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The Financial And Nonfinancial Costs Of Implementing Electronic Health Records In Primary Care Practices

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ABSTRACT The incentives in the American Recovery and Reinvestment Act to expand the “meaningful use” of electronic health record systems have many health care professionals searching for information about the cost and staff resources that such systems require. We report the cost of implementing an electronic health record system in twenty-six primary care practices in a physician network in north Texas, taking into account hardware and software costs, as well as the time and effort invested in implementation. For an average five-physician practice, implementation cost an estimated \$162,000, with \$85,500 in maintenance expenses during the first year. We also estimate that the HealthTexas network implementation team and the practice implementation team needed 611 hours, on average, to prepare for and implement the electronic health record system, and that “end users”—physicians, other clinical staff, and nonclinical staff—needed 134 hours per physician, on average, to prepare for use of the record system in clinical encounters.

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The Health Information Technology for Economic and Clinical Health (HITECH) provisions of the American Recovery and Reinvestment Act of 2009 make full implementation of electronic health record systems a national priority.¹ Potential adopters of this technology need information about the financial and other resources required to implement and maintain the systems.

We quantified the costs of implementing one system—GE Healthcare’s Centricity Electronic Medical Record²—at HealthTexas Provider Network, a large physician network in north Texas that provides fee-for-service ambulatory care. Financial costs included those pertaining to purchases of hardware and of software licenses. We also considered the maintenance costs for software licenses, hosting, and technical support for the first year following implementation.

We considered nonfinancial costs to be related to the time spent by many parties to bring the

system online and into full use. These parties included three groups of people.

First was the HealthTexas network implementation team, which consisted of the manager for training and work flow, the senior vice president for disease management and quality, the vice presidents for informatics and for electronic health records and information technology (IT), a project manager, a process improvement consultant, and staff who conducted the work-flow analyses and electronic health record training for physicians and clinic staff. This team planned and led the implementation of the system throughout the network.

Second were the individual practice implementation teams, which prepared for the practice’s implementation through planning, work-flow reengineering, and training, and which consisted of “physician champions” chosen to spearhead the implementation at the particular practice, clinical staff “superusers,” and office managers.

Third were the end users—the physicians, other clinical staff, and nonclinical staff. End users had to be trained to use the electronic health record and had to prepare for its use in clinical encounters—for example, by loading information from patients' paper records.

We interviewed key leaders of HealthTexas's electronic health record implementation: the vice presidents for informatics and for electronic health records and health IT, and the manager of training and work flow. The goal of these interviews was to understand and quantify the costs of implementation and maintenance from the perspective of all three groups described above during the design, implementation, and early use of the new electronic health record system.

Background

Despite the potential for health IT to improve the quality of medical care, results from the National Ambulatory Medical Care Survey³ reveal that in 2008 only 41.5 percent of office-based physicians used full or partial ambulatory electronic health records in their practices.⁴ Only 13–17 percent of all physicians reported using at least a basic electronic record system—one that contains patient demographic information, clinical notes, orders for prescriptions, and patient problem lists (which list the conditions with which a patient has been diagnosed) and that permits the user to view laboratory test and imaging results.^{4,5} Furthermore, only 4 percent of all physicians reported using a system with additional advanced functions, such as sending prescriptions and test orders electronically, providing warnings of drug interactions or contraindications, and providing point-of-care reminders of guideline-based interventions.^{4,5} These advanced functions are similar to several of the Stage 1 “meaningful use” standards and measures for fiscal year 2012.⁶

Providers who have not yet adopted electronic health record systems frequently cite financial reasons as barriers to adoption—such factors as high start-up costs, lack of capital, concern that a system would soon become obsolete, and lack of adequate and reliable information about return on investment.^{5,7,8} In fact, lack of capital, loss of productivity during implementation, and insufficient return on investment all ranked within the top five barriers to electronic health record adoption in a survey sampling from 34,000 medical groups nationwide.⁷

