

Working PAPER

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Perceptions of Electronic Health Records and Their Effect on the Quality of Care: Results from a Survey of Patients in Four States

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ABSTRACT

Introduction. As federal resources are invested into wider adoption of electronic health records (EHRs) in primary care practices, it is important to understand patients' perceptions of EHRs, including their effect on the patient-provider relationship, quality of care, and views toward data security and confidentiality.

Methods. A survey instrument was developed and administered to adult patients immediately following a provider visit. Descriptive and regression survey analyses compared outcomes of patients served by EHR adopter and non-adopter practices and those served by recent and early adopters. A survey of 670 patients with a patient-level response rate of 53 percent within the 37 participating practices was conducted from November 2010 to April 2011.

Results. Patients had favorable perceptions of EHRs. Most believed that EHRs improved the quality of care and most were not concerned with confidentiality of records. Adopters' patients rated the quality of care higher than non-adopters' patients. Survey results showed no detrimental effect of EHR use on patient-provider communication and no relationship between the way in which physicians interacted with the computer and patients' perceptions of care. Transition issues did not affect patient satisfaction. This is a cross-sectional study, this survey was not nationally representative; the participation rate of practices was low and the power was somewhat low.

Discussion. Policymakers and providers need not be concerned that EHRs will harm the patient-provider relationship, which is encouraging for policies promoting adoption. Because this study was conducted shortly after the EHR Incentive Programs began, it is important to continue to closely monitor the unintended consequences of providers' use of EHRs on the patient-provider relationship.

I. INTRODUCTION

The Health Information Technology for Economic and Clinical Health Act (HITECH), part of the American Recovery and Reinvestment Act of 2009 (ARRA), aims to reduce barriers to electronic health record (EHR) adoption and meaningful use by creating incentives for providers to acquire and effectively use EHRs. Nevertheless, the recognition and acceptance of the need for an improved health information technology (health IT) infrastructure is not new among health services researchers and policymakers. In 2001, the *Crossing the Quality Chasm* report from the Institute of Medicine detailed the underlying reasons for existing gaps in quality and called for a fundamental transformation of the system that includes an expanded and improved health IT infrastructure, arguing that health IT plays a central role in improving safety, effectiveness, timeliness, efficiency, equity, and patient centeredness, all of which are goals of the HITECH initiative.[1]*

The health IT community agrees that HITECH funds will likely improve how providers practice medicine for Medicare and Medicaid beneficiaries and will ultimately advance patient-centered medical care for all Americans.[2] However, the challenges of effectively using and implementing EHRs in primary care practices might disrupt the patient-provider relationship and, in turn, negatively affect the patient's perception or satisfaction with the quality of care.[3] For example, the patient-provider communication might be disrupted if EHRs interfere with eye contact.[4–5] Stakeholders such as providers and federal agencies involved in the Medicare and Medicaid EHR Incentive Programs are continuing to assess the impact of transition issues faced by recent EHR adopters on the quality of care.

Few studies in the literature examine patient perceptions of EHR use, likely because of its low adoption. Although physicians are increasingly adopting EHRs, their use is still not widespread. In 2011, an estimated 33.9 percent of office-based physician practices had a basic EHR system, up from 24.9 percent in 2010.[6] The few existing studies indicate that patients typically have favorable sentiments toward EHRs and believe that EHRs improve visit quality, rapport, and communication between patients and providers.[7–11] Some evidence indicates that patients believe that EHRs improve care coordination,[12–13] but privacy of personal health information continues to be cited as a concern of both patients and providers.[14–21]

A 2009 literature review found only seven studies in the United States that examine patient satisfaction with care and perceptions of EHRs ascertained after an ambulatory visit; each of these studies was based on a single site, did not address confounding, and did not measure EHR use directly.[22] As of March 2012, we identified four new studies, with similar limitations.[23–26] Our analysis addresses the gap in the literature by offering a more generalizable study of patients' views of EHRs used during an ambulatory visit.

* Numbers in brackets refer to references listed at the end of the text.

II. METHODS

A. Research Questions

Concerns raised in the literature suggest a strong need to understand how patients' satisfaction varies by whether a practice uses EHRs, (2) how satisfaction and perceptions of EHRs vary by how recently practices adopted EHRs, and how practices use EHRs. Therefore, we developed a survey centered on the following research questions:

1. How does patient satisfaction with various aspects of care vary among EHR adopters and non-adopters? How does patient satisfaction vary among recent adopters (those who adopted within two years of the survey) and early adopters (those who adopted more than two years before the survey)?
2. How do adopters' patients perceive EHR use in the exam room? Does the way in which providers use EHRs affect patients' perceptions of (1) the quality of care received and (2) the effect of EHRs on quality of care?
3. How does patient perception of computer use vary among patients served by early and recent EHR adopters? Is there differential use of EHR functionalities among early and recent adopters? What factors are related to the agreement that computer use improved quality of care?

