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A Survey Analysis Suggests That Electronic Health Records Will Yield Revenue Gains For Some Practices And Losses For Many

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ABSTRACT Health care providers remain uncertain about how they will fare financially if they adopt electronic health record (EHR) systems. We used survey data from forty-nine community practices in a large EHR pilot, the Massachusetts eHealth Collaborative, to project five-year returns on investment. We found that the average physician would lose \$43,743 over five years; just 27 percent of practices would have achieved a positive return on investment; and only an additional 14 percent of practices would have come out ahead had they received the \$44,000 federal meaningful-use incentive. The largest difference between practices with a positive return on investment and those with a negative return was the extent to which they used their EHRs to increase revenue, primarily by seeing more patients per day or by improved billing that resulted in fewer rejected claims and more accurate coding. Almost half of the practices did not realize savings in paper medical records because they continued to keep records on paper. We conclude that current meaningful use incentives alone may not ensure that most practices, particularly smaller ones, achieve a positive return on investment from EHR adoption. Policies that provide additional support, such as expanding the regional extension center program, could help ensure that practices make the changes required to realize a positive return on investment from EHRs.

Despite broad consensus that health information technology can improve the performance of the US health care delivery system, only a minority of physicians currently use even a basic electronic health record (EHR) system.^{1,2} The primary barriers to adoption have been financial: Most physicians have cited lack of capital and uncertain return on investment as substantial hurdles.³ Policy makers responded with the Health Information Technology for Economic and Clinical Health (HITECH) Act of 2009, which has provided direct dollars to doctors and hospitals who adopt and “meaningfully use” an EHR system.⁴

Whether the act's incentives will be sufficient to help providers overcome the financial barriers to EHR adoption is unclear, in part because much uncertainty remains about the technology's long-term economic impact. Many policy makers have argued that physicians should be able to recoup much of the cost in the long run.^{5,6} In theory, they could increase revenue through improved billing and efficiency gains that should enable them to see more patients per day. They could also realize cost savings from reduced dictation costs and the elimination of paper records.

However, we currently lack generalizable data on whether these benefits have been achieved by

actual practices. We also lack knowledge about the resulting long-term financial impact of EHR adoption on practices. Without these data, it is very difficult to know how many physicians or what types of practices are likely to come out financial winners or losers after adopting EHR systems, and whether the HITECH incentives will substantially improve their bottom line.

The Massachusetts eHealth Collaborative is one of the largest EHR pilot programs. With more than eighty ambulatory care practices in three diverse communities agreeing to adopt EHR systems simultaneously, the pilot offered a unique opportunity to study the long-term financial impact of adoption on a heterogeneous group of practices.

In this study, we examined the five-year return on investment for the ambulatory care practices in the pilot. We sought to answer three sets of questions: What is the average five-year return on investment from EHR adoption, and what proportion of practices realize a positive return? How do these results vary by practice type and size, and what distinguishes practices that achieve a positive return on investment from those that have a negative one? And for what percentage of practices that lost money would the meaningful-use incentives have resulted in a positive return on investment, had practices been able to receive the incentives during the study period?

Study Data And Methods

SETTING The Massachusetts eHealth Collaborative was established in 2004 under the leadership of the American College of Physicians and the Massachusetts Medical Society to support the adoption of EHRs and to assess their impact on the quality, efficiency, and safety of care. Some \$50 million in support for the collaborative came from Blue Cross Blue Shield of Massachusetts.

Over a five-year period, the collaborative worked with ambulatory care practices in three Massachusetts communities to adopt EHRs. For the purpose of the pilot, a *community* was defined as a community hospital and its referring providers. The collaborative selected three communities for the pilot from thirty-five communities that applied through a request for proposals that was open to all Massachusetts communities. The pilot communities were chosen to provide heterogeneous populations for study.

A few qualified EHR vendors were selected by a working group of volunteer clinical leaders from the pilot communities. The collaborative paid the cost of each practice's EHR system, employed consultants to help practices with implementa-

tion, and assisted with vendor selection and contract negotiation. Implementation of the systems began in March 2006 and ended in December 2007. Additional details on the pilot have been presented elsewhere.^{7,8}

DATA The data supporting our return-on-investment projections came from the following two sources: a survey completed by pilot practices and internal accounting documents maintained by the Massachusetts eHealth Collaborative that captured spending on behalf of pilot practices. We used the survey to collect costs and benefits realized by pilot practices as a result of EHR adoption. Our survey, modeled on the Medical Group Management Association's annual cost survey,⁹ asked practices to report retrospective financial data from fiscal years 2005 (before adoption) and 2008 (after adoption).

