transmit a record from an EHR. The initial outlays can be substantial. For example, if the Medicare program paid \$5 for a physician to transmit one EHR for each visit, the annual cost to the Medicare program would be \$4 billion. For all insurers it would be approximately \$10 billion per year.

For ambulatory care, the main financial beneficiary of an EHR is likely to be the managed care plan, health insurer, self-insured employer,

or self-insured union rather than the physician provider. Indeed, the benefit could greatly exceed the costs, although this still needs to be demonstrated. In a study of the financial benefits to insurers from primary care doctors in ambulatory care settings using an EHR, the cost per primary care physician of establishing and using an EHR ranged from \$5,500 to \$16,500 (Wang et al. 2003). Estimates of the savings to the insurer ranged from \$84,000 to \$140,100 per provider over five years. In this study, data on costs and benefits came from a hypothetical primary care provider patient panel that was constructed using average statistics from Partners Health Care, expert opinion, and other published studies.

Besides health plans, other entities have a financial interest as well. Hospitals, attentive to adverse events, want to adopt a system that will increase patients' safety, such as the direct physician order entry of medications to minimize errors (Bates et al. 1998). Hospitals also may want to support information systems to connect with clinicians outside their hospital in order to increase market share. Public health agencies may eventually use these electronic data systems to transmit accurate and timely information documenting disease outbreaks as part of the bioterrorism initiative or epidemic control (Teich et al. 2000).

Although public and private insurers may be reluctant to pay the incremental costs of EHRs without more demonstrations, some payers are encouraging the adoption of electronic clinical data systems, anticipating the benefits for quality care (Rosenfeld, Zeitler, and Mendelson 2004). One pay-for-performance model adds bonuses to payments to the individual physician or provider organization for adopting an EHR that can demonstrate a relationship to quality of care. This model is being tested by CMS through its quality improvement organizations (Centers for Medicare & Medicaid Services 2003) and also in the private sector. Another model gives an incentive to consumers by contributing to their copays or deductibles if they choose health providers that have adopted an EHR (Hayes 2004). Another model directly reimburses physicians for a service that uses EHRs, such as an online medical evaluation or a virtual visit (RelayHealth 2004). A shared withhold model makes a portion of the providers' fees contingent on their adoption of EHRs and related quality improvement. These and other incentives show the willingness of insurers to experiment with different ways to fund EHRs. Cost-effectiveness studies of these models will be critical to their widespread adoption.

Physicians' Readiness to Adopt the EHR

Physicians need to be convinced that the EHR will enable them to provide better medical care to their patients. Studies of various aspects of electronic clinical data systems have shown that the adoption of an EHR is associated with better health outcomes or processes leading to better outcomes in controlling infection (Fitzmaurice, Adams, and Eisenberg 2002), improving physicians' prescribing practices (Teich et al. 2000), reducing prescription errors through direct physician order entry and decision support (Kaushal, Shojania, and Bates 2003), preventing serious medication errors in hospitals (Bates et al. 1998; Gandhi et al. 2003), and detecting adverse events in hospital and ambulatory settings after they occur (Bates et al. 2003). Bates and Gawande (2003) have described how information technology leads to many of these safety improvements, such as providing access to information, requiring information and assistance with calculations for dosage of medicines, monitoring, offering decision support, and rapidly responding to and tracking adverse events.

Even with this knowledge about the benefits of the EHR, mostly for hospitals, different evidence may be needed to convince individual clinicians to adopt them. In interviews with EHR managers and early physician adopters, Miller and Sim (2004) found that a big obstacle is the extra time it takes physicians to learn how to use EHRs effectively in their daily routine. Also, some physicians may not believe that care needs to be better coordinated. In a national survey of practicing physicians, more than half agreed that most people with chronic medical conditions have difficulty coordinating their care (Mathematica Policy Research 2001). Yet only 17 percent reported that they themselves had a problem coordinating care with other physicians treating their patients. This may indicate that physicians are generally satisfied with the current level of coordination and therefore are unlikely to accept new and potentially expensive technology to improve communication. New empirical data will be needed to convince them that knowing what other clinicians are doing for their patients is important to good medical care.

Privacy Issues and Patients' Concerns with Information Sharing

The 1996 Health Insurance Portability and Accountability Act (HIPAA) affects many aspects of health care information technology and data sharing. The dual intent of HIPAA is to improve administrative efficiency

in the health care sector as well as to increase patient privacy protections. The common impression is that HIPAA discourages the sharing of clinical information. However, the administrative simplification rules required by HIPAA may encourage the creation of information systems that can communicate with other systems.