B. Data Collection Methods

Two instruments were designed for this study: (1) a telephone medical practice screener and (2) a patient questionnaire. The practice screener, administered to 37 participating primary care practices from October 2010 to April 2011, gathered information on practices' location, date of EHR adoption, and level of EHR use. From November 2010 to April 2011, 670 surveys were collected from patients served by 28 EHR adopter and 9 non-adopter practices. The self-administered paper-and-pencil patient survey was designed to take up to 15 minutes and was available in English and Spanish. The survey contained 48 questions about patients' demographics, health status, quality of and satisfaction with the care received, and perceptions of care coordination. The survey instrument received Office of Management and Budget approval before administration and is available on request. Although our instrument was not formally tested for reliability and validity, survey development was informed by surveys previously used with similar populations, several of which have established psychometric properties.[7,17,27–32] Many questions were drawn from the Consumer Assessment of Healthcare Providers and Systems (CAHPS) Adult Primary Care Questionnaire.[27]

A pretest of the survey instrument was conducted with nine patients from a primary care practice. After completing the questionnaire, patients participated in a 15- to 20-minute interview to assess the clarity of questions and their comprehension of key terms and to estimate respondent burden. Based on respondents' feedback, the wording of several questions was revised slightly to address inconsistencies in question interpretation.

The respondent universe includes patients who visited a primary care practice in Minnesota, New York, North Carolina, or Oregon. These states were selected using subjective criteria to represent the four U.S. census regions. The selection criteria were to (1) include one state from each of the four U.S. census regions (Midwest, Northeast, South, and West), (2) include practices from both urban and rural areas, and (3) ensure that the sample included a sufficient number of EHR

adopter practices. Three-stage sampling was used to select patients, with geographically based primary sampling units at the first stage covering urban and rural areas, practices at the second stage, and patients at the third stage. Practices were sampled using a database from SK&A Information Services, which maintains comprehensive databases of practices and physicians across the United States.

At each practice, a research assistant approached all patients in the waiting room after they had checked in for their appointments; obtained an oral informed consent from each patient; and screened to determine whether the patient was at least 18 years old and had been a patient at the practice for at least a year. Before the patient decided to participate, the research assistant provided a letter describing the purpose of the survey and a fact sheet of commonly asked questions and answers. The research assistant reiterated the voluntary nature of the survey and that individual responses would be kept confidential and offered to answer patients' questions. After the visit with the provider, the research assistant reapproached patients who agreed to participate, confirmed that the patient saw a provider that day, and provided a paper questionnaire. Incentives of \$100 were provided to practices for participation and \$10 to patients for completing the survey.

Of the 224 practices released into the sample, 37 (or 16.5 percent) agreed to participate. The 224 participant practices varied slightly from the pool of eligible practices: 19 percent of recruited practices, compared to 25 percent of eligible practices, were located in rural areas; 57 percent of recruited practices, compared to 54 percent of eligible practices, had only one physician; conversely, 16 percent of recruited practices, compared to 8 percent of eligible practices, had more than five physicians. In spite of these differences, the participants' characteristics met sampling goals: practices came from four states representing the four U.S. census regions and had the desired (high) proportion of EHR adopter practices; in addition, a large proportion were located in rural areas (Table A.1).

Among the 1,740 patients approached in 37 practices, 397 were screened out as ineligible, 310 were not screened, 363 were eligible refusals, and 670 completed the survey. Based on eligibility rates among those who completed the screener, an estimated 224 of the 310 patients not screened would have been eligible. This provided a marginal patient-level response rate of 53.3 percent within participating practices. This sample size provided 80 percent power to detect differences of 10 to 20 percent between outcomes for adopter and non-adopter practices, depending on the outcome measure. Because of somewhat low power, we used the 10 percent significance level to regard differences as statistically significant.

Although not generally representative of the nation as a whole, the surveyed patients were comparable to the population in the four states as well as to the nation as a whole. Surveyed patients were more likely to be older than the general population (as measured in the 2010 American Community Survey); however, that is expected because older people tend to visit doctors more. Further, a greater proportion were unemployed and had lower incomes. A smaller proportion of Hispanics were surveyed; however, the surveyed population was otherwise as racially diverse as the population in the four states and the nation as a whole (Table A.2). The response rate by gender is comparable to proportions of respondents to CAHPS adult surveys that have roughly 62 percent female and 38 percent male respondents.[33]

C. Data Analysis

Data were analyzed using Stata. Regression results are shown for the analyses of satisfaction with quality of care and attitudes toward computer use to obtain differences in outcomes net of

observable patient and practice characteristics (Tables 1 and 4). After regression analyses, we computed predicted means of binary outcome variables. Table A.4 provides frequencies of the outcomes measured in regression analyses (before they were collapsed into binary measures). Descriptive analyses are shown in Tables 2 and 3. Table 2 examines how the computer was used, measured in the patient survey, and sophistication of EHR use, measured in the practice screener. Table 3 examines the perceptions of the effect of computer use among adopters' patients. For the descriptive analyses, means and standard deviations and two-tailed t-tests of the difference between means were calculated.

