

Benefiting from Ambulatory EHR Implementation: Solidarity, Six Sigma, and Willingness to Strive

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ABSTRACT

Ambulatory electronic health record systems have the potential to improve healthcare quality. Optimizing the value of EHR implementation requires that providers and staff become effective and efficient EHR users so paper charts are no longer required or desired. Transitioning from paper charts to EHR systems requires new learning, significant effort, and workflow changes associated with an initial adverse effect on provider efficiency. This case study describes how timely EHR implementation and regular use in a large academic internal medicine clinic was encouraged, achieved, and demonstrated. Critical success factors included readiness to change, solidarity in EHR use, a commitment to striving, and process improvement strategies that used the EHR system to repair suboptimal clinic workflows. Observed benefits include improvements in patient access, workflow efficiency, communication, decision support use, and financial performance. These success factors and implementation strategies may help others seeking to encourage greater adoption and use of EHRs.

KEYWORDS

- Medical records systems ■ Computerized organization and administration
- Health personnel education ■ Computer standards ■ Consumer satisfaction
- Health personnel education ■ Office management

Electronic health record systems are increasingly considered essential to address pervasive and critically important defects in the U.S. healthcare delivery system. These problems compromise the nation's ability to ensure that high-quality healthcare is consistently available to all.^{1,2,3}

Estimated at \$1.8 trillion in 2004, U.S. healthcare costs continue to increase at a rate that threatens the availability of affordable healthcare in a nation that already has more than 46 million uninsured. At the same time, it has been estimated that at least 30 percent of healthcare expenses in

the U.S. are wasted; a significant portion of those could be avoided by appropriate use of EHR systems throughout the nation. This possibility has increased calls for investment in a national health information infrastructure (NHII) and the provision of financial incentives to encourage physicians to implement and use EHR systems.

Even physicians who agree with the urgency of adopting EHR systems to improve quality and decrease waste may hesitate because of challenges related to EHR system features, capitalization, vendor stability, privacy concerns, interoperability barriers, organizational culture issues, lack of reimbursement, absent or perverse incentives, or inadequate information technology infrastructure support. Recent studies describing the costs, benefits, and lessons learned in ambulatory EHR implementations have yielded mixed results.^{4,5,6}

This article describes the experience and main outcomes of ambulatory EHR implementation in a community-integrated academic internal medicine clinic whose providers made exemplary progress in meeting the objectives of an enterprise-wide, phased EHR implementation project through solidarity in EHR use, a willingness to strive, and a focus on Six Sigma process improvement strategies.

The Clinic and Enterprise

The MSU Internal Medicine Clinic is one of 40 clinics comprising the MSU HealthTeam faculty group practice, which consists of faculty and staff from the MSU College of Human Medicine, College of Osteopathic Medicine, and College of Nursing. The Internal Medicine Clinic is one of 12 clinics located at the MSU Clinical Center, a community-based ambulatory care facility with a central medical records department where paper charts are stored and distributed to clinics routinely or on demand. Medical records department staff are also responsible for scanning and indexing selected paper documents to the EHR system.

The Internal Medicine Clinic is the outpatient facility for the Division of General Medicine of the Department of Medicine for the MSU College of Human Medicine. Its 12 current faculty members (2.4 clinical full-time equivalents) provide longitudinal primary care services for a panel of patients and supervise 30 internal medicine residents (1.5 clinical FTEs) during their continuity clinic sessions. Several internal medicine subspecialty faculty physicians also see patients in the same clinic, including two infectious disease specialists (0.2 FTE), an occupational disease specialist (0.1 FTE) and a hematologist (0.3 FTE).

The clinic staff includes a nurse manager, two front desk personnel (one of whom also coordinates referrals), a switchboard operator, two triage nurses, and four-to-five medical assistants. Staff has been trained to do a variety of work roles to facilitate cross-coverage and responsiveness to changing clinic conditions. In the year prior to EHR imple-

mentation, 14 FTE staff members supported 4.3 FTE providers, a staff-to-provider FTE ratio of 3.25. Nearly three years after the initial EHR implementation, 11.5 FTE staff support 4.5 FTE providers, a staff-to-provider FTE ratio of 2.55. The roster of active EHR users in the clinic consistently averages more than 70, and the number of simultaneous EHR system users in the clinic generally ranges from 15-to-20 on a typical day.