To identify a comprehensive set of costs and benefits, we asked for pre- and postadoption figures for high-level categories, such as total revenue, total operating cost, and total labor cost. We also asked for specific subcategories that we expected to be affected by EHR adoption, such as costs of paper medical records, dictation services, information technology, and billing services. Then, for each line item in which there was a change in amount from pre- to postadoption, the survey asked respondents to distinguish the amount attributable to EHR adoption. The survey also asked practices to report one-time adoption costs that were incurred as a result of participating in the pilot.

ATTRIBUTION OF COSTS AND BENEFITS To produce accurate return-on-investment figures, it was critical to distinguish between costs and benefits that could be attributed to EHR adoption instead of to other changes happening simultaneously in the practices. Our aim was to decrease potential overattribution that could result from asking practices to focus exclusively on EHR adoption. We used several strategies.

First, to ensure that practices reported all one-time costs associated with EHR implementation, the survey included a list of the most common types of costs generated by the Massachusetts eHealth Collaborative's implementation specialists, who worked closely with practices and were therefore familiar with the types of costs that practices incurred. Next, for ongoing costs, the survey asked practices to explain why they attributed any difference between pre- and postadoption to EHR adoption as opposed to other factors. Finally, we conducted follow-up interviews with all respondents in which we discussed their approach to attribution, clarified ambiguities, and filled in missing data.

In general respondents did not have trouble identifying one-time costs incurred as a result of

EHR adoption or determining whether the specific subcategories expected to be affected by EHR adoption, such as the cost of paper medical records, did in fact change as a result. Practices had more difficulty in deciding whether or not to attribute changes in revenue to the adoption.

For example, if a practice reported revenue of \$200,000 in 2005 and \$300,000 in 2008, it was often not clear what proportion, if any, of the \$100,000 increase resulted from EHR adoption. In these cases, we asked each practice to examine additional relevant data such as changes in visit volume, revenue per visit, and rejected claims that occurred soon after implementation.

The result was that only 22 percent of practices attributed revenue gains to EHR adoption. Even in these cases, some uncertainty remained, which prompted us to assess how our results would change with attribution errors as large as 25 percent and 50 percent. We report these results as sensitivity analyses.

DATA COLLECTION We administered the survey to six pilot practices, refined it based on their feedback, and then administered it to all of the active pilot practices—including those that had tested the original survey for us—between January 2010 and January 2011. For a copy of the survey instrument, see the online Appendix.¹⁰

Since the Massachusetts eHealth Collaborative had paid for the majority of costs associated with the EHR purchase and initial implementation, we supplemented survey data with practice-level cost data provided by the collaborative. These included the cost of license and maintenance fees for software and hardware, technical site assessment, and support from implementation specialists employed by the collaborative.

GENERATING RETURN-ON-INVESTMENT PROJECTIONS We combined survey data and the collaborative's cost data to develop five-year return-on-investment projections for each practice. We selected a five-year window both to be consistent with other cost-benefit analyses^{5,11} of health information technology and because it is the duration of the HITECH incentives.

We first calculated costs and benefits attributed to EHR adoption for each practice. These were of two types. The first was one-time costs incurred as a result of EHR adoption. They included the amounts paid by the collaborative for the EHR purchase and initial implementation; costs paid by practices for scanners and other types of hardware; and the cost of temporary labor, productivity losses, or extra working hours incurred when the EHR system went live.

The second type consisted of ongoing costs and benefits that were attributed to EHR adop-

tion. These figures came from the survey and reflected amounts that changed from pre- to postadoption reporting years.

We treated both revenue increases and avoided costs as benefits. For example, a practice that reported spending \$2,500 on paper medical records in the preadoption year and \$500 in the postadoption year, as a result of switching to an EHR, was credited with \$2,000 per year in avoided costs. Newly incurred costs that persisted were treated as ongoing costs. For example, a practice that hired a half-time information technology expert for \$35,000 a year would incur this cost annually.