Similar barriers have been described in a qualitative study of Boston and Denver physicians.⁹ And in a survey on health IT use in Massachusetts, the most-cited barriers to adoption were inadequate funding; absence of physician sup-

port for change; lack of technical knowledge or support; interference with work flow; and inability to find a system that fit providers' needs.¹⁰ Physicians in the Indian Health Service most commonly considered the technical limitations of computers and clinical productivity loss to be major barriers to record adoption.¹¹

Not surprisingly, providers most frequently cited financial incentives for both the purchase and the use of an electronic health record system as measures to encourage adoption.⁵

This focus on financial barriers and incentives suggests that physicians' decisions about adopting an electronic health record system depend more on the costs and savings associated with the technology than on its demonstrated impact on clinical care. Multiple reports provide estimates of what it costs to implement a system, but these estimates vary too widely to give a physician practice a good sense of what it can expect to spend.^{7,8,12} Furthermore, few of the estimates cover all of the diverse costs associated with implementation.^{13,14}

One extensive review of the literature concluded that “more information is needed regarding the organizational change, workflow redesign, human factors, and project management issues involved with realizing benefits from [health] IT.”^{13(p749)} Another concluded that methodological approaches centered on social, cultural, and organizational factors might be necessary to accurately evaluate a record system's usefulness because the structure of care, work flow, and relationships between health professionals seem to play key roles in the impact of health IT on medical practice.¹⁴

Other studies have concluded that more research is needed outside of academic settings that use health IT systems developed in house over time, recognizing that the majority of providers adopting electronic health record systems will use commercially available products and implement them relatively quickly.^{13,15,16} Recently, Marie Federowicz and coauthors advocated the use of “activity-based costing.”¹⁷ Such an approach ensures that all relevant costs are included in assessments of the effects of change. It captures not only the costs that traditional accounting methods identify, but also the hidden costs related to changes in practice that occur with the implementation of an electronic health record system or other new technology.¹⁷

If the goal of nationwide adoption of electronic health records as defined under HITECH is to be realized, clinicians and others involved in decisions about the adoption and use of health IT need accurate and reliable information about the risks, costs, and benefits of the technology. To provide such information, we examined the

process of implementing an electronic health record system in primary care practices within a large fee-for-service physician network in north Texas.

Implementing An Electronic Record System

SETTING HealthTexas Provider Network is the fee-for-service ambulatory care provider network affiliated with Baylor Health Care System, a not-for-profit health care system serving patients throughout north Texas. The network consists of more than 100 primary care, specialty care, and senior health centers and more than 450 physicians in the Dallas–Fort Worth area. Because work flow and processes of care differ by specialty, our sample included only the twenty-six primary care practices—those with physicians specializing in family practice and general internal medicine—that implemented the electronic health record system between June 2006 and December 2008.

The Baylor Health Care System, including HealthTexas, has a long-standing organizational commitment to quality. The system's quality improvement initiatives in both the inpatient and ambulatory care settings have included linking administrators' compensation to performance on clinical quality measures;¹⁸ participating in the Institute for Healthcare Improvement's 100,000 Lives and 5 Million Lives Campaigns;^{19,20} introducing a rapid-cycle improvement training course;²¹ and using a multiprong approach to improve the delivery of adult preventive services.²²

Typically, quality improvement initiatives and evaluations within HealthTexas are approved, overseen, and monitored by the HealthTexas Best Care Committee. This committee of approximately thirty-five physicians is chaired by the senior vice president for disease management and quality. Its members include the HealthTexas chair, the senior vice president for medical affairs, the vice president for community health improvement, and the Baylor Health Care System senior vice president for health care quality and vice president for health care improvement.

Given the scope of the electronic health record implementation, however, a separate Ambulatory Electronic Health Record Committee was created. Its members—the HealthTexas chair, the senior vice president for medical informatics, the vice presidents for informatics and for electronic health records and IT, six physicians, a technical support representative, and a GE Centricity representative—are responsible for overseeing all aspects of the implementation and use of the electronic health record system.

