Electronic Medical Record Systems

Background

Electronic medical record (EMR) systems, defined as "an electronic record of health-related information on an individual that can be created, gathered, managed, and consulted by authorized clinicians and staff within one health care organization," [1] have the potential to provide substantial benefits to physicians, clinic practices, and health care organizations. These systems can facilitate workflow and improve the quality of patient care and patient safety. Despite these benefits, widespread adoption of EMRs in the United States is low; a recent survey indicated that only 4 percent of ambulatory physicians reported having an extensive, fully functional electronic records system and 13 percent reported having a basic system. [2]

Among the most significant barriers to adoption are:

- High capital cost and insufficient return on investment for small practices and safety net providers.
- Underestimation of the organizational capabilities and change management required.
- Failure to redesign clinical process and workflow to incorporate the technology systems.
- Concern that systems will become obsolete.
- Lack of skilled resources for implementation and support.
- Concern that current market systems are potentially not meeting the needs of rural health centers or federally qualified health centers (FQHC).
- Concern regarding negative unintended consequences of technology.

Recognizing the role that EMRs can play in transforming health care, in 2003, the Institute of Medicine issued a group of eight key functions for safety, quality, and care efficiency that EMRs should support.

- Physician access to patient information, such as diagnoses, allergies, lab results, and medications.
- Access to new and past test results among providers in multiple care settings.
- Computerized provider order entry.
- Computerized decision-support systems to prevent drug interactions and improve compliance with best practices.
- Secure electronic communication among providers and patients.
- Patient access to health records, disease management tools, and health information resources.
- Computerized administration processes, such as scheduling systems.
- Standards-based electronic data storage and reporting for patient safety and disease surveillance efforts.

[1] The National Alliance for Health Information Technology (NAHIT)
[2] DesRoches CM, Campbell EG, Rao SR, et al. Electronic health records in ambulatory care -- a national survey of physicians. N Engl J Med 2008 Jul 3;359(1):50-60.

Areas of Current Investigation

Traditionally, the EMR vendor community has created systems that conform only to proprietary database formats, making it difficult for them to send and receive data from other, potentially competing products. The medical informatics community has realized the need for interoperability and thus has created standards for data coding and communication. The Office of the National Coordinator for Health IT (ONC) has funded several major initiatives to harmonize standards and create a certification process for EMRs so that different products can interoperate better and be easily and objectively compared. This will enable decisionmakers to adopt EMRs more easily.

In 2006, the U.S. Department of Health and Human Services (HHS) recognized initial criteria for certification of ambulatory EHR systems as recommended by the Certification Commission for Healthcare Information Technology (CCHIT). The criteria were updated in 2010 (PDF, 2.3 MB). These criteria will help reduce barriers for ambulatory providers to adopt EHR systems by ensuring confidence in purchased products. CCHIT certified products also meet requirements set forth by HHS in final physician self-referral law and anti-kickback statute rules, providing access to external means of implementing EHR systems.

Federal initiatives are under way to drive adoption of interoperable EMRs, including funding of the Agency for Healthcare Research and Quality (AHRQ) Health IT portfolio. The recent American Recovery and Reinvestment Act (ARRA) of 2009 (PDF, 1 MB) authorizes $34 billion to be distributed starting in 2011 as adoption incentives through Medicare and Medicaid to qualified providers who adopt and use certified EMRs. In addition, several States have recently promoted EMR adoption by mandates, initiatives, or funding programs through the disbursement of grants and loans within their States:

- The State of Minnesota is perhaps the most aggressive in promoting the adoption of standards-based electronic health records to support statewide electronic health information infrastructure. Minnesota has done this through a combination of legislative mandates and grants and loans programs.
- Missouri has established a fund for health IT development that is being made available to health care providers. Senate Bill 577 (2007) (PDF, 2.29 MB) states, "There is hereby created in the state treasury the "Health Care Technology Fund" which shall consist of all gifts, donations, transfers, and moneys appropriated by the general assembly, and bequests to the fund."
- Wisconsin has created a tax credit for health care providers who purchase EMRs in Senate Bill 40 (2007). Providers can claim up to 50 percent of the cost of the system with a maximum of $10 million a

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year (PDF, 5.49 MB) .

