Trends in Primary Care Clinician Perceptions of a New Electronic Health Record

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BACKGROUND: Clinician perceptions of a newly implemented electronic health record play an important role in its success or failure.

OBJECTIVE: To measure changes in primary care clinician attitudes toward an electronic health record during the first year following implementation.

DESIGN: Longitudinal survey.

PARTICIPANTS: 86 primary care clinicians surveyed between December 2006 and January 2008.

MEASUREMENTS: Perceived impact on overall quality of care, patient safety, communication, and efficiency at 1, 3, 6, and 12 months following implementation.

RESULTS: Response rates for months 1, 3, 6, and 12 were 92%, 95%, 90%, and 82%, respectively. The proportion of clinicians agreeing that the EHR improved the overall quality of care (63% to 86%; p<0.001), reduced medication-related errors (72% to 81%; p=0.03), improved follow-up of test results (62% to 87%; p< 0.001), and improved communication among clinicians (72% to 93%; p<0.001) increased from month 1 to month 12. During the same time period, a decreasing proportion of clinicians agreed that the EHR reduced the quality of patient interactions (49% to 33%; p= 0.001), resulted in longer patient visits (68% to 51%; p= 0.001), and increased time spent on medical documentation (78% to 68%; p=0.006). Significant improvements in perceptions related to test result follow-up were first detected at 6 months, while those related to overall quality, efficiency, and communication were first identified at 12 months.

CONCLUSIONS: Primary care clinicians report increasingly positive perceptions of a new electronic health record within 1 year of implementation across a spectrum of domains of care.

KEY WORDS: quality improvement; electronic medical record; electronic health record; health information technology.

Improving health-care delivery in the ambulatory environment is a national priority. Effective medical care is often not delivered in the primary care setting,[1] while threats to patient safety in the form of adverse drug events and failure to follow up on abnormal test results persist.[2–4] These challenges exist in an environment where primary care physicians struggle with high workloads and an inability to deliver on an increasing number of clinical recommendations,[5] while patients continue to report suboptimal experiences of care.[6]

Improving primary care in the face of these substantial challenges will require a true paradigm shift.[7] Health information technology, and specifically electronic health records, are often cited as a crucial component of such change.[8] Electronic health records offer the potential to provide clinical decision support and increased access to information that can ultimately result in safer, more effective and efficient care.[9,10]

Despite their promise, the adoption of electronic health records remains sluggish, with only one-quarter of ambulatory practices in the US reporting their routine use.[11] Barriers to widespread electronic health record adoption include substantial costs,[8,12–14] as well as the need to significantly redesign workflows, provide extensive training and education, and a potential loss of clinical efficiency.[12,15,16] Clinician perceptions of these issues, as well as the perceived impact the electronic health record has on patient care, are important determinants of the success of a new implementation,[17–19] with some high-profile examples of failed implementation as a result of clinician dissatisfaction with the system.[20] Therefore, health system leaders and other key stakeholders would benefit from an increased understanding of how clinicians respond to a new electronic health record and how their perceptions change over time.

Despite the important role of clinicians, there are limited longitudinal data regarding the perceptions of clinicians experiencing a new implementation. The goals of our study were (1) to measure initial clinician perceptions of the impact of a new electronic health record on quality, safety, communication, and efficiency and (2) to analyze longitudinal changes in these perceptions during the first year following implementation.

METHODS

Study Setting

This survey was conducted at Atrius Health, an integrated multispecialty group practice with approximately 250 primary care physicians caring for 500,000 patients across 19 ambulatory health centers throughout eastern Massachusetts. Three of these health centers joined the organization in 2006 and transitioned from paper record systems to the same fully functional electronic health record (Epic systems, http://www.epicsys.com) in use at the other health centers in the network.

The electronic health record was implemented at the three health centers between June and November 2006. The implementation at each individual health center occurred in sequential planned stages over a 3-month period, including initial population of the electronic problem and allergy lists; followed by availability of electronic results viewing; electronic order entry for medications, laboratory tests, and referrals; and finally creation of electronic progress notes. Prior to the implementation of each stage of the process, clinicians and office support staff underwent training focused on the upcoming new electronic health record functionalities. This training was classroom-based and led by instructors who emphasized best practices and workflows. The fully implemented system is virtually paperless, supporting electronic entry of clinical notes, diagnostic codes, procedure codes, and laboratory results, as well as computerized ordering of all medications, laboratory tests, procedures, and referrals. Clinical notes can be generated either via free text typing, dictation, or the use of standard templates for common scenarios, such as annual physical exams or upper respiratory infections. Clinical decision support in the form of electronic reminders is also used for preventive services and chronic disease management.