A greater barrier may be the patients' unwillingness for their clinical data to be shared. One perspective is reflected by the growing numbers of persons with chronic conditions who are being educated to manage by themselves their daily medications or treatment regimens. For such patients, full electronic access to all their medical records offers an opportunity to join their physicians in managing their disease. Several health systems, including the Veterans Administration, are promoting patients' access to electronic records (Geisinger Health System 2004; Kilbridge 2002). In contrast, Fowles and colleagues (2004) found that only a third of patients were very interested in reading their medical records. Little is known about patients' attitudes toward sharing their clinical data with different providers. Some patients may want to withhold certain information from doctors, such as a history of mental illness or sexually transmitted diseases.

Over time, patients may come to believe that poorly coordinated care is a significant detriment to a good quality of care and can be rectified in part by better communication among physicians. If this happens, it would motivate health plans and physicians to adopt an EHR. The Foundation for Accountability, a nonprofit national organization, is actively advocating accountable and accessible health systems "where consumers are partners in their care and help shape the delivery of care" (FACCT 2004).

Legal Liability

The legal liability of physicians relying on data from other providers has not been established. For example, case law offers little guidance on the liability of a physician for acting on clinical information made available but not requested. Similarly, there is uncertainty about whether an e-mail message from a patient constitutes part of a medical record for which the physician may be liable (Blumenthal 2002). To assuage these concerns, physicians may need to be educated by legal experts about medical risk management (Grams and Moyer 1997) or actual legal protection. Guidelines and the active involvement of the medical

liability industry in designing electronic data systems may be necessary as well.

Current Clinical Data-Sharing Activities

Despite these obstacles, both the public and private sectors are moving forward in adopting systems that share information among multiple clinicians. Next we describe these electronic data exchange activities in seven sectors: patients; ambulatory care physicians; institutional providers; payers, including managed care and commercial insurers; disease management companies; the federal government; and regional initiatives.

Patients

Purchasers, providers of care, and government regulatory agencies are increasingly acknowledging the concerns of people with chronic conditions. The Institute of Medicine, bringing together health care professionals and policymakers to improve the quality of care for persons with chronic conditions, has repeatedly advocated computer-based personal health records. The Foundation for Accountability recommends electronic data sharing that allows the consumer full control over and access to his or her health information. The Patient Safety Institute, a national nonprofit organization, is promoting a common record controlled by both the patient and the health provider (Patient Safety Institute 2001).

Ambulatory Clinical Physicians

There is little empirical evidence of the extent of the adoption of EHRs or the direct value to physicians of shared patient clinical data. One study surveyed medical groups and independent practice associations with 20 or more physicians to determine the extent to which groups use organized processes to improve the quality of care and whether external incentives and clinical data systems were associated with the use of a larger number of care management processes (Casalino et al. 2003). The survey results showed that the percentage of physician groups' use of clinical systems varied by the functionality: standardized problem lists (18%), progress notes (9%), medications prescribed (24%), medication-ordering reminders and/or drug interaction information (15%), laboratory results (40%), and radiology results (30%). Fifty percent of groups

reported no clinical information technology capability. The authors concluded that the government and private purchasers of health care could increase use of care management processes by offering external incentives to improve health care and by helping physician groups improve their clinical electronic information capability.

Professional associations are becoming involved. Most specialty societies have addressed the barriers and benefits to members of electronic clinical data sharing. The American Academy of Family Physicians, for example, has taken the lead in an initiative to promote interoperable EHRs (American Academy of Family Physicians 2004). Designed mainly for solo or small-group practices, the model recommends vendors who have agreed to make an EHR capable of transmitting Continuity of Care Records via a secure Internet connection.

Institutional Providers

Health systems, academic medical centers, community hospitals, and home health agencies are building information systems that link multiple providers. A number of well-known health systems and academic medical centers, such as the LDS Hospital in Salt Lake City and Brigham and Women's Hospital in Boston, have developed their own integrated electronic clinical record systems (Doolan, Bates, and James 2003). A number of hospitals in Indianapolis use the Regenstrief Medical Record System (McDonald et al. 1999). Geisinger Health System (2004) in central Pennsylvania has created a fully integrated medical record with electronic communication with the primary care physician that also is accessible to the patient and the family caregiver. Partners HealthCare has created a clinical data repository that allows data to be shared across several hospitals in Boston as well as community health centers and community-based physicians (Partners Health System 2004).

Community hospitals are taking advantage of generalized software systems that provide direct clinician order entry, results reporting, and an EHR, as well as administrative functions. One vendor reports that it has implemented its basic system in over a quarter of the country's 6,000 hospitals (Meditech 2004). This basic system allows for the creation of an EHR within a hospital. In addition, several hospitals are migrating into ambulatory settings by integrating the medical record in the physician's office into the hospital's medical record. Future plans would include in the record any information collected in the patient's

home and other community settings, thus enabling the coordination of care across settings.