AHRQ-Funded Projects

AHRQ has funded organizations across the country that are implementing and evaluating electronic medical and health record systems. Some of these include:

Title: Ambulatory Electronic Medical Record and Shared Access
Principal Investigator: Michael DeLuca
State: IL

Title: An Interactive Preventive Health Record (IPHR) to Promote Patient-Centered Care
Principal Investigator: Alexander Krist
State: VA

Title: A Partnership for Clinician EHR Use and Quality of Care
Principal Investigator: Joanne Pohl
State: MI

Title: Bringing Measurement to the Point of Care
Principal Investigator: Winfred Wu
State: NY

Title: Can Risk Score Alerts Improve Office Care for Chest Pain?
Principal Investigator: Thomas Sequist
State: MA

Title: Cardio HIT Phase II
Principal Investigator: Karen Kmetik
State: IL

Title: Conversational IT for Better, Safer Pediatric Primary Care
Principal Investigator: William Adams
State: MA

Title: Creating an Evidence Base for Vision Rehabilitation
Principal Investigator: Cynthia Stuen
State: NY

Title: Crossing the Quality Assessment Chasm: Aligning Measured and True Quality of Care
Principal Investigator: Mark Weiner
State: PA

Title: Crossing the Quality Chasm in Eastern Rural Kern County
Principal Investigator: Kiki Nocella
State: CA

Title: Developing and Using Valid Clinical Quality Metrics for HIT with HIE
Principal Investigator: Rainu Kaushal
State: NY

Title: eHealth Records to Improve Dental Care for Patients with Chronic Illnesses
Principal Investigator: James Fricton
State: MN

Title: Electronic Prescribing and Decision Support to Improve Rural Primary Care Quality
Principal Investigator: James Veline
State: SD

Title: Electronic Support for Public Health - Vaccine Adverse Event Reporting System (ESP:VAERS)
Principal Investigator: Ross Lazarus
State: MA

Title: Evaluation of a Computerized Clinical Decision Support System and EHR-Linked Registry to Improve Management of Hypertension in Community-Based Health Centers
Principal Investigator: Helene Kopal
State: NY

Title: Feedback of Treatment Intensification Data to Reduce Cardiovascular Disease Risk
Principal Investigator: Joe Selby
State: CA

Title: Harnessing Health IT to Prevent Medication-Induced Birth Defects
Principal Investigator: Eleanor Schwarz
State: PA

Title: Health Information Technology in the Nursing Home
Principal Investigator: Jerry Gurwitz
State: MA

Title: Impact of Health Information Technology on Clinical Care
Principal Investigator: John Hsu
State: CA

Title: Impact of Office-Based e-Prescribing on Prescribing Processes and Outcomes
Principal Investigator: Michael Fischer
State: MA

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Title: Implementing a Low-Literacy, Multimedia IT System to Enhance Patient-Centered Cancer Care
Principal Investigator: Elizabeth Hahn
State: IL

Title: Improving Laboratory Monitoring in Community Practices: A Randomized Trial
Principal Investigator: Steven Simon
State: MA

Title: Improving Otitis Media Care with EHR-based Clinical Decision Support and Feedback
Principal Investigator: Christopher Forrest
State: PA

Title: Massachusetts Quality e-Measure Validation Study
Principal Investigator: Eric Schneider
State: MA

Title: Medication Monitoring for Vulnerable Populations via IT
Principal Investigator: Christoph Lehmann
State: MD

Title: Medication Safety in Primary Care Practice - Translating Research into Practice
Principal Investigator: Steven Ornstein
State: SC

Title: Monitoring Intensification of Treatment for Hyperglycemia and Hyperlipidemia
Principal Investigator: Alexander Turchin
State: MA

Title: Patient-Centered Online Disease Management Using a Personal Health Record System
Principal Investigator: Paul Tang
State: CA