A Physician Advisory Group was also created within HealthTexas, consisting of twenty physicians representing most specialties, geographic areas, and clinic sizes and having varying degrees of computer expertise. The group developed best-practice guidelines and made recommendations to the Ambulatory Electronic Health Record Committee on “key policies, decisions, workflow and content,” with a guiding principle of “evidence based clinical guidelines and standardization of clinical process.”²³

THE ELECTRONIC HEALTH RECORD SYSTEM

HealthTexas adopted a web-based, externally hosted electronic health record package, consisting of GE Healthcare's Centricity Electronic Medical Record,² Clinical Content Consultants advanced forms,²⁴ and Clinical Messaging and Docutrack from Kryptiq.²⁵ Together, these components integrate individual patients' clinical and demographic information with embedded clinical content and decision support (including point-of-care reminders and disease-specific forms), secure physician-to-physician messaging, and integrated scanning. This last feature means that items such as reports or paper charts can be scanned directly into patients' electronic records, reducing the likelihood of errors and removing the need for additional scanning and indexing software.

Given the impracticality of implementing the package at all 100 HealthTexas centers simultaneously, implementation occurred on a staggered schedule based on practices' technical readiness and willingness to adopt the technology.²⁶ Preparation began at each practice 120 days before that practice's scheduled launch of the package. The elaborate schedule of activities included planning; evaluating existing hardware, network capabilities, and interfaces—for instance, with scheduling and laboratory information systems—and updating them as needed; and training physicians, other clinical staff, and nonclinical staff separately in the use of the new system.

Another key activity was reengineering practice work flows. A consultant helped each practice refine such processes as checking patients in, verifying insurance coverage, and administering medications.

The HealthTexas network's implementation team made key recommendations to each practice. These included reducing the number of appointments for two weeks after the launch of the new system and entering information before the launch, taken from paper medical records. This “preloading” was required for patients' drug allergy lists, problem lists, medicines, and advance directives, and it was recommended for preventive services and immunizations. In addition,

full chart loading was recommended for all patients who had had six or more visits in the previous twelve months.

Data Collection And Analysis

ESTIMATING COSTS The financial costs of implementation include capital expenditures (typically depreciable) for hardware, some of which vary according to the number of physicians in a practice; and operational expenditures for software licensing, hosting, and technical support.

To quantify nonfinancial costs, we collected payroll data and time estimates for staff at the network and practice level, such as the vice presidents for informatics and for electronic health record and health IT, the managers of technical deployment and of training and work flow, and trainers. We specifically examined how much time the members of the HealthTexas network implementation team spent in such activities as the development of interfaces; work-flow redesign; and the deployment of technology, including hardware and network connections. Also included was the compensation paid to external consultants for the time they spent on preparation for and implementation of the electronic health record system.

We also considered the nonfinancial cost of the time spent by each practice's "physician champion," electronic health record manager, and end users in such tasks as training; simulation, or using the new system with practice cases; and related activities after implementation. We based the time estimates on interviews with the members of the HealthTexas network implementation team. They quantified the time spent on each of the implementation tasks from the perspectives of the network, the individual practice, and the end user, using supporting documents, e-mail messages, and calendar appointments. We used payroll data to assign an average hourly wage by job category for practice members (physicians, other clinical staff, and nonclinical staff) and to estimate the costs of the time spent in training and preparation.

Total implementation costs included all items related to the electronic health record system for the 120 days prior to its launch and the first 60 days following the launch. We estimated the financial impact of nonfinancial costs from the three perspectives based on 2009 salary levels for the different job categories.

We performed a similar analysis to quantify the ongoing maintenance costs. These include software licenses, hosting, and technical support. We estimated costs for the maintenance period starting with the practice's launch date and continuing through the first year of operations.

LIMITATIONS We studied twenty-six primary care practices in a single large network, which may mean that our results are not generalizable to small, isolated practices or to other practice settings.

The network in our study may be considered a best-case scenario. Substantial corporate support was given to individual primary care practices for the implementation of an electronic health record system, thereby avoiding many of the perceived barriers to implementation. Our example could also be viewed as an excessive-case scenario, as more resources than necessary may have been provided by the HealthTexas network implementation team.