Clinic providers and staff process approximately 15,500 office visits and 4,000 outgoing referrals annually. More than 20,000 telephone encounters and 688 secure e-mail exchanges also were documented in the past year. Some 59 percent of clinic patients are female, and 32 percent are older than age 60. Outpatient visits by insurance type include 35 percent Medicare, 10 percent Medicaid, 14 percent managed care (including 7 percent Medicaid), and 48 percent commercial.

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Before EHR implementation, staff used computers principally for word processing, e-mail, and computerized registration, scheduling, and billing. With the exception of a single faculty member who had used an EHR system as a medical student, no one in the clinic had previously used an EHR system for patient care.

EHR System Implementation

EHR system implementation began in 2000 with the selection of an ambulatory EHR system, the Centricity Physician Office EMR, formerly called Logician, from GE Healthcare Technologies, Waukesha, WI. EHR implementation was piloted in a single HealthTeam clinic in 2001. While the initial EHR implementation plan called for a clinic-by-clinic “full implementation” strategy, increasing employee healthcare costs, and Institute of Medicine reports of medical errors³ and the “quality chasm”² prompted a call from university leadership to accelerate EHR implementation throughout the faculty group practice.

As a result, in 2002 an enterprise-wide, phased EHR implementation plan was developed. The plan called for clinic providers and staff to proceed expeditiously through four phases of EHR use, with cycles of training followed by regular practice for three-to-six months before proceeding to the next phase. The phases were organized according to

a “crawl-walk-jog-run” model to give providers and staff time to practice and become comfortable with simpler tasks before proceeding to more advanced EHR tasks.

The stages in this initiative included reviewing and signing, involving EHR and chart navigation, reviewing and signing test results and transcriptions; then, simple data entry, including phone notes, flags, vital signs, problems, medications and allergies; next, basic office visit documentation, with options including dictation/transcription, free-text entry, narrative templates, and checklist/drop-down menu templates; and finally full office visit documentation, with appropriate use of structured data entry to facilitate reminders, alerts, clinical decision support and chronic disease management, automated evaluation and management coding advice, and documentation compliance auditing.

Deans asked their respective department chairs to assign physician and staff champions for each clinic who would undergo “train-the-trainers” classes to become

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highly competent users. Champions were responsible for helping others in their clinic make appropriate progress in EHR use and to serve as a liaison to the clinic implementer and EHR project team regarding EHR issues and enhancement requests.

Enterprise-wide EHR implementation initially was funded through a combination of practice revenues, a grant from the MSU Department of Radiology, which covered the full cost of all EHR licenses and nearly 200 wireless tablet computers, University Academic Program Planning and Review funds, and a University loan. Ongoing EHR costs were funded from practice revenues.

Major EHR preparation steps included planning workshops; selecting and testing hardware, specifically desktop computers for front and back office staff and provider documentation stations, and wireless tablet PCs for examination rooms and mobile documentation; testing software and network connections; documenting and redesigning clinical workflow; selecting, customizing, and testing office note templates; installing and developing interfaces for laboratory, radiology, pathology, and transcription; downloading demographics and scheduling information; preloading selected data from paper charts, such as problem lists, medications and allergies; and developing and delivering EHR workflow simulation classes and training materials, including paper-based, slide presenta-

tions, and narrated Web-based video tutorials.

Internal Medicine Clinic leaders employed specific strategies to reinforce the enterprise strategic plan and facilitate timely progress during EHR implementation. Examples included employing principles of change leadership and management;^{7,8} visioning and strategic planning;^{9,10} readiness assessment;⁸ clinical microsystems practice assessment;¹¹ Six Sigma process improvement approaches;^{12,13} raising awareness of potential unintended consequences;¹⁴ creating realistic expectations regarding the necessity, importance, and economic benefits of striving;⁵ and communicating the expected economic benefits of advanced EHR system use.¹⁵ The clinic also documented paper chart-related problems identified by providers or staff as most frustrating, time-consuming, wasteful, costly, or potentially dangerous and enabled the implementation team to develop standardized yet flexible EHR workflows to encourage greater EHR buy-in and use.