Clinicians eligible for inclusion in our study were defined as those primary care clinicians practicing at one of the three health centers at the time of initial implementation of the electronic health record. We surveyed all 86 eligible primary care clinicians, including 73 physicians, 10 nurse practitioners, and 3 physician assistants. The health centers ranged in size from 22 to 36 primary care clinicians. The study was approved by the human studies committees at Partners Healthcare System and Harvard Vanguard Medical Associates/Atrius Health.

Survey Implementation

The survey instrument was based on two prior physician surveys that assessed perceptions of the impact of electronic health records on health-care quality.[21,22] Survey items were selected to assess dimensions of health-care quality defined by the Institute of Medicine where prior evidence suggests that electronic health records may play an important role, including patient safety,[23,24] patient-centered care,[25,26] and efficiency,[27] as well as a summary measure of overall quality of care.

We surveyed all eligible clinicians at 1 month (baseline survey), 3 months, 6 months, and 12 months following the completion of all stages of the electronic health record implementation at his or her health center. We chose a 12-month time frame to ensure that stable estimates in longitudinal trends could be identified for each of our survey metrics. The surveys were administered in a three-stage process that involved an initial paper mailing, followed by a reminder e-mail, and a final paper mailing. All eligible clinicians maintaining a clinical practice at one of the three target health centers were surveyed in each survey round, regardless of response to other survey rounds. Two clinicians were excluded from later survey rounds as they were no longer maintaining a clinical practice at their respective health centers.

During the baseline survey, we collected clinician sex, year of graduation from professional school, number of half-day clinical sessions per week, average number of patients per clinic session, and a rating of their training experience and their attitude toward the implementation of the electronic record on a 5-point Likert scale from "very positive" to "very negative." The ratings of the training experience and implementation process were used in descriptive statistics only.

The survey instrument employed eight individual items to explore the perceived impact of the electronic health record on four domains of health-care quality: (1) overall quality of care, (2) patient safety, (3) communication, and (4) efficiency. We assessed patient safety by evaluating agreement with the statements that the electronic health record "Reduces medication-related errors" and "Improves follow-up of test results." We assessed communication by evaluating agreement with the statements that the electronic health record "Improves communication among clinicians" and "Decreases the quality of the patient-physician interaction during an office visit." We assessed efficiency by evaluating agreement with the statements that, compared to before the implementation of the electronic record, "Patient visits take longer" and "I currently spend more time on medical documentation outside of clinical sessions," and that the electronic record "Improves access to clinical information". The responses for each question were recorded on a 5-point Likert scale ranging from "strongly agree" to "strongly disagree."

Data Analysis

We classified responses of "strongly agree" and "agree" as indicating clinician support of the electronic health record's impact on that domain and calculated frequencies during each survey round. We analyzed changes in clinician responses from month 1 to month 12 by fitting multivariable logistic regression models with generalized estimating equations to account for repeated measures among clinicians. For the primary analysis, statistically significant trends were identified by incorporating a linear time variable representing the number of months since implementation of the electronic health record. The number of years since graduation from medical school was included as a covariate to adjust for potential differences in experience using electronic health records during medical training, while measures of clinical volume were included as covariates to account for potential differences in learning curves among clinicians. Finally, we included a health center identifier in the multivariable models to account for differences between health centers in local workflow processes or the availability of technical support.

Each model was tested for goodness of fit using aggregates of residuals[29] implemented via the ASSESS statement in the SAS statistical package, with a p-value computed based on 10,000 simulated paths. All models adequately fit the raw data, with a goodness-of-fit p-value >0.05 for all outcomes. To evaluate for non-responder bias, we repeated these analyses

among the subset of 56 clinicians who responded to all four survey rounds.

We performed a secondary analysis to determine whether the length of time to identify a significant change in clinician perceptions varied across the four domains of health-care quality. We compared the proportions of clinicians agreeing with each survey item in the first round and each subsequent round by fitting multivariable logistic regression models with separate time indicators for each survey round. This approach allowed our model to treat each survey round as a separate predictor and to perform statistical tests between rounds. To account for performing three comparisons within each survey item (baseline month compared to months 3, 6, and 12), we used a Bonferonni correction to define a significance threshold of $\alpha=0.0167$. All analyses were performed using SAS version 9.1 (SAS Institute, Inc., Cary, NC).