Health Plans and Insurers

Insurers, managed care organizations, self-insured corporations, and self-insured unions are major purchasers of care and are committed to providing high-quality and less expensive health care. A leading example of data sharing from the managed care sector is the Clinical Information System (CIS) that Kaiser Permanente is implementing throughout its organization (Kaiser Permanente 2003). Kaiser's EHR includes demographic and benefit data, pharmacy data, and transcribed reports such as radiology, discharge summaries, history and physical examinations, operative reports, consultations, surgical pathology, cytology, and outpatient laboratory results. The clinician can use the system to confer with other providers, thereby better coordinating the patient's care. Eventually, patients will be able to interact online with their medical team. An evaluation of the pilot phase of the outpatient system found that the clinicians' acceptance was high, with 95 percent of visits entered and 70 percent of prescribing and laboratory and radiology test ordering on the system (Chin and McClure 1995).

PacifiCare, one of the nation's largest managed care organizations, has an open system and contracts with thousands of physicians in primary care or specialty practices, in groups or independent practice associations. Given this open network and reliance on individual physicians' decisions whether to invest time and/or dollars in adopting electronic systems, the company has used incentives to encourage physicians to adopt electronic patient records, for example, giving physicians a PDA, or personal digital assistant, for point-of-service prescribing and electronic clinical decision support. Notwithstanding the offer, adoption was low (personal communication with Dr. Sam Ho, senior vice president, PacifiCare Health Systems, January 2004).

Many insurers have Web sites that enable enrollees to store their personal clinical records as well as to access their self-management information (Harvard Pilgrim Health Care 2004). Blue Cross Blue Shield of Alabama has developed an information system that creates an EHR for its patient population, using claims data to capture charges, pharmacy data, referrals, and lab data. A summary record also allows physicians to enter their notes from their visits with patients (Blue Cross Blue Shield

of Alabama 2004). From this information, a summary medical record is constructed containing a problem list, procedures, medications, allergies, immunizations, lab results, and encounter notes. Participation in InfoSolutions is voluntary for the patient and physician. Although more than 500,000 patients have agreed to allow their clinical data to be shared on the network, only 20 percent of physicians were participating in the first years of implementation, with approximately 450 exchanges of patient data on any given day (personal communication with Guy Jones, CHC, InfoSolutions manager, Blue Cross Blue Shield of Alabama, June 2003).

Health plans and insurers encourage their physician providers to follow evidence-based clinical guidelines, which are available on Web sites and also to the physician at the point of service. This type of disease-specific decision support can be more useful to the clinician if tailored to a specific patient's data in his or her EHR. Analysts who forecast large financial benefits from the use of EHRs base much of their prediction on physicians following this type of decision support. However, the level of interest and participation among physicians in using clinical decision support for disease management requires further study. Researchers from the Regenstrief Institute looked at whether treatment suggestions made online to primary care physicians and pharmacists at the point of care improved the health outcomes of outpatients with uncomplicated hypertension (Murray et al. 2004). The rates of compliance with treatment suggestions were disappointing. For the physician-intervention-only arm of the study, compliance was 29 percent; pharmacist intervention only, 25 percent; intervention by both physician and pharmacist, 35 percent; and comparison group with no intervention, 26 percent. Furthermore, there was no measurable effect on the health-related quality of life outcomes. Among the reasons cited by the authors for the negative findings was that the physicians received too many suggestions to comply with all of them or that the physicians may have found the interventions to be intrusive or time-consuming.

Disease Management Companies

Disease management companies use electronic tracking systems to improve care by monitoring the condition of patients assigned to them by insurers. Typically, insurers employ disease management companies to manage their patients with chronic diseases in an attempt to keep the

disease under control so as to prevent the recurrence of symptoms and the use of expensive health services. Nurses contact the assigned patients to monitor their symptoms and periodically consult with the patients' physicians regarding the appropriate care plan. If the disease management companies' EHRs were able to link with the physicians' EHRs, the nurse managers, primary care physicians, and specialists could better coordinate their care.

Federal Health Programs and Agencies

Medicare spends more than two-thirds of its funds providing fee-for-service medicine to people with five or more chronic conditions who see an average of nine ambulatory clinicians during one year (Partnership for Solutions: Better Lives for People with Chronic Conditions 2002b). Pay-for-performance models are being tested in which the payer offers an incentive to the care provider to improve quality by reimbursing a set amount for each complex patient when the physician provides evidence that certain standards of care have been met (Centers for Medicare & Medicaid Services 2003). This model is similar to a pay-for-performance model implemented with the sponsorship of Bridges to Excellence, a non-profit organization of employers, providers, and health plans (Bridges to Excellence Working Group 2004). Several innovations in reimbursement from CMS are in the demonstration phase, and the Medicare Prescription Drug, Improvement, and Modernization Act of 2003 provides for more demonstrations of reimbursement systems and EHRs to enhance coordination of care (U.S. Congress 2003). The Agency for Health Care Research and Quality (AHRQ), which has been the lead federal agency in supporting research on information technology (Fitzmaurice, Adams, and Eisenberg 2002), will be awarding \$50 million in grants to "support organizational and community-wide implementation and diffusion of health information technology [HIT] . . . and to assess the extent to which HIT contributes to measurable and sustainable improvement in patient safety, cost, and overall quality of care" (Agency for Healthcare Quality and Research 2003).