Our nonfinancial cost estimates were based on time estimates provided by key personnel from supporting documents, e-mail communications, and appointment calendars, rather than contemporary recording of the time spent on each of the activities. Although such time recording would be more accurate, the exploratory and observational nature of this study—combined with the practical difficulties of requiring all of the personnel and end users involved to record their time separately in various categories—made such an approach impossible.

Study Results

HealthTexas requires its practices to adopt the electronic health record system. All twenty-six of the network's primary care practices—each consisting of two to twelve physicians—implemented the system and used it for all clinical encounters after the launch date.

HARDWARE COSTS HealthTexas's one-time infrastructure purchases amounted to \$25,000 per practice for switches, cables, and wireless Internet connections per practice, and approximately \$7,000 per physician for personal computers, printers, and scanners.

SOFTWARE AND MAINTENANCE COSTS Maintenance costs—which began at implementation—amounted to approximately \$14,700 per physician per year for software licensing, hosting and technical support (through a third-party vendor), and networking. The support provided by the network cost an additional \$2,400 per year, yielding a total of approximately \$17,100 per physician for maintenance.

NONFINANCIAL COSTS We calculated the time expended during the implementation process by the HealthTexas network implementation team; the practice implementation team; and the end users (physicians, other clinical staff, and nonclinical staff).

► **NETWORK IMPLEMENTATION TEAM:** The HealthTexas network implementation team's

costs resulted from time spent on the activities shown in Exhibit 1. We estimated that the team spent 468.5 hours before the electronic health record system was launched at a practice and an additional 12 hours during the first 60 days after the launch, for a total of 480.5 hours and \$28,025 per practice.

► **PRACTICE IMPLEMENTATION TEAMS:** These teams' time was spent on the activities shown in Exhibit 2. We estimated that the average practice implementation team spent 130 hours and \$7,857 on implementation. As noted above, each practice had two to twelve physicians.

► **PRACTICE END USERS:** End users spent time during the implementation on the activities shown in Exhibit 3. We assumed that the physicians evenly split the eighty-five hours of entering data from the recommended paper medical records with the other clinical staff. Based on the HealthTexas average of 3.3 staff members per physician, we estimated a total of 134.2 hours and \$10,325 expended per physician.

TOTAL COSTS Exhibit 4 shows the total cost of implementing an electronic health record system through the first year after launch, based on a five-physician practice. We estimated that the total cost for implementation through the first sixty days after launch was \$162,047 for a five-physician practice, with an average per physician total cost of \$32,409. Adding maintenance costs for the whole first year after launch, we estimated the total costs through the first year to be \$233,297, with an average per physician cost of \$46,659.

The specific fixed and variable costs demonstrate that some reduction in cost can be

achieved for larger practices, compared to those with fewer physicians.

Discussion

The purpose of this study was twofold. We wanted to inform real-world health IT implementation decisions, especially in the context of the current national priority placed on the adoption of electronic health records.¹ And we wanted to stimulate more comprehensive research on health IT implementation in the ambulatory care setting by clarifying the costs related to the implementation of an electronic health record system. In particular, this research addressed commonly perceived, but seldom fully investigated, barriers to health IT implementation in primary care practices related to uncertainties about financial and nonfinancial costs.

Our results are consistent with the \$34,000–\$39,000 direct costs—including software, hardware, staff support, and quality improvement efforts—of electronic health record implementation reported per physician in large community-wide initiatives in Massachusetts and New York City.²⁷ These results should be encouraging to physician practices that have yet to implement record systems. They are considerably lower than those in the recent CDW Healthcare Physician Practice EHR Price Tag study, which estimated the total cost (outlay plus lost revenue) at approximately \$120,000 per physician in the first year after implementation, with annual recurring costs of \$30,000 per physician.²⁸

Understanding the financial and nonfinancial costs related to implementation is important for

\$32,409

Per Physician

Average cost per physician of implementing an electronic health record system, through the first 60 days after launch.