RESULTS

The response rates at months 1, 3, 6, and 12 were 92% (79/86), 95% (81/85), 90% (76/84), and 82% (69/84). The majority of clinicians (62%) were female and had graduated from medical school or the equivalent for nurse practitioners and physician assistants a median of 19 years prior (Table 1). Most clinicians practiced full time, with a median number of half-day clinical sessions of 8.0. During the baseline survey, 86% of clinicians reported their training experience to be either "very positive" or "somewhat positive," while 78% reported a "very positive" or "somewhat positive" attitude towards the overall implementation process.

The proportion of clinicians agreeing that the electronic health record improved quality of care increased from 63% at month 1 to 86% at month 12 (p<0.001, Table 2). Clinicians increasingly agreed that the electronic health record reduced medication-related errors (72% to 81%, p=0.03) and improved follow-up of test results (62% to 87%, p<0.001) during the 12 months following implementation. In the communication domain, an increasing proportion of respondents agreed that communication among clinicians improved (72% to 93%, p<0.001), and a decreasing proportion reported a worsening in the quality of patient-physician interactions (49% to 33%, p=0.001). Significant downward trends were also identified in the proportion of clinicians agreeing that the electronic health record resulted in longer patient visits (68% to 51%, p=0.001)

Table 1. Primary Care Clinician Demographics and Practice Characteristics

Characteristic	Frequency (%) or median (IQR*) (n=86)
Health center	
1	36 (42)
2	28 (33)
3	22 (26)
Female	53 (62)
Years since graduation	19.0 (11.0–26.0)
Number of weekly clinical sessions†	8.0 (6.0–8.0)
Number of patients per clinical session†	12.0 (10.0–13.0)

*IQR denotes interquartile range
†Clinical session defined as a ½-day session

Table 2. Changes in Primary Care Clinician Perceptions of the Electronic Health Record

Proportion agreeing, n (%)	Months since implementation				
	1 (n=79)	3 (n=81)	6 (n=76)	12 (n=69)	Trend p value*
Overall quality					
Improves overall quality of care	50 (63)	55 (68)	56 (74)	59 (86)†	<0.001
Patient safety					
Reduces medication-related errors	57 (72)	57 (70)	59 (78)	56 (81)	0.03
Improves follow-up of test results	49 (62)	46 (57)	61 (80)†	60 (87)†	<0.001
Communication					
Improves communication among clinicians	57 (72)	61 (75)	61 (80)	64 (93)†	<0.001
Decreases quality of patient interactions	39 (49)	39 (48)	34 (45)	23 (33)†	0.001
Efficiency					
Improves access to clinical information	73 (92)	77 (95)	71 (93)	64 (93)	0.68
Patient visits take longer	54 (68)	55 (68)	44 (58)	35 (51)†	0.001
Spend more time on medical documentation outside of clinical sessions	62 (78)	66 (81)	58 (76)	47 (68)	0.006

*Indicates statistically significant trend in proportion after adjusting for clinician characteristics
†p<0.0167 for comparison to proportion at baseline (1 month). This threshold represents a Bonferroni correction for multiple testing

and increased time spent on medical documentation outside of clinical sessions (78% to 68%, p=0.006). At baseline, the vast majority of clinicians (92%) felt that the electronic record improved access to clinical information, and this proportion did not change significantly from month 1 to month 12. These results were consistent among the subset of 56 clinicians who responded to all four survey rounds (data not shown).

The change in proportion of clinicians agreeing that the electronic health record improved follow-up of test results achieved statistical significance at 6 months following implementation. For several other items related to overall quality, communication, and efficiency, significant changes were not identified until 12 months following implementation (Table 2).

COMMENT

We surveyed community-based primary care physicians transitioning from a paper record system to a commercially available electronic health record over a 12-month period and noted increased support for the system across a spectrum of health-care quality domains. Within 1 year of the implementation of the record, a vast majority of clinicians felt that it improved overall quality, patient safety, communication among clinicians, and access to clinical information. We also noted that improvements related to the availability of clinical information and test result follow-up were perceived by clinicians

sooner than other measures of efficiency, quality, and communication. Our findings provide an important rationale for persevering through the initial difficulties of implementation related to clinician perceptions.