The federal government already has highly developed integrated electronic clinical data systems in the Veterans Health Administration (VHA) and the U.S. Department of Defense. A Computerized Patient Record System (CPRS) enables clinicians to enter, review, and continuously update all information connected with any patient in their medical

system (VHA Office of Information 2001/2002). With CPRS, a clinician can order lab tests, medications, diets, radiology tests, and procedures; record a patient's allergies or adverse reactions to medications; request and track consults; enter progress notes, diagnoses, and treatments for each encounter; and enter discharge summaries. CPRS allows hospital personnel to keep comprehensive patient records and enables clinicians, managers, and quality assurance staff to review and analyze the data gathered on any patient in a way that directly supports clinical decision making.

The Department of Defense is currently implementing an online e-Health communications system named TRICARE Online (U.S. Department of Defense 2004). This system provides information about health conditions, disease management, appointment scheduling, and prescriptions and allows the patient to create his or her own personal health care home page. In conjunction with the Department of Health and Human Services, the VHA and TRICARE have adopted the first Consolidated Health Information Standards and are finalizing the details to adopt more than a dozen additional standards.

Regional Initiatives

Communication systems can be integrated into the closed systems just described, in which there is a centralized authority. In open settings, which are typical of most health care in the United States, the challenge is greater. Possibly the most comprehensive approaches to interoperable EHRs are the regional initiatives that attempt to enroll all providers within a given geographic region. If successful, they will be able to offer an integrated clinical record with the exchange of clinical data among providers caring for a defined population. The Regenstrief Medical Record, for example, evolved from a single hospital-based clinical information system to a system that currently uses the Internet to connect all five Indianapolis hospital systems and a total of 11 geographically separated hospitals.

An example of a regional solution explicitly designed for clinical data exchange is currently being used in Santa Barbara, California. This project, developed over four years with \$10 million in financial support from the California Health Care Foundation and the Robert Wood Johnson Foundation, was designed to improve the quality, clinical efficiency, and safety of health care by making inter- and

intra-organizational, patient-specific information more readily available at the point of care (California Health Care Foundation 2004). In 2004 the data exchange was composed of 12 health care organizations, with a central policymaking council, technical and clinical advisory committee, and data alliances. Data alliances are multiple provider organizations that agree on and coordinate data-sharing goals and technical standards and business rules to facilitate implementation. The number of participating physicians in the data exchange will be critical to determining the value of this model.

Remaining Stakeholder Concerns and Possible Solutions

Before EHRs that can connect with other health providers will be widely adopted, a number of policy issues must be resolved. In this section of our article, we summarize the concerns and possible solutions from the perspective of patients, physicians, institutional providers, and payers and examine those issues that must be resolved in order for these systems to be implemented broadly.

Patients with multiple chronic conditions must recognize that their care will be better coordinated if information is shared with all their providers. The consumers' interest in quality of care—specifically, the reduction of adverse drug events, unnecessary hospitalizations, and unnecessary tests—may become the primary motivation to improve electronic communication among clinicians. The public's concerns may persuade the purchasers of care to make these changes. The challenge will be mobilizing the 60 million Americans with multiple chronic conditions to demand the coordination of their care.

Ambulatory care physicians will need proof that the care of their patients has improved, that their time is being used more efficiently, that shared clinical data are complete and reliable, and that the initial costs of an EHR and participation in a shared data system and interconnectivity with other health providers has a financial return. They will need to be paid for the additional time and expense involved. Concerns about increased liability must be resolved. Perhaps one of the most difficult obstacles to overcome will be convincing physicians to accept the role of care coordinator. Current medical training emphasizes episodic specialty care, not integrated coordinated care, which will require major changes in medical training and physicians' attitudes.

Hospitals, both individual and the American Hospital Association, have recognized the importance of quickly implementing clinical information systems in order to improve quality and performance. From the hospitals' perspective, such an undertaking will require a considerable expenditure of funds without any apparent financial return. The greater access to hospitals' medical records will involve the technical issues of integrating the hospitals' and offices' practice records and possibly legal issues related to data sharing. Hospitals will also need to protect data submitted by community-based physicians who may not want their medical records readily accessible to other clinicians.