Controlling for patient and especially practice characteristics was important because underlying differences in practices (or their patients) could have driven the differences in outcomes. The control variables in regression analyses differed depending on the outcome analyzed and are listed in the notes to each regression table. All regressions controlled for patient demographics and health characteristics, practice size and location, and visit duration.

III. RESULTS

A. Characteristics of Participating Practices

Patients were surveyed at 12 practices in Minnesota, 13 in New York, 6 in North Carolina, and 6 in Oregon. Three of 8 non-adopter practices and 4 of 28 adopter practices were located in rural areas. Compared with adopters, non-adopter practices were smaller in numbers of full-time providers, locations, and patients served per week. Five of 9 non-adopters planned to adopt EHRs within the next year. No rural practices were among the 10 recent adopters, whereas 4 of 18 early adopters were rural, a statistically significant difference.

B. Respondent Demographics

More women than men responded to the survey (64 versus 36 percent). Among respondents, 80 percent were white, 16 percent were African American, and 4 percent associated with another race. Among all racial categories, 6 percent identified as Hispanic.

Several statistically significant differences in demographics were noted between respondents served by EHR adopters and those served by non-adopters. Adopters' patients were statistically significantly older and more likely to be African American, highly educated, and unemployed, and more likely to have a greater number of chronic conditions and to pay more visits to the practice than patients served by non-adopters.

1. Satisfaction with Care: Adopters Versus Non-Adopters

Quality of care. All patients favorably rated the quality of care they received, with adopters' patients reporting higher quality of care than non-adopters' patients (Table 1). However, survey findings also suggested that non-adopters' patients received more attention from their providers than adopters' patients in terms of process measures of care. For example, a higher proportion of non-adopters' patients discussed with the provider their expectations for health in the future and worked with the provider to set goals (Table 1). The findings that these process measures of care were lower among the adopters' patients are worthy of further study. Both adopters' and non-adopters' patients were highly (and equally) comfortable with the confidentiality of their records.

Care coordination. Both adopters' and non-adopters' patients reported high levels of satisfaction with care coordination: only 12 percent were dissatisfied with communication between providers across practices. Adopters' patients were more likely than non-adopters' to report that specialists they visited had all the needed information (Table 1).

Table 1. Satisfaction with Quality of Care Among Patients of Adopters and Non-Adopters (Regression-Adjusted Means)*

Description	Definition of Outcome Measures (All Are Binary)	Sample Size	EHR Adopters (%)	EHR Non-Adopters (%)	p-Value
Rating of quality of care	Excellent=1; poor to very good=0	663	71.2	59.3	0.022
Overall satisfied with visit	Very satisfied=1; somewhat satisfied to very dissatisfied=0	662	92.6	90.8	0.508
Rating of provider's knowledge of patient's health problems	Excellent=1; poor to very good=0	664	67.5	62.6	0.213

Description	Definition of Outcome Measures (All Are Binary)	Sample Size	EHR Adopters (%)	EHR Non-Adopters (%)	p-Value
Satisfied with amount of time spent with provider	Very satisfied=1; somewhat satisfied to very dissatisfied=0	664	92.1	89.2	0.294
Confidence in confidentiality of patient's medical records	Very confident=1; somewhat confident to not at all confident=0	654	82.6	86.1	0.302
During the Past 12 Months					
Dissatisfied with communication between providers in same practice	Yes=1; No=0	431	12.1	12.4	0.893
Dissatisfied with communication between providers in different practices	Yes=1; No=0	480	6.6	14.0	0.048
Specialist had needed health information (if visited)	Yes=1; No=0	439	86.8	80.4	0.059
During visit					
Provider worked with patient to set goals for staying healthy	Yes=1; No=0	645	80.2	89.0	0.002
Provider gave materials on health topics	Yes=1; No=0	631	29.0	37.8	0.177
Provider explained expectations with patient's health in the future	Yes=1; No=0	646	76.4	86.7	0.014
Provider explained what to do if symptoms change	Yes=1; No=0	645	89.5	90.3	0.787
Number of Practices			28	9	
Number of Patients Surveyed			499	171	

*The regressions controlled for patient characteristics (age, gender, race/ethnicity, education, work status, income, number of chronic conditions), practice characteristics (number of full-time providers at practice, location of practice [state]), details about the visit (has seen a provider at this practice more or fewer than five times this year, patient has been with practice for more or fewer than five years, number of minutes spent with provider during the visit).