Increased access to clinical information represented the only measure where improvements in clinician perceptions were not noted. However, virtually all clinicians (92%) reported immediate improvement in this measure at study baseline, which has important implications for clinical efficiency, where lack of access to information often results in redundant test ordering and the resultant substantial cost implications.[30] This very early benefit might be used as a lever to hasten the conversion of clinicians resistant to accepting the electronic health record in the early phases of the implementation.

The implementation was not free of challenges. Many clinicians felt that the electronic health record had an initial negative effect on their patient interactions and resulted in worsening efficiencies related to medical documentation and length of patient visits. Fortunately, there were improvements in clinician perceptions of all three of these metrics within the first year following implementation. However, roughly two thirds of clinicians still reported that more time was being spent on medical documentation outside of their clinical sessions at 12 months, a situation that will likely worsen the growing problem of increased time spent providing care outside of office visits.[31] Solutions are needed to address problems in workflow efficiency, potentially through the use of customizable note templates, speech recognition software for dictation, and more user-friendly management of problem lists, medication lists, and test results.

Our study findings expand on the literature of electronic health record adoption by providing a longitudinal assessment of clinician perceptions. Prior surveys have relied on cross-sectional data to provide a snapshot of clinician perceptions, often combining the views of clinicians with varied lengths of exposure to an electronic health record or focusing only on either the initial implementation period or long-term follow-up.[32–39] Interestingly, some cross-sectional studies of physicians have shown more positive perceptions of the impact of electronic health records among those who have already implemented such systems compared to those who have not.[22,40] However, it is not clear whether these more positive perceptions were in fact the initial impetus for adopting the electronic health record or if they were a result of a positive experience with the new record system. By quantifying the time required for changes in clinicians' perceptions of the electronic health record, our results provide a benchmark for electronic health record adoption patterns. Additional longitudinal data from other implementations would help determine which design, training, and support interventions lead to improvements in the adoption rates of new systems.

Our study is strengthened by its longitudinal design and high survey response rate. In addition, we evaluated the implementation of a common commercially available electronic health record within a community setting, which builds on prior work in this field that has largely focused on internally developed systems within academic hospitals.[9] However, our findings should be considered in the context of some limitations. Our study sample consisted of primary care clinicians practicing within a single health network that devoted significant resources to the implementation process, and our results may not extend to other settings with different core infra-structures or those implementing different electronic health record systems. In particular, the health centers in this study were relatively large, and there are legitimate concerns regarding the feasibility of implementing such electronic systems in smaller physician practices.[16] Implementations in settings that are unable to employ such a resource intensive training model may not achieve the same results.

In addition, the adoption of the electronic health record within our study clinics occurred in the context of a merger with a larger umbrella organization that had been using the commercial electronic health record for several years. The experience of the umbrella organization with the electronic health record may have facilitated a smoother transition for the new practices joining the network. The recent merger may also have created more positive clinician responses towards the electronic health record. However, the initial level of support for the new electronic health record in our clinician sample closely mirrors findings from a recent study of all ambulatory practices in Massachusetts, arguing against such a bias. In this prior study, 80% of physicians not currently using an electronic health record reported that computers have the potential to positively impact the quality of health care and 84% reported that computers can positively impact the problem of medication errors.[22]

Another potential limitation of our study is that we only surveyed clinicians for 1 year following the implementation, and there may be continued changes beyond this time frame. However, our results indicated consistent trends across all survey items, and it is unlikely that a longer study period would identify contrasting results. We measured clinician acceptance of the electronic health record using a confidential survey rather than alternative methods, such as direct observation or qualitative interviews.[28] We also did not collect actual clinical outcomes or measures of efficiency to validate the perceptions of the clinicians. While these alternative methods provide valid information regarding physician acceptance, clinician self report provides important insights into the perceived limitations or benefits of an electronic health record, which will play a strong role in the eventual long-term uptake of such technology. Finally, it is possible that the longitudinal changes in clinician perceptions we identified were influenced not only by their personal experience with the new electronic record, but also by the increased national focus on the need for electronic health records to improve quality of care.

In conclusion, we found that while clinicians may perceive some initial problems with a new electronic health record, they become significantly more receptive to it within 1 year of implementation. There is some variation in how quickly improvements are perceived, with those related to increased access to information and test result follow-up coming sooner than measures of overall quality, communication, and efficiency. These findings should provide support for clinicians and health system leaders as they seek to implement this new technology with the goal of improving health-care delivery in the ambulatory setting.

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