To generate five-year return-on-investment projections, we multiplied all annual ongoing costs by five and added them to amortized one-time costs. The Appendix includes a detailed example of how projections were calculated.¹⁰ All projections were in 2008 dollars, and costs and benefits were discounted at an annual rate of 2.3 percent, based on Office of Management and Budget recommendations.¹²

ANALYZING RETURN-ON-INVESTMENT PROJECTIONS We used practice-level five-year return-on-investment projections to determine the proportion of practices that at least broke even. Then, to calculate the average five-year return-on-investment per physician, we divided each practice's five-year return on investment by the number of full-time-equivalent physicians and averaged these results across practices.

We examined break-even proportion and average return on investment separately for primary care and specialty care practices, as well as for practices with different numbers of full-time-equivalent physicians—one or two, three to five, and six or more.^{1,13} After we confirmed that size and type were not confounded in our sample (chi square = 3.58; $p = 0.17$), we used chi-square tests (for proportions) and one-way analysis of variance (for averages) to test for differences by type and size.

To determine the proportion of practices for which the meaningful-use incentives would have resulted in a positive return on investment, we assumed that all physicians in the practice would receive the maximum Medicare incentive of \$44,000. Because our study took place prior to the meaningful-use incentive program, no practices received incentive payments during the time periods in which financial data were reported, although many probably received the incentive subsequently.

We then added the net present value of the incentive to the five-year projected return on investment. We used chi-square tests to assess differences, by practice type and size, in the proportion of practices that would have achieved a

positive return on investment with the incentive. We also assessed the percentage of practices that would at least break even if the federal incentive payment were doubled or tripled.

Finally, to identify factors associated with a positive return on investment, we examined costs and benefits across eight categories and used *t* tests to assess whether average costs (or benefits) within categories differed between practices that achieved a positive return on investment and those with a negative return.

LIMITATIONS Our methodological approach had several limitations. We sought to capture a comprehensive set of costs and benefits associated with EHR adoption, and we designed a survey that asked respondents to report a broad set of financial data. As a result, there were instances in which it was not clear to what extent a change in cost or revenue was attributable to the pilot program.

We took several steps (described above) to increase attribution precision and ran sensitivity analyses to assess the impact of attribution errors. However, factors such as practice attitudes toward the EHR system may have systematically biased attribution in ways that we were unable to address. In addition, our projections did not include benefits from EHR adoption that may accrue to other stakeholders—such as patients—which could be substantial.

Caution should be taken when generalizing our results. Although our sample included the most heterogeneous group of practices for which return-on-investment projections could be made, practices voluntarily adopted EHR systems by participating in the pilot and could thus be considered early adopters.

In addition, the Massachusetts eHealth Collaborative used a “concierge” approach that provided substantial implementation support, which might not be available in other settings. The net effect of the concierge approach was unclear, since it could have simultaneously increased implementation costs and allowed greater realization of benefits.

Finally, we were not able to capture the degree to which practices used their EHR system to transform their approach to care delivery, rather than simply automating prior processes. In particular, pilot practices may have felt less compelled to make changes that would help them recoup their investment because they did not shoulder the majority of adoption costs. The meaningful-use incentive may have a similar effect; it is therefore important to continue to study the types of changes practices make in response to EHR adoption and the impact of those changes on cost and quality.

Study Results

Sixty of the eighty-three active pilot practices responded to the survey, a 72 percent response rate. Respondents and nonrespondents did not differ significantly by practice type or size.¹⁰ We excluded practices with unusual situations that made their data inappropriate for the study. For example, one single-physician practice was ramping down to prepare for the physician’s retirement, and several other practices merged with larger organizations.

As a result, return-on-investment projections were calculated for forty-nine practices (59 percent of the pilot practices) that reported generalizable data. This analytic subset was not significantly different from the broader set of respondents by practice type or size.¹⁰

Average projected five-year return on investment was negative, with the average physician losing \$43,743 (Exhibit 1). Only 27 percent of practices achieved a positive five-year return on investment (Exhibit 2).