Direct economic incentives for providers to use EHRs were not included in the enterprise clinical practice plan. Instead, the clinic attempted to achieve economic benefits from EHR implementation by emphasizing the importance of efficiency improvements through technology-supported workflow redesign and the use of structured office visit EHR documentation linked to evaluation and management coding decision support.

Results of Implementation

The Internal Medicine Clinic began using the EHR system in late October 2002 and made unusual progress in EHR implementation when compared with other HealthTeam clinics. For example, monthly paper chart pulls (Figure 1) decreased from a baseline average of 3,478 to 434 at 12 months and 37 at 24 months, or declines of 88 percent and 99 percent, respectively. The next closest performing clinic (Clinic 4; Figure 1) had begun EHR implementation the previous year, achieving 31 percent and 83 percent decreases at approximately 12 months and 24 months, respectively. Other clinics at the same facility ranged from a 66 percent decrease to a 16 percent increase in paper chart pulls at 12 months and a 97 percent decrease to a 27 percent increase in paper chart pulls at 24 months following enterprise-wide go-live.

The major costs and savings resulting from ambulatory EHR implementation in the Internal Medicine Clinic are summarized in Table 1. To avoid cost underestimation, all major components were included even when those costs were paid by the grant that covered implementation. Even though the clinic network infrastructure was already largely in place, estimates also included full IT infrastructure costs based on a formula used in MSU HealthTeam EHR outreach contracting.

Implementation costs fell within but toward the upper end of the expected per physician FTE range commonly