Title: Pharmaceutical Safety Tracking (PhaST): Managing Medications for Patient Safety
Principal Investigator: William Gardner
State: OH

Title: Statewide Implementation of Electronic Health Records
Principal Investigator: David W. Bates
State: MA

Title: The BLUES Project: Improving Diabetes Outcomes in Mississippi with Health IT
Principal Investigator: Karen Fox
State: MS

Title: Tulare District Hospital Rural Health EMR Consortium
Principal Investigator: Paul D. Galloway
State: CA

Title: Using an Electronic Personal Health Record to Empower Patient with Hypertension
Principal Investigator: Peggy Wagner
State: GA

Title: Using Electronic Records to Detect and Learn from Ambulatory Diagnostic Errors
Principal Investigator: Eric Thomas
State: TX

Title: Using Health IT to Improve Ambulatory Chronic Disease Care
Principal Investigator: David Mehr
State: MO

Title: Using Information Technology to Provide Measurement Based Care for Chronic Illness
Principal Investigator: Madhukar Trivedi
State: TX

Title: Using IT for Patient-Centered Communication and Decision Making about Medications
Principal Investigator: Michael Wolf
State: IL

Title: Using IT to Improve the Quality of CVD Prevention & Management
Principal Investigator: Thomas Vogt
State: HI

Title: Using Precision Performance Measurement to Conduct Focused Quality Improvement
Principal Investigator: David Baker
State: IL

Title: VA Integrated Medication Manager
Principal Investigator: Jonathan Nebeker
State: UT

Selected EMR Resources

A Cost-Benefit Analysis of Electronic Medical Records in Primary Care
Author(s): Wang SJ, Middleton B, Prosser LA, Bardon CG, Spurr CD, Carchidi PJ, Kittler AF, Goldszer RC, Fairchild DG, Sussman AJ, Kuperman GJ, Bates DW
Source: Am J Med 2003 Apr 1;114(5):397-403.
Summary: The purpose of this study was to estimate the net financial benefit or cost of implementing electronic

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medical record systems in primary care. Much of the data and conclusions are based on expert opinion and assumptions, with a minority of data from actual studies. We performed a cost-benefit study to analyze the financial effects of electronic medical record systems in ambulatory primary care settings from the perspective of the health care organization. The reference strategy for comparisons was the traditional paper-based medical record. The estimated net benefit from using an electronic medical record for a 5-year period was $86,400 per provider. Benefits accrue primarily from savings in drug expenditures, improved utilization of radiology tests, better capture of charges, and decreased billing errors. Implementation of an electronic medical record system in primary care can result in a positive financial return on investment to the health care organization.

AProposal for Electronic Medical Records in U.S. Primary Care
Author(s): Bates DW, Ebell M, Gotlieb E, Zapp J, Mullins HC
Source: J Am Med Inform Assoc (JAMIA) 2003 Jan-Feb;10(1):1-10.
Summary: Delivery of excellent primary care?central to overall medical care?demands that providers have the necessary information when they give care. This paper, developed by the National Alliance for Primary Care Informatics, a collaborative group sponsored by a number of primary care societies, argues that providers' and patients' information and decision support needs can be satisfied only if primary care providers use electronic medical records (EMRs). Although robust EMRs are now available, only about 5 percent of U.S. primary care providers use them. Recently, with only modest investments, Australia, New Zealand, and England have achieved major breakthroughs in implementing EMRs in primary care. Substantial benefits realizable through routine use of EMRs include improved quality, safety, and efficiency, along with increased ability to conduct education and research. Nevertheless, barriers to adoption exist and must be overcome. Implementing specific policies can accelerate utilization of EMRs in the United States.