When we examined results by practice type, primary care fared somewhat better than specialty care, although the difference was not significant because of a large variation within each group (Exhibit 1). Approximately one-quarter of each group achieved a positive five-year return on investment (Exhibit 2). Differences by practice size were larger on average, although not significant. Practices with six or more physicians had a small positive average return on investment. Thirty-eight percent of practices with six or more physicians achieved a positive return on investment, compared to 26 percent of practices with one or two physicians.

When we assessed the impact that the meaningful-use incentives would have had on the pilot practices, we found that an additional 14 percent of practices, for a total of 41 percent, would have at least broken even after five years (Exhibit 2). When we assessed the percentage of practices that would have achieved a positive return on investment if the \$44,000 Medicare incentive payment were increased, we found that doubling the incentive would result in 59 percent of practices at least breaking even. Tripling the incentive would increase this proportion to 67 percent of practices.

The incentive appeared to favor primary care practices and larger practices over specialty care practices and smaller ones, although the differences remained insignificant. With the \$44,000 incentive, more than half of primary care practices would achieve a positive return on investment, compared to only a third of specialty practices (chi square = 2.34; *p* = 0.13). Three-quarters of the practices with six or more physicians would achieve a positive return on

EXHIBIT 1

Projected Five-Year Return On Investment After Adopting An Electronic Health Record System, Per Physician

	Number of practices	Average return (2008 \$)
All practices	49	-43,743
Primary care	16	-29,349
Specialty care	33	-50,722
1-2 physicians	27	-53,360
3-5 physicians	14	-51,452
≥6 physicians	8	2,205

SOURCE Authors' analysis. **NOTES** We used analysis of variance to assess whether the distribution of five-year returns on investment differed by practice type or size. F statistics and *p* values, respectively, for differences between groups were as follows: primary care versus specialty care, 0.17, 0.68; number of physicians, 0.35, 0.71.

investment, compared to only about a third of smaller practices (chi square = 4.65; *p* = 0.098).

The most common financial change that practices saw as a result of EHR adoption was a reduction in the cost of paper medical records, with 55 percent of practices reporting such savings (Exhibit 3). The most common ongoing cost—that is, not including the one-time implementation costs—was additional hours of physician time, reported by 22 percent of practices.

When we examined what distinguished practices that were able to achieve a positive return on investment from those that were not, we found the largest difference was that successful practices used their EHR system to increase revenue to a greater degree than unsuccessful practices did. On average, practices that realized a positive return on investment increased revenue by \$114,613 per physician over five years (Exhibit 4), more than twelve times the

average increase of \$9,204 per physician for practices with a negative return on investment (*p* < 0.001).

The increases in revenue occurred in two ways. First, five of the practices, or 10 percent, reported improved efficiency that enabled them to see more patients per day. By quickly accessing information or performing documentation in the EHR, these practices were able to shorten patient visits and reduce the time between visits.

Second, nine practices, or 18 percent, increased revenue through improved billing, which resulted in fewer rejected claims, and more accurate coding of work performed, which in turn led to higher reimbursements.

In a related analysis, we found that practices that had a practice management system in place to assist with billing functions prior to EHR adoption benefited less on average than practices that acquired these billing capabilities when they adopted an EHR. The average five-year return on investment for practices in the first category was -\$57,885, compared to \$34,573 for practices in the second category (*t* = 1.51; *p* = 0.14).¹⁰

Other significant differences between practices with and without a positive return on investment were the ability to reduce the need for two types of outsourced services—dictation and billing—and their associated costs (Exhibit 4). For practices with a positive return on investment, reducing these services saved just over \$100,000 per physician on average over five years. Practices with a negative return on investment were also able to reduce these services, but to a lesser degree: They saved roughly \$13,000 per physician.

In addition, practices with a positive return on investment were able to reduce support staff to a greater extent than practices with a negative return on investment, either by eliminating positions entirely or by cutting back on hours. Summary statistics and results by size and type of practice are included in the online Appendix.¹⁰

When we assessed the sensitivity of our primary results to an increase or decrease of 25 percent within each cost category, we found that the average five-year return on investment per physician was most sensitive to changes in information technology and implementation costs.¹⁰ Increasing these costs by 25 percent lowered the average return on investment from -\$43,743 to -\$75,297 per physician; decreasing the costs by 25 percent raised the return to -\$12,189.