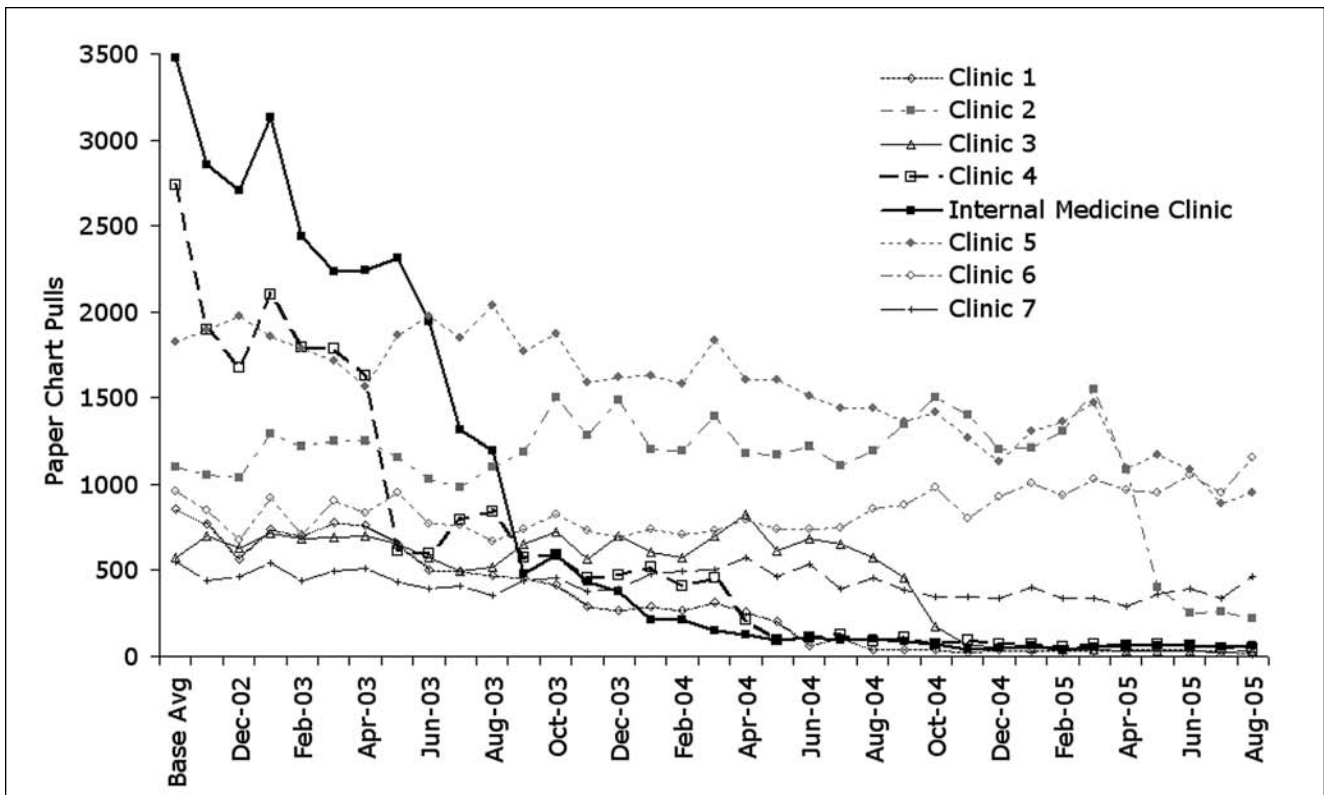


Figure 1. Monthly chart pulls by clinic.

“Problems cited by nurses and other clinic staff included excessive time and effort required by those who had little or no prior typing skills...”

reported for ambulatory EHR systems,⁵ likely partly resulting from the simultaneous user licenses required for a large group of part-time practitioners. The savings from timely EHR implementation resulted from a combination of reductions in the staff-to-provider FTE ratio, chart pulls, and use of a transcription service. A return-on-investment analysis, using “payback period” methods adjusted for the timing of staff, chart pull, and transcription changes, is shown in Figure 2, with the break-even point occurring approximately 16.5 months after initial implementation.

Evaluation and management coding also changed as EHR system implementation progressed. Physicians previously said they believed that medical necessity and the content of their paper-based office notes often justified higher evaluation and management codes, but they were unwilling to use them more often without a practical strategy for tallying elements of care. As physicians became more comfortable

documenting office notes electronically, the group spontaneously migrated toward greater use of EHR documentation templates that facilitated automated coding assistance.

As a proportion of total billing codes used in 2002-2003 vs. 2004-2005, CPT-99213 use decreased by 16 percent, while use of the higher effort/complexity CPT-99214 code increased by 20 percent. While per outpatient encounter gross charges during the same interval increased by 9.9 percent, net revenues per encounter remained essentially unchanged, increasing only 0.2 percent.

User Feedback

Spontaneous feedback, semi-structured interviews, and responses to requests for written comments regarding user experiences with the EHR system in the Internal Medicine Clinic revealed several common themes regarding benefits and problems.

In general, nurses and medical assistants adapted most quickly to EHR workflows and they strongly favored the dramatically improved speed with which they could access and use patient chart information, their ability to process patient requests for assistance without multiple telephone calls and voice-mail messages, and the ability to promptly handle patient care issues through the use of flags and telephone notes routed to physician EHR desktops. They also appreciated the availability of documentation templates, text macros, and clinical decision support forms,

	Initial Implementation (2002)	Annual Maintenance (2005)
EHR Costs*		
EHR licenses (20 concurrent user licenses)	\$ (43,700)	
EHR license maintenance	\$ (12,500)	\$ (12,500)
Hardware, network, implementation services	\$ (91,375)	
Hardware, network, implementation maintenance	\$ (44,925)	\$ (44,925)
Total Costs	\$ (192,500)	\$ (57,425)
EHR Savings*		
Pre-EHR staff-to-physician FTE ratio	3.25	
Post-EHR staff-to-physician FTE ratio		2.55
Change in support staff per physician FTE		(0.70)
Absolute Change in Staff**		(2.50)
Average Salary + Fringe for clinic staff (\$/hr)	\$ 23.26	
Staff : Physician S+F savings (\$)		\$ 120,952
Med records chart pull charges		\$ 87,155
Transcription savings		\$ 75,717
Total Savings		\$ 283,824
FTE Providers	4.30	4.50
Estimated EHR costs per Physician FTE	\$ (44,767)	\$ (12,761)
Savings per provider FTE (\$)		\$ 63,072

Table 1. Major costs and savings from ambulatory EHR implementation.

such as anticoagulation management, to facilitate care and speed documentation.