EXHIBIT 1

Time And Cost For Network Implementation Team To Implement An Electronic Health Record System At An Average Primary Care Practice In The HealthTexas Provider Network

Activity	Time period			
	Before and during implementation		Before, during, and after implementation	
	Time (hours)	Cost (\$)	Time (hours)	Cost (\$)
Content development/customization	63.0	5,631	63.0	5,631
Creating interfaces with other systems	29.0	1,486	29.0	1,486
Work-flow mapping/redesign	59.0	2,462	64.0	2,635
Training	73.5	3,067	78.5	3,241
Support for launch	104.0	4,106	104.0	4,106
Technical deployment, including networking	130.0	9,856	132.0	10,009
Project management	10.0	765	12.0	918
Total	468.5	27,372	480.5	28,025

SOURCES Authors' interviews with key informants; authors' analysis of HealthTexas documents and salary data. **NOTES** Data are from the twenty-six primary care practices in the network that implemented the electronic health record between June 2006 and December 2008. Before implementation is the 120 days before the system's launch. Before and after implementation is the period from 120 days before launch through 60 days after launch. Technical deployment refers to acquiring, installing, and testing equipment, connectivity, network hardware, cabling, and communication.

EXHIBIT 2

Time And Cost For A Practice Implementation Team To Implement An Electronic Health Record System At An Average Primary Care Practice In The HealthTexas Provider Network

Activity	Members of the practice implementation team											
	Physician champion		Electronic health record manager		Clinical support staff		Front office staff		Medical records/communications		Total	
	Cost (\$)	Hours	Cost (\$)	Hours	Cost (\$)	Hours	Cost (\$)	Hours	Cost (\$)	Hours	Cost (\$)	Hours
Work-flow mapping/redesign	1,778	12.0	376	12.0	108	5.0	133	6.0	56	2.5	2,452	37.5
Training	1,778	12.0	376	12.0	433	20.0	133	6.0	56	2.5	2,777	52.5
Simulation ^a	296	2.0	0	0.0	22	1.0	22	1.0	22	1.0	363	50.0
Ongoing support during the 60 days after launch	1,482	10.0	783	25.0	0	0.0	0	0.0	0	0.0	2,265	35.0
Total	5,335	36.0	1,535	49.0	563	26.0	289	13.0	134	6.0	7,857	130.0

SOURCES Authors' interviews with key informants; authors' analysis of HealthTexas documents and salary data. **NOTE** Data are from the twenty-six primary care practices in the network that implemented the electronic health record between June 2006 and December 2008. ^aPractice cases.

everyone involved in deciding whether to adopt an electronic health record system.²⁹ For those still uncertain about adopting a commercially available system and considering the alternatives of continuing to use paper records or developing a customized system in house, information regarding the costs they can expect to encounter will inform their decisions.

Other studies have addressed various financial

aspects of electronic health record implementation, but they have not typically examined the perceived barriers related to organizational change, work-flow redesign, human factors, and project management issues involved in realizing benefits from health IT,¹³ or the barriers related to technical knowledge and support identified elsewhere.¹¹ These barriers carry a non-financial cost that must be taken into consider-

EXHIBIT 3

Time And Cost Per Physician For End-User Activities Related To Implementation Of An Electronic Health Record System At An Average Primary Care Practice In The HealthTexas Provider Network

Activity	End user											
	Physician		Electronic health record manager		Clinical support staff		Front office staff		Medical records/communications		Total	
	Cost (\$)	Hours	Cost (\$)	Hours	Cost (\$)	Hours	Cost (\$)	Hours	Cost (\$)	Hours	Cost (\$)	Hours
Work-flow mapping/ redesign	593	4.0	6	0.2	130	6.0	67	3.0	4	0.2	800	13.4
Entering info from paper records	6,299	42.5	0	0.0	920	42.5	0	0.0	0	0.0	7,219	85.0
Training	1,186	8.0	19	0.6	260	12.0	67	3.0	9	0.3	1,538	23.9
Simulation ^a	296	2.0	0	0.0	49	2.3	33	1.5	3	0.1	381	5.9
Ongoing support during the 60 days after launch	296	2.0	6	0.2	49	2.3	33	1.5	3	0.1	387	6.0
Total	8,670	58.5	31	1.0	1,408	65.0	200	9.0	16	0.7	10,325 ^b	134.2