An increase or decrease in revenue was the second most sensitive category. Our projections were largely insensitive to changes in costs for staffing and paper medical records. A sensitivity

EXHIBIT 2

Percentages Of Practices Projected To Achieve A Positive Five-Year Return On Investment After Adopting An Electronic Health Record System

	Without incentive (baseline)	With incentive
All practices	27%	41%
Primary care	25	56
Specialty care	27	33
1-2 physicians	26	33
3-5 physicians	21	36
≥6 physicians	38	75

SOURCE Authors' analysis. **NOTES** Results for meaningful-use incentives were calculated in 2011 dollars. We used chi-square tests to assess whether the distribution of five-year returns on investment differed by practice type or size. Chi-square statistics and *p* values, respectively, for differences between groups were as follows: without incentive: primary care versus specialty care, 0.03, 0.87; number of physicians, 0.69, 0.71; with incentive: primary care versus specialty care, 2.34, 0.13; number of physicians, 4.65, 0.098.

EXHIBIT 3
Five-Year Benefits And Costs Of Adopting An Electronic Health Record System, Per Physician

Results of adoption	Hardware, software, and implementation costs	Operating costs					Revenue
		Supplies and services			Personnel		
		Dictation services	Billing services	Paper medical records	Physicians	Support staff	
PRACTICES REPORTING BENEFIT OR GAIN							
Number	0	22	13	27	2	11	11
Percent	0	45	27	55	4	22	22
Average benefit or gain (2008 \$)	— ^a	46,385	75,487	10,431	59,048	97,770	165,574
PRACTICES REPORTING COST OR LOSS							
Number	49	2	4	5	11	8	0
Percent	100	4	8	10	22	16	0
Average cost or loss (2008 \$)	-130,822	-16,949	-25,405	-6,823	-52,142	-43,540	— ^a

SOURCE Authors' analysis. ^aNot applicable.

analysis with the 25 percent change as well as a 50 percent change are included in the Appendix, along with ten-year return-on-investment projections.¹⁰

Discussion

We surveyed a diverse group of practices that adopted commercially available electronic health record systems as part of one of the nation's largest pilot programs of community-based EHR adoption. We found that although some practices would achieve a positive return on investment five years after adoption, nearly three-quarters of practices would incur a loss.

Average projected return on investment was

-\$43,473 per physician over a five-year period (Exhibit 1). This return was after substantial technical support was made available to the practices through the Massachusetts eHealth Collaborative, much more support than will be available to most practices in the country. Based on our projections, even if practices had been able to receive the full Medicare meaningful-use incentives—which had not been implemented during our study period—only an additional 14 percent of practices would be able to achieve a positive return on investment, and the majority would still lose money.

Although our findings suggest that HITECH incentives alone are not likely to ensure a positive return on investment for most practices,

EXHIBIT 4
Average Five-Year Costs And Benefits Per Physician For All Practices Adopting An Electronic Health Record System

	Total cost or benefit	Hardware, software, and implementation costs	Operating costs					Revenue
			Supplies and services			Personnel		
			Dictation services	Billing services	Paper medical records	Physicians	Support staff	
Average for all practices (N = 49)	-43,743	-130,822	20,134	17,953	5,052	-9,295	14,840	37,170
Average for practices with positive ROIs (n = 13)	170,503	-95,157	52,782	54,240	8,245	5,796	41,983	114,613
Average for practices with negative ROIs (n = 36)	-121,109	-143,700	8,345	4,850	3,898	-14,745	5,038	9,204
Difference between averages, practices with positive versus negative ROIs	291,612****	48,543**	44,437***	49,391***	4,346	20,541**	36,946*****	105,409*****

SOURCE Authors' analysis. **NOTES** Negative numbers reflect incurred costs (that is, financial losses); positive numbers reflect savings or increased revenue (that is, financial gains). All losses or gains are in 2008 dollars. ROI is return on investment. ** $p < 0.05$ *** $p < 0.01$ **** $p < 0.001$

they point to the types of changes that practices can make to realize financial savings following EHR adoption. For example, practices with a positive return on investment realized savings by eliminating paper medical records, as well as dictation and billing services and positions of, or hours worked by, staff members who were performing services no longer required after EHR adoption.