Purchasers of care are the most likely to benefit financially from the EHR. Insurers and large self-insured employers and unions must recognize the real savings associated with enhanced care coordination and the resulting improvement in quality of care. Because people with multiple chronic conditions represent 57 percent of health care spending (Partnership for Solutions 2002a), the potential for cost savings from better coordination of their care is obvious. Equally obvious are the problems associated with poor care coordination: unnecessary hospitalizations, unnecessary nursing home visits, duplicate tests, and adverse drug events. The challenge will be convincing these purchasers that paying for physicians to use an EHR is cost effective. If a few pilot programs are able to demonstrate cost savings, it is likely that other insurers will follow. So far there has been little information to guide insurers.

Managed care organizations have a similar motivation to change, which may be easiest for staff model HMOs. For example, Kaiser Permanente announced that it will create secure 24/7 access to up-to-date patient records, "whether patients visit their personal physician or any provider in our medical groups across the country" (Kaiser Permanente 2003). In order to make this type of investment, other managed care organizations must be convinced of the financial return on the investment and the concomitant improvement in quality of care. As the PacifiCare experience demonstrated, it may be more difficult in highly decentralized systems. Evaluations may provide the financial and quality of care evidence needed to take action.

The federal government has taken the lead in using integrated clinical health records that are interoperable within their domain, such as the VHA and TRICARE. It has mandated the adoption of uniform EHR standards within its agencies, and it has advocated widespread adoption as a means to improve the safety and care of patients. But its most

powerful role—as the purchaser of care for Medicare and Medicaid—is just beginning to be explored through the use of incentive payments to providers. Political persuasion will be necessary for the U.S. government to demand that the health care delivery system adopt clinical data systems that can be shared among health providers, as the United Kingdom plans to do. The UK announced that it will revamp its national health system by electronically linking every hospital, clinic, and doctor's office (Naik 2003).

Summary and Recommendations

Each of the stakeholders must see the advantage of paying for, completing, or reading an EHR. The models described earlier reveal the considerable interest of a wide range of participants. To accelerate the adoption of the EHR, we offer three recommendations that we believe are essential:

1. Physicians and their professional leaders should agree on a common health record, such as the Continuity of Care Record, that will facilitate the exchange of clinical information among health providers. The ability of physicians to have an up-to-date summary of key clinical information to inform their decisions for care can improve care by reducing the redundancy of diagnostic tests and avoiding polypharmacy and possibly adverse drug events. Physicians will spend less time taking a history of a recent medical visit and spend more time on the current problem and the coordination of care. Patients and family members who leave an appointment with a physician puzzled by the plan for care will be given a summary to take with them. The Continuity of Care Record will contain the most current information from the EHR.

The common record can be sent to the next visit provider electronically, through secure Web sites or e-mail, or patients can be given a disk to carry with them. The record can be copied in a common word-processing format, solving the problem of a need for an expensive reader, which was needed for the early smart cards. If the patient loses the disk, an electronic version can be sent to the next provider. Giving the patient and/or family member full control over transmitting the record solves many of the confidentiality issues.

Preparing and transmitting a Continuity of Care Record is recommended for patients with a chronic disease or those who may be seeing several different health providers. Less complex patients may need a Continuity of Care Record only for their own use.

2. Regional governance structures that encourage the exchange of clinical data should be established. In geographic locations where health plans or a large self-insured employer do not dominate the market, a regional health council can become a decision-making body regarding the structure of data exchange and the common record to be exchanged. Nearly a dozen such models are in various stages of development.

The regional governance council should encourage widespread participation, aiming for at least 80 percent of physicians, to ensure that the medical record will reflect the patients' current status and will be easily available to most of the health providers caring for them.

For patients who travel outside a governance region or seek care outside a region, the common record will give valuable summary information to the new physicians. If the physician outside the region does not have an interoperable EHR able to read directly into the common record, the patient or his or her primary care provider will need to enter the results of these visits. However, the majority of patients receive most of their care in the region.

The importance of a regional solution is that it recognizes and maintains the physicians' existing referral patterns. A regional solution can also offer reimbursements that will lead to high participation in the exchange network.

3. Insurers and managed care plans should pay for completing the EHR. Because the physicians' use of the EHR benefits public and private payers, we recommend that public and private insurers pay physicians \$5 for completing the EHR. This, as noted earlier, would result in an estimated \$4 billion expenditure per year for Medicare. For most physicians' offices, this would pay the ongoing expense of maintaining the EHR. Studies of the cost effectiveness of this approach are needed.