2. EHR Use: Sophistication and Patient Perceptions

Sophistication of EHR use. Survey analysis revealed that many recent adopters were still transitioning their paper records to EHRs (Table 2). Only three-fourths of recent adopters order prescriptions through EHRs (compared with nearly all early adopters). Most practices used basic EHR functions such as recording patient demographics, entering clinical notes, using diagnosis and medication lists, ordering prescriptions, and reviewing lab results. Three-fourths or fewer of all adopters used more sophisticated functions, such as reviewing imaging reports and radiology and other functions. Only “other functions” were used more frequently by the early adopters.

Table 2. Provider’s Computer Use Among Recent and Early Adopters of EHR (Unadjusted Means)

	Number of Responses	Early Adopters (%)	Recent Adopters (%)	Difference	p-value
Type of Computer/EHR Use (from Patient Survey)					
Provider used computer during visit	493	86.1	73.1	13.0	0.198
During visit, provider used computer to					
Enter notes	390	91.2	92.4	-1.1	0.809
Show information to patient	390	49.0	67.2	-18.2	0.022
Look up test results and other information	389	88.9	87.0	1.9	0.720
Provide printed health-related materials	386	40.5	52.0	-11.5	0.154
Provider focused on computer screen during visit	395				
All or most of the time		26.7	24.0	2.7	0.570
Some of the time		36.5	32.9	3.6	0.550
A little or none of the time		36.8	43.1	-6.2	0.478
During the past 12 months, patient communicated with provider by email to get a prescription	483	11.7	7.7	4.0	0.164
During the past 12 months, patient communicated with provider by email to get advice	481	9.0	6.5	2.5	0.309
Sophistication of EHR Use (from Practice Screener)					
Proportion of paper records transitioned to EHR	26				
Less than 1/4		8.6	62.3	-53.7	0.002
1/4 to 3/4		15.6	19.3	-3.8	0.801
More than 3/4		75.8	18.3	57.5	0.001
Practice is part of a health information exchange	22	50.2	44.7	5.5	0.838
Practice receives lab results electronically	16	87.4	81.9	5.4	0.780
Practice reviews imaging reports electronically	25	75.7	71.9	3.8	0.812
EHR Functions Used at the Practice					
Record patient demographics	27	93.4	100.0	-6.6	0.302
Clinical notes	27	96.0	100.0	-4.0	0.293
Patient problem or diagnosis list	27	100.0	100.0	0.0	n/a
Patient medication list	27	100.0	100.0	0.0	n/a
Order new or refill prescriptions	25	96.0	76.3	19.6	0.162

	Number of Responses	Early Adopters (%)	Recent Adopters (%)	Difference	p-value
Review electronic lab results	26	92.7	100.0	-7.3	0.162
Review imaging reports	25	75.7	71.9	3.8	0.812
View radiology or diagnostic test	26	71.8	84.1	-12.3	0.475
Use any other EHR function	23	80.6	38.4	42.2	0.050
Number of Patients Surveyed		320	179		
Number of Practices		18	10		

Perceptions of EHR use in the exam room. Patients generally had very positive perceptions of EHR use in the exam room. More than 93 percent of patients reported that the computer either had no effect (55 percent) or made it easier (39 percent) to talk to their provider (Table 3). More than two-thirds of survey respondents served by EHR adopters reported that computer use was very helpful overall (Table 3). Providers at EHR adopter practices spent less time with a patient: 10 percent of providers at EHR practices versus 16 percent at non-adopter practices spent more than 30 minutes with the patient. However, non-adopters also spent less time reviewing the chart: 27 percent versus 35 percent spent all or most of their time on the chart (raw means, not shown in tables). Nevertheless, regression-adjusted analysis suggests that EHRs do not negatively affect patients’ perceptions of the time they spent with their physicians, as 92.1 percent of adopters’ patients (and 89.2 percent of non-adopters’ patients) were very satisfied with the amount of time spent with the provider (Table 1).

Type of EHR use and patient perceptions of care. Somewhat surprisingly, the results did not suggest that how providers used their EHRs (such as using the computer to show the patient results) or the time they spent interacting with the screen was systematically related to the patients’ overall rating of the quality of care received and their opinion of whether the computer improved the quality of care (Table A.3).

3. Satisfaction with Care: Early Versus Recent Adopters

Quality of care. We examined the hypothesis that, because of transition issues, patients served by early EHR adopters might have higher levels of current satisfaction than patients of recent adopters. Survey results showed that transition issues did not affect patient satisfaction with care. Satisfaction with care was very high (more than 92 percent) among both recent and early adopters’ patients, and slightly higher among recent adopters (Table 4). Patients of both early and recent adopters were very comfortable with the confidentiality of their records. Recent adopters’ patients reported receiving more attention (such as explanations about expectations and discussions to set goals). Although recent adopters’ patients were more likely to disagree that the provider spent less time talking to them because of the computer (Table 3), a similar proportion of patients of recent adopters and early adopters (50 and 46 percent, respectively) thought that the quality of face-to-face communication was very positive because of computer use (Table 3).