Electronic Health Record Systems: the Vehicle for Implementing Performance Measures
Author(s): O'Toole MF, Kmetik KS, Bossley H, Cahill JM, Kotsos TP, Schwamberger PA, Bufalino VJ
Source: Am Heart Hosp J 2005 Spring; 3(2):88-93.
Summary: Advances in information technology and recent national directives have the potential to support dramatic improvements in health care. Two key components are the implementation of functional electronic health record (EHR) systems and widely accepted, evidence-based clinical performance measures for physicians. Midwest Heart Specialists, a 55-physician cardiovascular group at 14 locations in northern Illinois, has utilized an outpatient electronic health record (HER) system since 1997. Since 2003, the group has integrated cardiovascular measurement sets developed by the American Medical Association-convened Physician Consortium for Performance Improvement into its EHR system. With this integration, the group was able to capture data needed for internal quality assessment and improvement as part of routine outpatient care without the need for additional resources. Critical disease-management data for decision support are available continuously, resulting in improvements in health care. The reporting of these standardized data could be the foundation to support quality-based reimbursement strategies and physician office-based, disease-management strategies.

How to Successfully Navigate Your EHR Implementation
Author(s): Adler KG
Source: Fam Pract Manag 2007 Feb;14(2):33-9.
Summary: This article identifies the three major do's and don'ts of electronic health record (EHR) system implementation and explores the application of these components. The author characterizes these areas as "the three T's": team, tactics, and technology. Each EHR implementation team should have a physician champion who motivates others, a skilled and collaborative project manager, broad stakeholder involvement, and specific, measurable goals. Tactics to employ for a successful implementation include: design a balanced scanning strategy, utilize a phased implementation, lighten workloads when going "live" and for a short period afterward, and enter data into the EHR electronically as much as possible. Havingproper speed and high network availability and capability, maintaining a test environment to mirror the live environment in case of problems, utilizing expert information technology (IT) advice when it comes to servers and networks, maintaining servers, and having a disaster recovery plan in place are all technology issues to address for successful implementation.

Medical Groups' Adoption of Electronic Health Records and Information Systems
Author(s): Gans D, Kralewski J, Hammons T, Dowd B
Source: Health Aff (Millwood--Spring Hope) 2005 Sep-Oct;24(5):1323-33.
Summary: We surveyed a nationally representative sample of medical group practices to assess their current use of information technology (IT). Our results suggest that adoption of electronic health records (EHRs) is progressing slowly, at least in smaller practices, although a number of group practices plan to implement an EHR within the next 2 years. Benefits of implementing an EHR include improved access to medical record information, workflow, patient communications, and accuracy for coding evaluation and management procedures. For those both with and without EHRs, the top five barriers were related to costs and concerns about physicians' support and their ability to use the new system. Overall, the process of choosing and implementing an EHR appears to be more complex and varied than we expected. This suggests a need for greater support for practices, particularly smaller ones, in this quest, if the benefits expected from EHRs are to be realized.

Physicians' Use of Electronic Medical Records: Barriers and Solutions
Author(s): Miller RH, Sim I
Source: Health Aff (Millwood--Spring Hope) 2004 Mar-Apr;23(2):116-26.
Summary: The electronic medical record (EMR) is an enabling technology that allows physician practices to pursue more powerful quality improvement programs than is possible with paper-based records. However, achieving quality improvement through EMR use is neither low-cost nor easy. Based on a qualitative study of physician practices that had implemented an EMR, we found that quality improvement depends heavily on physicians' use of the EMR?and not paper?for most of their daily tasks. The key barriers to physicians' use of EMRs include high initial costs and uncertain financial benefits; high initial physician time costs to learn the system; difficulties with technology, including EMR usability; and difficult complementary changes and inadequate assistance from both IT support and EMR vendors. We then suggest policy interventions to overcome these barriers, including providing work/practice support systems, improving electronic clinical data exchange, and providing financial rewards for quality improvement.