In addition, staff also could process internal and external referrals more efficiently. This was particularly the case after automated external referral letter generation was introduced that conformed to individual consultant content and formatting expectations. The clearest indicator of the net benefits of EHR implementation to staff was the frequent comment from nurses that they would be unwilling to go back to working in a paper chart environment.

EHR benefits as reported by physicians included greater access to and efficiency in retrieving, organizing, and

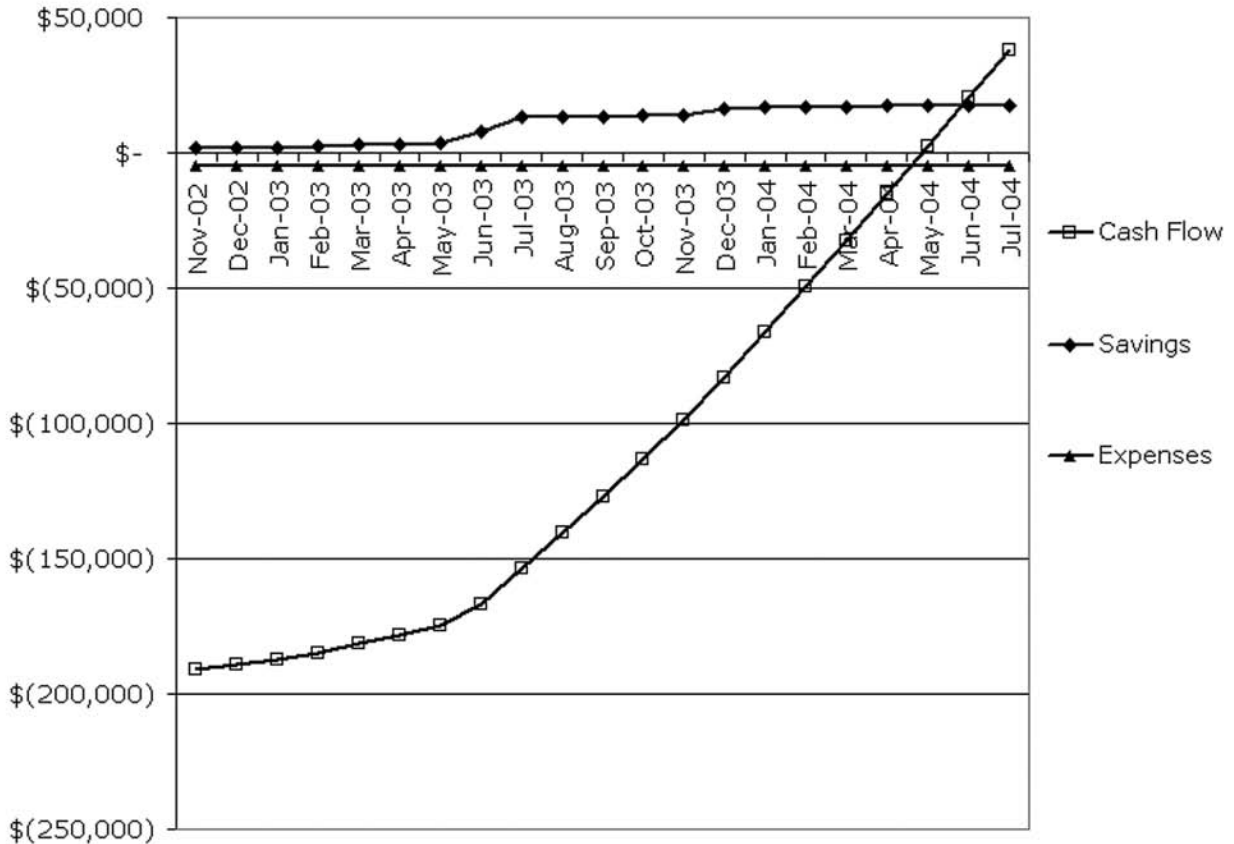


Figure 2. Return on investment analysis.

reviewing patient information; prescription renewal efficiency and accuracy; reminders and alerts regarding the need for tests or preventive care interventions and alerts regarding drug interactions and non-formulary prescriptions; the ability to handle documents and complete notes outside the clinic at more convenient times; interface-mediated elimination of the need to contact the laboratory for results of tests ordered in the clinic; the ability to view radiology images in real time; fewer pager interruptions when physicians were not in clinic; and improved information support for decision-making by on-call physicians.