Table 3. Perceptions of Effect of Computer Use Among Patients of EHR Adopters (Unadjusted Means)

	Sample Size	Adopters' Patients	Patients of Early Adopters (%)	Patients of Recent Adopters (%)	Difference	p-Value
General Perceptions of Effect of Computer Use During the Current Visit^a						
Computer use in exam room improved quality of care						
Strongly agree	386	28.0	28.5	26.9	1.5	0.749
Agree		46.0	46.6	44.8	1.8	0.704
Neither agree nor disagree		17.0	17.3	16.2	1.1	0.839
Disagree or strongly disagree		8.9	7.6	12.1	-4.4	0.144
Computer use was helpful to patient overall						
Very helpful	393	69.7	68.1	67.5	0.6	0.888
Somewhat helpful		23.4	23.9	22.3	1.6	0.715
Indifferent		7.1	6.4	8.9	-2.5	0.417
Somewhat to very unhelpful		1.5	1.6	1.4	0.2	0.826
Communication and satisfaction with care during the current visit						
Because of computer use:						
Provider spent less time talking with patient						
Strongly agree or agree	388	7.1	7.6	5.9	1.7	0.589
Indifferent		13.5	15.3	9.3	6.0	0.111
Disagree		44.4	43.3	47.1	-3.8	0.478
Strongly disagree		35.0	33.9	37.7	-3.9	0.439
It was harder to talk to provider						
Somewhat or much harder	392	6.8	7.3	5.7	1.6	0.578
Neither harder nor easier		54.5	53.0	58.2	-5.2	0.355
Somewhat or much easier		38.7	39.8	36.1	3.7	0.513
Quality of face-to-face communication						
Very positive	390	47.2	46.1	49.7	-3.7	0.548
Somewhat positive		12.5	12.0	13.6	-1.6	0.758
No effect		38.0	39.6	34.3	5.3	0.449

	Sample Size	Adopters' Patients	Patients of Early Adopters (%)	Patients of Recent Adopters (%)	Difference	p-Value
Somewhat or very negative		2.4	2.4	2.4	0.0	0.973
Provider was more aware of medical history	390					
Strongly agree		37.4	37.3	37.5	-0.2	0.973
Agree		44.8	47.5	38.3	9.2	0.082
Indifferent		8.1	7.7	9.0	-1.3	0.571
Disagree or strongly disagree		9.8	7.5	15.2	-7.7	0.058
Number of patients surveyed		499	320	179		
Number of practices		28	18	10		

^a Current visit refers to the visit to provider at the time of the survey. Patients responded to the survey after their visit with the provider.

Care coordination. Although a large majority of both recent and early adopters' patients were satisfied with communication between providers across practices, recent adopters' patients reported higher levels of satisfaction (Table 4).

Table 4. Satisfaction with Quality of Care Among Patients of Early and Recent EHR Adopters (Regression-Adjusted Means)*

Description	Definition of Outcome Measures (All Are Binary)	Sample Size	Early EHR Adopters (%)	Recent EHR Adopters (%)	p-value
Satisfaction with Care					
Rating of quality of care	Excellent=1; poor to very good=0	494	70.4	78.0	0.172
Overall satisfaction with visit	Very satisfied=1; somewhat satisfied to very dissatisfied=0	494	92.6	96.5	0.047
Rating of provider's knowledge of patient's health problems	Excellent=1; poor to very good=0	495	66.1	73.0	0.212
Satisfied with amount of time spent with provider	Very satisfied=1; somewhat satisfied to very dissatisfied=0	495	92.9	95.0	0.307
Confidence in confidentiality of patient's medical records	Very confident=1; somewhat confident to not at all confident=0	488	77.1	86.8	0.037
Dissatisfied with communication between providers in same practice	Yes=1; No=0	324	13.4	9.4	0.240