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Primary Care Physician Time Utilization Before and After Implementation of an Electronic Health Record: A Time-motion Study

Author(s): Pizziferri L, Kittler AF, Volk LA, Honour MM, Gupta S, Wang S, Wang T, Lippincott M, Li Q, Bates DW
Source: J Biomed Inform 2005 Jun;38(3):176-188.
Summary: Despite benefits associated with the use of electronic health records (EHRs), one major barrier to adoption is the concern that EHRs may take longer for physicians to use than paper-based systems. To address this issue, we performed a time-motion study in five primary care clinics. Twenty physicians were observed and specific activities were timed during a clinic session before and after EHR implementation. Postimplementation, the adjusted mean overall time spent per patient during clinic sessions decreased by 0.5 min (p=0.86; 95 percent confidence interval [-5.05, 6.04]) from a preintervention adjusted average of 27.55 min (SE=2.1) to a post-intervention adjusted average of 27.05 min (SE=1.6). A majority of survey respondents believed EHR use results in quality improvement, yet only 29 percent reported that EHR documentation takes the same amount of time or less compared to the paper-based system. While the EHR did not require more time for physicians during a clinic session, further studies should assess the EHR's potential impact on nonclinic time.

The Impact of Electronic Health Records on Time Efficiency of Physicians and Nurses: A Systematic Review
Author(s): Poissant L, Pereira J, Tamblyn R, Kawasumi Y
Source: J Am Med Inform Assoc (JAMIA) 2005 Sep-Oct;12(5):505-16.
Summary: This systematic review examined the impact of electronic health records (EHRs) on documentation time of physicians and nurses. Twenty-three papers met our inclusion criteria; five were randomized controlled trials, six were posttest control studies, and 12 were one-group pretest/posttest designs. The use of bedside terminals and central station desktops saved nurses, respectively, 24.5 percent and 23.5 percent of their overall time spent documenting during a shift. Using bedside or point-of-care systems increased documentation time of physicians by 17.5 percent. In comparison, the use of central station desktops for computerized provider order entry (CPOE) was found to be inefficient, increasing the work time from 98.1 percent to 328.6 percent of physician's time per working shift. Studies conducting their evaluation process relatively soon after implementation of the EHR tended to demonstrate a reduction in documentation time; studies with a longer interval between implementation and the evaluation process observed an increase in time. This review highlighted that a goal of decreased documentation time in an EHR project is not likely to be realized.

The Value of Electronic Health Records in Solo or Small Group Practices
Author(s): Miller RH, West C, Brown TM, Sim I, Ganchoff C
Source: Health Aff (Millwood--Spring Hope) 2005 Sep-Oct;24(5):1127-37.
Summary: We conducted case studies of 14 solo or small-group primary care practices using electronic health record (EHR) software from two vendors. Initial EHR costs averaged $44,000 per full-time equivalent (FTE) provider, and ongoing costs averaged $8,500 per provider per year. The average practice paid for its EHR costs in 2.5 years and profited handsomely after that; however, some practices could not cover costs quickly; most providers spent more time at work initially, and some practices experienced substantial financial risks. Policies should be designed to provide incentives and support services to help practices improve the quality of their care by using EHRs. This article provides useful information for clinicians interested in purchasing and implementing an EHR, and for provider organizations and policymakers who may be involved in making decisions about EHR adoption. While only focusing on two EHR vendor systems is a limitation of this study, the numbers are consistent with other cost data from similar studies.

Using Diffusion of Innovation Concepts to Enhance Implementation of an Electronic Health Record to Support Evidence-Based Practice
Author(s): Geibert RC
Source: Nurs Adm Q 2006 Jul-Sep;30(3):203-10.
Summary: The article identifies the explosion of clinical data that is available and how difficult it is for clinicians to find answers to clinical questions. Electronic health records (EHRs) are used increasingly to assist clinicians in this process; however, resistance to the implementation of technology-assisted care is not uncommon. The article reviews the diffusion of innovation research and provides the nurse manager with suggestions for applying these concepts to enhance the implementation of an EHR that can support evidence-based practice. Five characteristics of innovations are discussed, as they help explain different rates of adoption. These characteristics are represented by the acronym TACOS: Trialability (Can we try this on a small scale first?), Advantage (Is this an important goal for our unit?), Compatibility (Will the practice work in our environment?), Observability (Can we see the practice in action at another site?), and Simplicity (How big a change will this be?). The five-stage, innovation-decision process is studied as it relates to EHR implementations.

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