However, we also observed that many practices failed to make such changes. Almost half of the practices did not realize savings in paper medical records because they continued to keep records on paper. Practices may therefore need encouragement and assistance in changing the way they operate so they can benefit from EHR adoption. More nuanced data on implementation experience—in particular, on the impact of differences in how practices spend resources to support implementation—will be particularly helpful.

Among the practices we studied, there were striking differences between financial winners and losers. In particular, winners increased revenue by more than \$100,000 per physician on average compared to losers (Exhibit 4). One in ten practices in our sample were able to see more patients per day through improved efficiency. Almost twice as many increased revenue through improved billing that enabled them to reduce rejected claims and code at higher levels. This finding, however, highlights the potential misalignment between optimal provider use of EHRs and the savings that policy makers hope will result from greater EHR adoption, underscoring the recent concern about the potential for EHRs to drive up health care costs.

From a policy perspective, our results suggest that although the \$44,000 Medicare meaningful-use incentive comes close to offsetting the financial losses from EHR adoption on average, the one-size-fits-all structure of the incentive may not be as effective as an approach that is tailored to the practice setting. For larger practices, the incentive appears more than sufficient to encourage widespread EHR adoption. However, our data suggest that this may not be the case for smaller practices. This difference is particularly problematic because EHR adoption rates are currently much lower among small practices.¹

Policy makers could consider a range of additional efforts. Although future meaningful-use incentives could be increased for providers in small practices, a more compelling approach would be to pursue policies that lower the cost and increase the benefits of EHR adoption. For example, policies that encourage smaller practices to affiliate with larger groups could lower the costs of adoption through economies

of scale.^{14,15} Also, allocating additional funding to expand regional extension center activities could enable these centers to help practices implement operational changes that reduce adoption costs.

Our results differ somewhat from prior efforts to estimate return on investment from EHR adoption in ambulatory care. Two widely cited studies, both nearly a decade old, found a positive five-year return on investment: Robert Miller and colleagues reported a return of \$77,799 per physician,⁶ and Samuel Wang and coauthors reported a figure of \$86,400 per physician,⁵ compared to our negative return of −\$43,743.

However, Wang and coauthors included benefits that do not accrue directly to the practice under volume-based payment; these amounts accounted for 62 percent of the benefits in their projections. For example, they included savings from reduced use of services, which practices would actually experience as a revenue loss. (Under fee-for-service reimbursement, care avoided is lost revenue from the provider's perspective. The stakeholder who benefits from this avoided cost is the payer.) And Miller and colleagues did not quantify the ongoing costs incurred by physicians and staff who work overtime as a result of EHR adoption.

In addition, the smaller samples in these two studies may not reflect the heterogeneity of experience we observed. Our study extends this body of work by developing comprehensive return-on-investment projections for a diverse group of practices that ranged from solo primary care practices to large multispecialty organizations.

Conclusion

Our study suggests that the adoption of an electronic health record system can have a markedly positive financial impact, particularly for practices that leverage the systems to increase revenue. However, the five-year return on investment was negative for the majority of practices—particularly for smaller practices. Losses may have been due in part to the failure of practices to make the operational changes required to realize benefits.

Whether the meaningful-use incentive is sufficient to ensure that practices at least break even probably depends on both the practice setting and the decisions made by practices to organize and deliver care differently after EHR adoption. Understanding how to help all practices benefit from adoption is crucial to the success of HITECH and represents an important area for future research. ■

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In this month's *Health Affairs*, Julia Adler-Milstein and coauthors report on their attempt to project five-year returns on investment for the adoption of electronic health records (EHRs). Their analysis was based on survey data from forty-nine community practices in the Massachusetts eHealth Collaborative, a large EHR pilot. The authors found that the average physician would lose \$43,743 over five years; just 27 percent of practices would have achieved a positive return on investment; and only an additional 14 percent of practices would have come out ahead had they received the \$44,000 federal meaningful-use incentive. The results varied, largely based on whether practices were able to cut costs or grow their revenues with the aid of EHRs—suggesting that assistance from the federally backed regional extension center program could be a way to maximize the returns to practices.

Adler-Milstein is an assistant professor in the School of Information, with a joint appointment in the Department of

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