SOURCES Authors' interviews with key informants; authors' analysis of HealthTexas documents and salary data. **NOTE** Data are from the twenty-six primary care practices in the network that implemented the electronic health record between June 2006 and December 2008. ^aPractice cases. ^bTotal cost per physician for end-user activities should not be compared to the total cost per practice for implementation team activities in Exhibit 2 because they reflect different work for complementary purposes. Combined end-user costs per physician are higher than implementation team costs per practice because of the greater time commitment required for physicians as end users, related to entering information from paper records.

EXHIBIT 4
Total Cost Of Implementation Of Electronic Health Record System For An Average Five-Physician Practice In The HealthTexas Provider Network Through First Year Of Use

Expenditures	Costs through 60 days after launch	First-year costs ^a	Total costs ^b
FINANCIAL COSTS (DEPRECIABLE CAPITAL EXPENSES)			
Hardware costs (fixed)	\$25,000	\$0	\$25,000
Hardware costs (variable)	\$35,290	\$0	\$35,290
Software license, hosting, etc. (variable)	\$14,250	\$85,500	\$85,500
NONFINANCIAL COSTS			
HealthTexas network implementation team (fixed)	\$28,025	\$0	\$28,025
Practice implementation team (fixed)	\$7,413	\$0	\$7,413
Practice end user (variable)	\$51,657	\$0	\$51,657
TOTAL			
Per practice	\$162,047	\$85,500	\$232,297
Per physician	\$32,409	\$17,100	\$46,659

SOURCES Authors' interviews with key informants; authors' analysis of HealthTexas documents and salary data. **NOTES** Data are from the twenty-six primary care practices in the network that implemented the electronic health record between June 2006 and December 2008. Fixed costs are constant across practices, regardless of size. Variable costs depend on the number of physicians in a practice. ^aIncludes costs for first sixty days after launch. ^bNot all totals in previous columns sum to total because of double counting of some operating costs.

ation in planning a successful electronic health record implementation.

The Department of Health and Human Services is creating regional extension centers to assist providers with the adoption of electronic health record systems. This collaboration has the potential to address many of the challenges to electronic health record implementation faced by individual providers or small physician practices.¹ However, the mismatch between who pays for the implementation and maintenance of the systems (health care providers) and who reaps the potential savings from the systems' use (chiefly third-party payers)^{30,31} remains a substantial barrier to adoption. This is the case even though the Institute of Medicine recognized more than a decade ago that financial incentives need to be aligned with efforts to improve the quality of health care—including the elimination of handwritten clinical notes.³²

Future Research And Conclusions

Our ongoing research, funded by the Agency for Healthcare Research and Quality, examines the impact of the electronic health record system in these twenty-six primary care practices between January 2004 and December 2009. We focus in particular on the time just before and after each practice launched the system. We are particularly interested in the effect of adopting the system on

work flow, including number of patient visits and level of staffing, and on the practices' expenses, revenues, and net income.

We are also examining the impact of the system on patient safety—particularly on drug-related adverse events—as well as its impact on the quality and outcomes of diabetes care. These research projects will provide further information about the potential costs and benefits of adopting electronic health records.

Future research should also examine the impact of adoption on patient-centeredness, especially during the implementation period. Physicians' satisfaction with electronic health record systems should be examined over time, because their opinions of a system will be critical components of its successful use.

This study's strength lies in the fact that it addressed the question of what resources—both financial and nonfinancial—a small practice needs to implement an electronic health record system. We made some progress toward making health IT research more generalizable to real-world implementation.¹³⁻¹⁵ We also showed that a division of labor that is well defined and coordinated is required to meet the challenges of successful health IT implementation and maintenance. Our results should be useful to policy makers considering how to achieve the goals of widespread electronic health record adoption and “meaningful use.”¹ ■

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