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Other EHR benefits reported by physicians included guideline-assisted documentation templates with embedded clinical decision support for common chronic diseases; computer-assisted assessment and plan generation for selected conditions, with automatic insertion of current test results and treatments in place for the patient; automated evaluation and management coding assistance; and the capture of information in structured data fields for subsequent reporting and eligibility for pay-for-performance initiatives.

A number of less tangible benefits from the clinic's EHR implementation includes improved population management capabilities, e-visit capacity, pay-for-performance readiness, increased brand recognition, and an enhanced local and regional reputation.

One particularly gratifying benefit was the ability to implement an “open access” appointment scheduling policy, enabling most patients who called requesting an appointment to be seen on the same day or within 24 hours, even if the patient's primary care physician was unavailable. This policy was made possible by the existence and predictable availability of sufficient electronic patient information to make covering physicians comfortable seeing frequently complex patients in an efficient and effective manner, something they were not comfortable attempting in a multi-volume paper chart environment. In a clinic that had virtually no open access appointment slots before EHR implementation, it now has 66 slots available each week (2.9 per FTE provider per day) for open access appointments, enabling it to meet 75 percent to 100 percent of patient demand. Patient feedback from the introduction of open access appointments has been overwhelmingly positive. Likewise, the great majority of comments received from

patients regarding the clinic's EHR implementation have been favorable.

Implementation Problems

The most important challenge initially experienced by all related to network availability and related EHR performance speed issues. This was particularly but not exclusively seen in the first-generation wireless tablet computers that had just become available in late 2002. Network availability problems commonly manifested as apparent EHR screen freezes lasting 20 to 60 seconds or more and database connections interruptions that required restarting the EHR program on the local computer.

In the first year of implementation, such problems occurred at least once and sometimes several times during a clinic session. Failure mode effects analyses revealed a combination of mostly non-EHR system factors, including problems with the internal wireless cards of the first-generation tablet computer, wireless access points, unauthorized local software installation, failure to follow documented computer use and storage protocols, network traffic, and inadequate monitoring of network availability from servers to and from user devices.

While clinic providers and staff had unanimously selected wireless tablet PCs for use in examination rooms, continued use resulted in problems for some physicians with comfort, convenience, or performance, prompting requests for alternatives. The issue was resolved by supporting the use of faculty-owned wireless notebook computers in examination rooms and greater availability of desktop computers for documenting outside examination rooms.

Problems cited by nurses and other clinic staff included excessive time and effort required by those who had little or no prior typing skills; intermittent slow system response times on computers with full client software installation, compared with thin clients; printer selection problems on computers with thin client installations; inadequate time for EHR system training and practice; physician variation or noncompliance in updating EHR problem lists, medication lists, allergies, and health maintenance protocol items; and evidence that physicians or other staff were not checking their EHR desktops and responding to their requests for information or assistance in a timely manner.

Problems identified by physicians included needing to type in too much information with at least temporary decreases in office visit documentation efficiency; inadequate screen-to-screen response times in a full-client environment, which was resolved by converting to thin-client technology; printer selection problems on computers with thin client installations; too many screens to navigate; being temporarily prevented from adding problems or medications because another provider had failed to sign problem or medication changes in a separate note; and a

sense that physicians now were expected to complete certain tasks in the EHR that previously had been delegated to staff through verbal orders.

Other problems identified by physicians included delays in activating the EHR orders module, requiring the continued use of paper; lack of interface activation for inpatient test results because of hospital staff failure to designate correct ordering physicians; excessive incoming paper resulting from delays in other HealthTeam clinic EHR use or lack of hospital interfaces; some template forms were perceived as being too complex; delays in transitioning from paper-based patient history questionnaires to Web-based histories that integrate with office visit documentation; and a lack of regular performance reports.

Achieving Success

The Internal Medicine Clinic EHR experience underscores the truism that like success, EHR implementation “is a journey, not a destination.”¹⁶ While many important milestones have been attained, the opportunities to use EHR systems to further improve quality and eliminate waste stretch to the visible horizon.