Description	Definition of Outcome Measures (All Are Binary)	Sample Size	Early EHR Adopters (%)	Recent EHR Adopters (%)	p-value
Satisfied with communication between providers in different practices	Yes=1; No=0	319	8.1	11.4	0.274
Specialist had needed health information (if visited)	Yes=1; No=0	331	95.3	97.1	0.215
During visit					
Provider worked with patient to set goals for staying healthy	Yes=1; No=0	485	79.2	82.0	0.503
Provider gave materials on health topics	Yes=1; No=0	473	29.5	38.2	0.121
Provider explained expectations with patient's health in the future	Yes=1; No=0	484	73.7	82.4	0.069
Provider explained what to do if symptoms change	Yes=1; No=0	485	87.9	93.4	0.003
Satisfaction with Care and Computer Use					
Computer use in exam room improved quality of care	Strongly agree or agree=1; indifferent to strongly disagree=0	386	73.0	77.2	0.446
Computer use was helpful to patient	Very or somewhat helpful=1; indifferent to very unhelpful=0	393	93.5	96.4	0.288
Because of computer use					
Provider spent less time talking with patient	Disagree or strongly disagree=1; indifferent to strongly agree=0	388	79.2	88.4	0.074
Provider was more aware of medical history	Strongly agree=1; agree to strongly disagree=0	499	63.0	65.6	0.728
Number of Patients Surveyed			320	179	
Number of Practices			18	10	

*The regressions controlled for patient characteristics (age, gender, race/ethnicity, education, work status, income, number of chronic conditions), practice characteristics (number of full-time providers at practice, location of practice [state], practice is part of a health information exchange network), details about the visit (patient has seen a provider at this practice more or fewer than five times this year, patient has been with practice for more or fewer than five years, number of minutes spent with provider during the visit).

C. Focus Groups

We conducted three focus groups with 21 patients who did not wish to participate in the patient survey.[34] Lessons from the focus groups echoed survey findings. Participants viewed the ability of EHRs to enhance the coordination of care as a major benefit and attributed it to improved

information sharing. Participants reported that EHRs improved patient-provider communication and shortened visit duration. Many patients reported that quality of care improved because of efficiencies that EHRs introduce. However, they stressed that the quality of a health care visit is ultimately in the provider's hands.

D. Discussion

Patients generally had favorable perceptions of EHRs, and most believed that EHRs improved the quality of care. Patients of EHR adopters generally rated the quality of care they received more highly than did patients of non-adopters. However, survey findings also suggested that non-adopters' patients received more attention from their providers than adopters' patients in terms of process measures of care—such as whether their provider worked with them to set goals for staying healthy. Further study might explore why EHR adopters did not fare well according to these process measures, as this was the only area in which EHR adopters fared worse than non-adopters.

Transition issues did not affect patient satisfaction with care. Although patients of both very recent adopters (those who adopted within a year of the survey) and early adopters reported that quality of care either stayed the same or improved over the past year, patients of very recent adopters were more likely to report that it improved. It is difficult to speculate why care might have improved over the past year more in practices of very recent adopters. Perhaps the adopters had overcome transition issues; however, the small sample size of practices and the cross-sectional design do not make it possible to identify other changes that might have occurred at these practices.

Our findings have encouraging implications for providers who are hesitant to adopt EHRs as well as for the Office of the National Coordinator for Health Information Technology and its policies to incentivize EHR adoption. First, the vast majority of patients are not concerned about confidentiality of EHR records, a common concern cited in the literature. Therefore, practices should not necessarily be wary of adopting EHRs and policymakers can divert attention to issues of greater concern to patients. Second, fewer than 2 percent of patients thought that the computer had a negative effect on the quality of face-to-face communication. Third, the vast majority of patients believed that the computer improved quality of care. Finally, patient satisfaction is high even among practices that adopted EHRs within a year of the survey. An interesting finding was that adopter practices reported a somewhat limited use of sophisticated functions (such as viewing radiology reports), seen in the literature as a barrier to reaping full benefits from EHRs.[35–36] Because nonuse of sophisticated functions might result from interoperability issues, this finding confirms the necessity of including interoperability as a meaningful use requirement in the Medicare and Medicaid EHR Incentive Programs.

Most important, this study provides some evidence that providers' concerns about patients' negative perceptions and feedback are not warranted and that EHRs are not likely to detrimentally affect the patient-provider relationship. Further, EHR adopters' patients perceive improvements in some aspects of the coordination and quality of care resulting from EHR use.

E. Limitations

The limitations of this study include: cross-sectional design, low practice participation rate, lack of national representation, and small sample size of practices. First, because of the cross-sectional design, differences in outcomes might be the result of underlying differences between practices. This limitation was addressed by controlling for all available practice and patient characteristics, although there could be unobserved differences for which we could not control. Second, because of the low

participation rate of practices, the practices that agreed to participate might have been more successful at implementing EHRs. We addressed this concern in a sensitivity analysis of practices that were eager or reluctant to participate and found no systematic differences in main satisfaction outcomes between the two groups. (Eager practices were those that agreed to participate soon after the initial contact; reluctant ones agreed long after the initial contact.) Third, although the study is not nationally representative and the results can be generalized only to the eight primary sampling units, the recruited practices span four states and include both rural and urban areas, making this study more generalizable than existing studies of patients' perceptions of EHRs used in physician practices. Fourth, the sample size is small, which prevents us from detecting with statistical significance small differences in outcomes. Fifth, although questionnaire creation was informed using surveys with established psychometric properties, our survey was not tested for reliability and validity. However, we did conduct a pretest and adjusted the wording based on feedback from the pretest.