Conclusion

Health providers, policymakers, and payers who have a high stake in improving the medical care system in the United States recognize that

EHRs offer the possibility of improving the quality of care through better coordination while controlling health care costs. With new emphasis and priority from the federal government, the public will be made aware of these benefits. Large closed health systems have successfully implemented interoperable electronic health records and are learning what is effective as well as where different approaches are needed. Nonetheless, there are significant barriers to adopting an EHR, particularly by those physicians who have the major role in terms of time and cost invested in implementation. To replicate this success in the larger open health care arena of the United States, we have three suggestions: agreement on a common health record, a geographic governance structure that can offer a common solution for a geographic region, and reimbursement for the costs by payers for health care. These suggestions, aimed at encouraging the use of electronic health records, will improve the quality of care for all patients and greatly improve the coordination of care for the 60 million Americans with multiple chronic diseases who see many different physicians.

References

- Agency for Healthcare Quality and Research. 2003. Transforming Healthcare Quality through Information Technology. Available at <http://grants.nih.gov/grants/guide/rfa-files/RFA-HS-04-011.html> (accessed May 10, 2004).
- American Academy of Family Physicians. 2004. Mission of the Center for Health Information Technology. Available at <http://www.aaafp.org/x24654.xml> (accessed January 9, 2004).
- Anderson, G., and J.R. Knickman. 2002. Changing the Chronic Care System to Meet People's Needs. *Health Affairs* 20:146–60.
- ASTM International. 2004. Continuity of Care Record (CCR): The Concept Paper of the CCR. Available at http://www.astm.org/COMMIT/E31_ConceptPaper.doc (accessed May 25, 2004).
- Aubert, B.A., and G. Hamel. 2001. Adoption of Smart Cards in the Medical Sector: The Canadian Experience. *Social Science & Medicine* 53:879–94.
- Barthell, E.N., W.H. Cordell, J.C. Moorhead, J. Handler, C. Feied, M.S. Smith, D.G. Cochrane, C.W. Felton, and M.A. Collins. 2002. The Frontlines of Medicine Project: A Proposal for the Standardized Communication of Emergency Department Data for Public Health Uses Including Syndromic Surveillance for Biological and Chemical Terrorism. *Annals of Emergency Medicine* 39:422–9.

- Bates, D.W., R.S. Evans, H. Nurff, P.D. Stetson, L. Pizziferri, and G. Hripcsak. 2003. Detecting Adverse Events Using Information Technology. *Journal of the American Medical Informatics Association* 10:115–28.
- Bates, D.W., and A.A. Gawande. 2003. Improving Safety with Information Technology. *New England Journal of Medicine* 348:2526–34.
- Bates, D.W., L.L. Leape, D.J. Cullen, N. Laird, L.A. Petersen, J.M. Teich, E. Burdick, M. Hickey, S. Kleefield, B. Shea, M.V. Vliet, and D.L. Seger. 1998. Effect of Computerized Physician Order Entry and a Team Intervention on Prevention of Serious Medication Errors. *Journal of the American Medical Association* 280:1311–6.
- Blue Cross Blue Shield of Alabama. 2004. InfoSolutions: A Medical Information Network. Available at <http://www.infosolutions.net/patientWhat.html> (accessed January 7, 2004).
- Blumenthal, D. 2002. Doctors in a Wired World: Can Professionalism Survive Connectivity? *Milbank Quarterly* 80:525–46.
- Bridges to Excellence Working Group. 2004. Bridges to Excellence: Rewarding Quality across the Healthcare System. Available at http://www.bridgestoexcellence.com/bte/bte_overview.htm (accessed January 12, 2004).
- California Health Care Foundation. 2004. Moving toward Electronic Health Information Exchange: Interim Report (2003) on the Santa Barbara County Data Exchange. Available at <http://www.chcf.org/topics/view.cfm?itemID=21086> (accessed May 19, 2004).
- Casalino, L., R. Gillies, S. Shortell, J. Schmittdiel, T. Bodenheimer, J. Robinson, T. Rundall, N. Oswald, H. Schauffler, and M. Wang. 2003. External Incentives, Information Technology and Organized Processes to Improve Health Care Quality for Patients with Chronic Diseases. *Journal of the American Medical Association* 289:434–41.
- Centers for Medicare & Medicaid Services. 2003. Doctors' Office Quality Information Technology (DOQIT) Demonstration Concept, June 24, 2003.
- Chin, H.L., and P. McClure. 1995. Evaluating a Comprehensive Out-patient Clinical Information System: A Case Study and Model for System Evaluation. In *Proceedings of the Annual Symposium on Computer Applications for Medical Care*, 717–21. Copyright by the American Medical Informatics Association.
- Dolin, R.H. 1999. Advances in Data Exchange for the Clinical Laboratory. *Clinics in Laboratory Medicine* 19:385–419.
- Doolan, D.F., D.W. Bates, and B.C. James. 2003. The Use of Computers for Clinical Care: A Case Series of Advanced U.S. Sites. *Journal of the American Medical Informatics Association* 10:107.