Reaching these new horizons can be encouraged by aligning systems and incentives for EHR use. Because direct financial incentives for EHR use were not available to the clinic, overall progress relied on the shared vision, teamwork, and determined effort of providers and staff dedicated to achieving the quality and financial benefits achievable from transforming healthcare with information technology. Having an EHR system capable of supporting the needs of the practice is important but insufficient to ensure timely and beneficial EHR implementation.

Critical success factors in the Internal Medicine Clinic included a history of clinician trust, team-building, tolerance, patience, resiliency and accountability; a track record of effective use of healthcare IT solutions, such as personal digital assistants; clinician recognition of the urgent need to improve care and the importance of EHR systems; clinician buy-in and commitment to use the EHR; realistic expectations regarding the capabilities and limitations of EHR systems; physician willingness to strive and change how they work to achieve levels of EHR use that predict net financial benefits;⁵ and effective clinic and division leadership with clear expectations for use.

Other critical success factors included identifying dedicated physician and staff champions, an insightful and creative EHR implementer, and supportive and responsive IT staff; giving early adopters freedom to innovate; identifying top workflow problems in a paper chart environment and focusing on corrective EHR technology and workflow redesign; responding to user requests for specific EHR system features, preloading selected paper chart data, training and interface development; encouraging the use of structured data entry and advanced EHR features; and

regularly communicating with and including stakeholders in decision-making.

Some Conclusions

There was considerable variation in the rate and extent of EHR adoption between individual clinics. For example, transitioning from paper charts to the EHR system has been uneven and remains incomplete (Figure 1). A preliminary analysis of feedback data from various internal sources suggested that EHR implementation problems tended to fall into predictable categories, including technology infrastructure (inconsistent network availability), organizational culture (resistance to change), training (quality and attendance), leadership (incentives and accountability), user interface concerns (navigation, custom documentation templates), and user-specific issues (computer literacy, willingness to strive).

The striving and stamina required by clinic providers and staff is a key factor in successfully implementing an EHR system in the current U.S. healthcare delivery system, which pays more for doing than thinking and for quantity rather than quality of care. It is uncertain how many practices have the necessary expertise, resources, leadership, resiliency and stamina to achieve a high probability of success in a similar effort.

For example, despite having access to an experienced IT team, this implementation encountered a number of network technical difficulties that tested the patience and fortitude of many providers. Office practices that do not have access to the necessary IT expertise may be at higher risk for workflow interruption during EHR implementation, as was underscored in a recent report.⁴

In addition, EHR systems are expensive, and while achieving a positive return on investment is possible, it is by no means assured, and many small practices lack the capital to invest in such systems. Without financial incentives for EHR adoption and use, the benefits of widespread EHR adoption to the U.S. healthcare delivery system will likely be diminished and delayed.

Similarly, driving meaningful improvement in U.S. healthcare quality will likely require a national health information network to transport information, and health information exchange and interoperability standards to ensure that patient-specific health information is recognizable and usable when it arrives from a disparate system.

The estimated costs of establishing a NHIN¹⁷ and promoting such standards are considerable but so are the anticipated savings,¹⁸ and having interoperable systems exchanging information over reliable and secure networks would considerably lessen the effort and cost required to redesign care in individual physician practices striving to implement EHR systems. Despite having more than a dozen interfaces in place, the Internal Medicine Clinic still must handle and send more than 1,300 separate paper

documents each month to be scanned and indexed into the EHR at an estimated annual cost of more than \$25,000.

While pay-for-performance and pay-for-quality programs are beginning to emerge across the nation, they remain too scarce to affect most decisions to implement EHR systems. Policy decisions that create meaningful financial incentives for physicians to produce data demonstrating high or improving levels of healthcare quality will be required, both to encourage adoption of EHR systems and to ensure that they are used in a manner that drives improvements in quality. After a mighty effort requiring solidarity, Six Sigma improvement principles and a willingness to strive, the Internal Medicine Clinic and its patients have a stable and robust EHR system in place that will enable the clinic to

benefit when the urgently needed financial incentives finally arrive.

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