F. Implications for Future Policy

Because this study is not nationally representative and was conducted within a few months of the start of the EHR Incentive Programs, it is important to closely monitor the unintended consequences of these programs as providers increasingly use EHRs, so that policies can be developed to predict, avert, and mitigate patients' criticism or providers' rejection of EHR adoption. One way to address the unintended consequences is to develop a monitoring system that includes regular patient and provider satisfaction surveys. If perceptions of EHRs are negative, outreach and information campaigns about the EHR benefits would have to be conducted targeting the population that needs them most. Lessons from the monitoring activities could be used to further develop meaningful use requirements and inform other policymaking.

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APPENDIX A

Table A.1. Comparison of Participating and Sampled Practices (Means)

	Participating Practices (%)	Practices Eligible to Participate (%)
Practice located in		
Minnesota	32.4	23.7
New York	16.2	25.5
North Carolina	35.1	26.3
Oregon	16.2	24.6
Practice located in a rural area	18.9	25.0
Practice uses EHR software		
Yes	73.0	67.0
No	24.3	26.3
Unknown	2.7 ^b	6.7
Number of providers		
1	56.8	54.0
2 to 5	27.0	38.4
More than 5	16.2	7.6
Number of patients seen per day		
10 to 40	54.1	56.3
More than 40	40.5	33.9
Missing	5.4	9.8
Type of practice		
Family practice	62.2	53.1
General practice	2.7	0.5
Internal medicine	24.3	33.0
Multi-specialty with primary care providers	10.8	13.4
Number of practices	37	224

^a This practice later became an EHR adopter.

Table A.2. Comparison of the 670 Surveyed Patients to the U.S. Population Using 2010 American Community Survey Data (Means)

	All Survey Respondents (%)	ACS Data (Minnesota, New York, North Carolina, and Oregon) (%)	National ACS Data** (%)
Age^a			
18 to 44	34.7	41.0	41.1
45 to 64	36.7	44.4	44.5
65 or older	28.6	14.6	14.4
Gender^a			
Male	38.5	48.8	49.2
Female	61.5	51.2	50.8
Race/Ethnicity^b			
African American	10.9	14.1	12.5
Asian	4.6	5.1	4.7
Hispanic	7.5	12.4	15.7
Native American, Hawaiian or Pacific Islander, or multiple race	3.9	3.0	3.4
White	71.5	71.9	74.0
Some other race	n/a	5.8	5.5
Education^c			
High school diploma or less	41.4	41.4	43.1
Some college	32.4	28.2	28.9
Bachelor's degree or higher	25.4	30.4	28.0
Employment Status^d			
Employed	49.5	59.4	59.1
Unemployed	17.2	5.7	5.8
Not in labor force	33.3	34.9	35.1
Total Household Income^e			
Less than \$50,000	59.4	44.1	48.1
\$50,000 to \$100,000	26.4	28.2	30.9
More than \$100,000	14.2	27.7	10.9

Sources: Weighted survey data and the 2010 American Community Survey from the U.S. Census (<http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml>).

^aACS data include people age 20 and over; survey includes people age 18 and over.

^bACS data include people of all ages; survey includes people age 18 and over.

^cACS data include people age 25 and older; survey includes people age 18 and over.

^dACS data include people age 16 and older, excluding members of the Armed Forces. Survey includes people age 18 and over.

^eACS data include households of people above and below age 18; survey includes households of people age 18 and over.

Table A.3. Perceptions of Computer Use and Rating of Quality of Care by Patients of EHR Adopters (Regression-Adjusted Means)

	Regression 1*: patient rated quality of care as excellent**		Regression 2: patient strongly agreed that computer use in exam room improved quality of care***	
	%	p-value	%	p-value
During visit, provider used computer to show information to patient				
Yes	82.7	0.498	26.0	0.297
No	85.2		21.6	
Sample size	386		380	
During visit, provider used computer to provide printed health-related materials				
Yes	81.0	0.279	28.0	0.228
No	86.6		20.3	
Sample size	382		376	
During past 12 months, communicated with provider by email to get a prescription				
Yes	72.6	0.404	26.4	0.827
No	76.8		24.4	
Sample size	479		378	
During past 12 months, communicated with provider by email to get advice				
Yes	59.2	0.012	16.7	0.240
No	78.2		25.2	
Sample size	477		376	
During visit, provider explained what he or she was doing on computer while doing it				
Yes	84.8	0.617	27.4	0.075
No	82.8		20.9	
Sample size	380		375	
Provider focused on computer screen during visit				
All or most of the time	77.5	0.153	28.3	0.173
Some of the time	80.6		23.3	
Sample size	391		386	

Notes: Both regressions controlled for: patient characteristics (age, gender, race/ethnicity, education, work status, income, number of chronic conditions), practice characteristics (number of full-time providers at practice, location of practice [state], practice is part of a health information exchange network, number of years using an EHR), details about the visit (patient has seen a provider at this practice more or fewer than five times this year, patient has been with practice for more or fewer than five years, number of minutes spent with provider during the visit).