- Health Initiative. 2002. The Health Legacy Partnership Conference. National Press Club, Washington, D.C., October 29.
- FACCT. 2004. What's New in Consumer-Centered Health Care. Available at <http://www.facct.org/facct/site/facct/facct/home> (accessed May 15, 2004).
- Fitzmaurice, J.M., K. Adams, and J.M. Eisenberg. 2002. Three Decades of Research on Computer Applications in Health Care: Medical Informatics Support at the Agency for Healthcare Research and Quality. *Journal of the American Medical Informatics Association* 9:144–60.
- Fowles, J., A.C. Kind, C. Craft, E.A. Kind, J.L. Mandel, and S. Adlis. 2004. Patients' Interest in Reading Their Medical Record: Relation with Clinical and Sociodemographic Characteristics and Patients' Approach to Health Care. *Archives of Internal Medicine* 164:793–800.
- Gandhi, T.K., S.N. Weingart, J. Borus, A.C. Seger, J. Peterson, E. Burdick, D.L. Seger, K. Shu, F. Federico, L.L. Leape, and D.W. Bates. 2003. Adverse Drug Events in Ambulatory Care. *New England Journal of Medicine* 348:1556–64.
- Geisinger Health System. 2004. MyChart. Available at <http://www.geisinger.org/mychart/index.shtml> (accessed May 15, 2004).
- Goldsmith, J., D. Blumenthal, and W. Rishel. 2003. Federal Health Information Policy: A Case of Arrested Development. *Health Affairs* 22:44–55.
- Grams, R.R., and E.H. Moyer. 1997. The Search for the Elusive Electronic Medical Record System—Medical Liability, the Missing Factor. *Journal of Medical Systems* 21:1–10.
- Harvard Pilgrim Health Care. 2004. Available at http://www.harvardpilgrim.org/portal/page?_pageid=213,65233&_dad=portal&_schema=PORTAL (accessed May 2004).
- Hayes, P. 2004. Hanaford Consumer Driven HealthCare. Available at <http://www.hcfo.net/pdf/hayes.pdf> (accessed May 27, 2004).
- Health Care Information and Management Systems Society (HIMSS). 2003. Continuity of Care Record (CCR). Available at http://www.himss.org/ASP/search_results.asp (accessed December 2003).
- Institute of Medicine. 2003a. Key Capabilities of an Electronic Health Record System: Letter Report. Available at <http://www.nap.edu> (accessed March 12, 2004).
- Institute of Medicine. 2003b. Priority Areas for National Action: Transforming Health Care Quality. In *Committee on Identifying Priority Areas for Quality Improvement*, edited by K. Adams and J. Corrigan, 1–13. Washington, D.C.: National Academies Press.
- Institute of Medicine, Board on Science Technology, Policy and Global Affairs, and Board on Health Care Services. 2001. Medical Innovation in the Changing Healthcare Marketplace: Conference Summary,

- edited by National Research Council, 1–34. Washington, D.C.: National Academy Press.
- Kaiser Permanente. 2003. News release. Marriage between Nation's Largest Health Care Group and Most Advanced Technology to Revolutionize Health Care. Available at <http://ckp.kp.org/newsroom/releases/020403.html> (accessed January 9, 2004).
- Kaushal, R., K. Shojania, and D.W. Bates. 2003. Effects of Computerized Physician Order Entry and Clinical Decision Support Systems on Medication Safety. *Archives of Internal Medicine* 163:1409–16.
- Kilbridge, P. 2002. Crossing the Chasm with Information Technology: Bridging the Quality Gap in Health Care. Prepared by First Consulting Group for California Healthcare Foundation. Available at <http://www.chcf.org/documents/ihealth/crossingchasmIT.pdf> (accessed June 21, 2004).
- Loomis, G.A., J.S. Ries, R.M. Saywell, and N.R. Thakker. 2002. If Electronic Medical Records Are So Great, Why Aren't Family Physicians Using Them? *Journal of Family Practice* 51:7.
- Mathematica Policy Research. 2001. National Public Engagement Campaign on Chronic Illness—Physician Survey. Cited in Chronic Conditions: Making the Case for Ongoing Care, prepared by Partnership for Solutions, Johns Hopkins University, December 2002.
- McDonald, C.J., J.M. Overhage, P.R. Dexter, W.M. Tierney, and J.G. Suico. 1999. The Regenstrief Medical Record System 1999: Sharing Data between Hospitals. *Proceedings of the American Medical Informatics Association Symposium* 1–2:1212.
- Meditech. 2004. Meditech Integrated Communications System. Available at <http://www.meditech.com/productbriefs/pages/ProductBriefsCSICS.htm>. (accessed May 10, 2004).
- Miller, R.H., and I. Sim. 2004. Physicians' Use of Electronic Medical Records: Barriers and Solutions—A Survey of Physician Practices Shows Slow but Steady Progress in Adopting This New Technology. *Health Affairs* 23:116–26.
- Murray, M.D., L.E. Harris, J.M. Overhage, X. Zhou, G.J. Eckert, F.E. Smith, N.N. Buchanan, F.D. Wolinsky, C.J. McDonald, and W.M. Tierney. 2004. Failure of Computerized Treatment Suggestions to Improve Health Outcomes of Outpatients with Uncomplicated Hypertension: Results of a Randomized Controlled Trial. *Pharmacotherapy* 24:324–37.
- Naik, G. 2003. U.K. Awards Two Contracts for Linking Health Networks. *Wall Street Journal*, December 29.
- National Committee on Vital and Health Statistics. 2003. Consolidated Healthcare Informatics Initiative Final Recommendation Information Sheet. Available at <http://www.ncvhs.hhs.gov/031105rpt.pdf> (accessed January 9, 2004).