* Additional control in regression 1 included: patient characteristic: patient’s rating of his or her knowledge about his or her health.

**Patient’s rating of quality of care received is based on the question, “How would you rate the quality of care you received in today’s visit overall?” We collapsed the rating score into a binary indicator, comparing excellent with very good, good, fair, and poor, because the distribution of responses was skewed toward an excellent rating of quality of care received.

*** Patient’s agreement that computer improved quality of care is based on the question, “The use of the computer in the exam room improved the quality of care I received from my health care provider: strongly disagree, disagree, neither agree nor disagree, agree, strongly agree.” We collapsed the agreement score into a binary indicator, comparing strongly agree with the other four categories, because the distribution of responses was skewed toward an agreement of improved quality of care.

Table A.4. Patient Satisfaction Among EHR Adopters, Non-Adopters, Early Adopters, and Recent Adopters (Unadjusted Means)

	EHR Adopters’ Patients (%)	Patients of Non-Adopters (%)	Difference	p-Value	Patients of Early Adopters (%)	Patients of Recent Adopters (%)	Difference	p-Value
During the Current Visit^a								
Patient’s rating of quality of care received								
Excellent	69.4	55.4	14.0	0.047	69.4	69.4	0.0	0.998
Very good	21.0	31.4	-10.4	0.030	21.4	20.2	1.2	0.764
Good, fair, or poor	9.6	13.2	-3.6	0.284	9.2	10.4	-1.2	0.715
Patient’s overall satisfaction with visit								
Very satisfied	88.6	84.6	4.0	0.324	88.0	89.9	-1.9	0.493
Somewhat satisfied	9.7	11.7	-2.0	0.543	10.4	8.4	1.9	0.457
Somewhat or very dissatisfied	1.7	3.6	-1.9	0.123	1.7	1.7	0.0	0.986
During visit, provider:								
Worked with patient to set goals for staying healthy	76.2	86.7	-10.5	0.002	73.8	81.0	-7.2	0.178
Provided materials on health topics	31.5	39.2	-7.6	0.248	29.6	35.5	-5.9	0.211
Explained what to expect with patient’s health or illness in the future	74.7	84.4	-9.8	0.034	72.6	78.9	-6.3	0.098
Explained what to do if problems or symptoms continue, get worse, or come back	82.7	85.8	-3.1	0.448	80.7	86.8	-6.1	0.064
Patient’s rating of health care provider’s knowledge of patient’s health care problems								
Excellent	65.6	59.2	6.4	0.402	66.0	64.6	1.4	0.811
Very good	24.9	31.0	-6.2	0.461	22.8	29.1	-6.2	0.201

	EHR Adopters' Patients (%)	Patients of Non-Adopters (%)	Difference	p-Value	Patients of Early Adopters (%)	Patients of Recent Adopters (%)	Difference	p-Value
Good, fair, or poor	9.6	9.8	-0.2	0.935	11.1	6.3	4.8	0.064
Satisfaction with the amount of time spent with provider								
Very satisfied	88.8	81.2	7.6	0.299	89.1	88.2	0.9	0.774
Somewhat satisfied, somewhat dissatisfied, or very dissatisfied	11.2	18.8	-7.6	0.299	10.9	11.8	-0.9	0.774
Confidence that patient's medical records remain confidential								
Very confident	80.6	80.8	-0.1	0.976	79.6	82.7	-3.1	0.481
Somewhat confident	17.5	14.9	2.6	0.435	18.0	16.4	1.6	0.701
Not too confident	1.9	4.3	-2.5	0.150	2.4	0.8	1.5	0.202
During the Past 12 Months								
Dissatisfied with communication between providers in same practice	20.2	25.5	-5.3	0.536	21.4	17.9	3.5	0.488
Dissatisfied with communication between providers in this and other practices	14.0	22.0	-8.0	0.267	13.9	14.2	-0.3	0.952
If visited specialist, specialist had needed health information ^b	85.1	74.4	10.7	0.019	83.4	88.5	-5.1	0.166
Number of Patients Surveyed	499	171			320	179		
Number of Practices	28	9			18	10		

Notes:

^a Current visit refers to the visit to provider at the time of the survey. Patients responded to the survey after their visit with the provider.

^b This survey question was asked with a positive connotation, whereas the previous three were asked with a negative connotation. This was done with an intention of getting responses from the patients that are unbiased by the undertone of the question itself.

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