- Partners Health System. 2004. Partners. Available at <http://www.partners.org> (accessed May 27, 2004).
- Partnership for Solutions: Better Lives for People with Chronic Conditions. 2002a. *Chronic Conditions: Making the Case for Ongoing Care*. Baltimore: Johns Hopkins University.
- Partnership for Solutions: Better Lives for People with Chronic Conditions. 2002b. Two-Thirds of Medicare Spending Is for People with Five or More Chronic Conditions. Source: Medicare Standard Analytic File, 1999. *Analysis by Partnership for Solutions*. Baltimore: Johns Hopkins University.
- Patient Safety Institute. 2001. Launch of Patient Safety Institute Empowers New Era in Patient Safety and Quality of Care. Washington, D.C. Available at <http://www.ptsafety.org/news/nr011211.asp> (accessed May 20, 2004).
- Raymond, B., and C. Dold. 2002. Clinical Information Systems: Achieving the Vision. Kaiser Permanente.
- RelayHealth. 2004. 4 Out of 5 Doctors Say It Improves Patient Communication. Available at <http://www.relayhealth.com/rh/defaultNoFlash.aspx> (accessed May 27, 2004).
- Rosenfeld, S., E. Zeitler, and D. Mendelson. 2004. Financial Incentives: Innovative Payment for Health Information Technology. Report for the Health Strategies Consultancy. Washington, D.C.: Foundation for eHealth Initiative.
- Shortell, S.M., R.R. Gillies, D.A. Anderson, K.M. Erickson, and J.B. Mitchell. 1996. Physician Integration. In *Remaking Health Care in America: Building Organized Delivery Systems*, ch. 4. San Francisco: Jossey-Bass.
- Smithline, N., and E. Christenson. 2002. Physicians and the Internet: Understanding Where We Are and Where We Are Going. *Journal of Ambulatory Care Management* 24:39–53.
- Teich, J.M., P.R. Merchia, J.L. Schmiz, G.J. Kuperman, C.D. Spurr, and D.W. Bates. 2000. Effects of Computerized Physician Order Entry on Prescribing Practices. *Archives of Internal Medicine* 160:2741–7.
- U.S. Congress. 2003. Medicare Prescription Drug, Improvement, and Modernization Act, 2003. Subtitle C—Chronic Care Improvement. H.R. 1. Available at <http://thomas.loc.gov/cgi-bin/query/D?c108:5:/temp/~c108wcj461> (accessed May 28, 2004).
- U.S. Department of Defense. 2004. Online. Available at <http://www.tricareonline.com> (accessed January 9, 2004).
- U.S. Secretary of Health and Human Services. 2003. SNOMED: Systematized Nomenclature of Medicine—Clinical Terms. Press release, July. Available at <http://aspe.hhs.gov/sp/nhii/News/hixs.htm> (accessed May 10, 2004).

- VHA Office of Information. 2001/2002. VISTA Monograph, 2001/2002. VHA Office of Information System Design and Development, Washington, D.C.
- Wang, S., B. Middleton, L. Prosser, C. Bardon, C. Spurr, P. Carchidi, A. Kittler, R. Goldszer, D. Fairchild, A. Sussman, G. Kuperman, and D.W. Bates. 2003. A Cost-Benefit Analysis of Electronic Medical Records in Primary Care. *American Journal of Medicine* 114:397–403.
- Wolff, J.L., B. Starfield, and G. Anderson. 2002. Prevalence, Expenditures, and Complications of Multiple Chronic Conditions in the Elderly. *Archives of Internal Medicine* 162:2269–76.

Acknowledgments: All the authors are affiliated with Partnership for Solutions: Better Lives for People with Chronic Conditions, a Robert Wood Johnson Foundation National Program.