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Do provider attitudes about electronic health records predict future electronic health record use?

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Abstract

Introduction—Prior research has shown that provider positive attitudes about EHRs are associated with their successful adoption. There is no evidence on whether comfort with technology and more positive attitudes about EHRs affect use of EHR functions once they are adopted.

Methods—We used data from a survey of providers in the Primary Care Information Project, a bureau of the New York City Department of Health and Mental Hygiene and measures of use from their EHRs. The main predictor variables were scores on three indices: comfort with computers, positive attitudes about EHRs, and negative attitudes about EHRs. The main outcome measures were four measures of use of EHR functions. We used linear regression models to test the association between the three indices and measures of EHR use.

Results—The mean comfort with computers score was 2.37 (SD 0.53) on a scale of 1 to 3 with 3 being the most comfortable. The mean positive attitude score was 2.74 (SD 0.40) on a scale of 1 to 3 with 3 being more positive. The mean negative attitude score was 1.81 (SD 0.54) on a scale of 1 to 3 with 3 being more negative. Within the first twelve months of having the EHR, 59.5% of visits had allergy information entered into a structured field, 64.8% had medications reviewed, and 74.3% had blood pressured entered. Among visits with a prescription generated, 24.5% had prescriptions electronically prescribed. In multivariate regression analysis, we found no significant correlations between comfort with computers, positive attitudes about EHRs, or negative attitudes about EHRs and any of the measures of use.

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Discussion—Comfort with computers and attitudes about EHRs did not predict future use of the EHR functions. Our findings suggest that meaningful use of the EHR may not be affected by providers' prior attitudes about EHRs.

Introduction

Studies of the impact of electronic health records (EHRs) to improve quality of care have shown mixed results.[1–7] One possible explanation for these mixed results is that clinicians use EHRs more as electronic document writers and not as tools to better manage patients and to improve efficiency.[8,9] In order to improve meaningful use of EHRs, the Centers for Medicare and Medicaid Services launched the Electronic Health Record Incentive Program which paid out more than $5.7 billion to providers in the first year of the program.[10,11]

Prior research has shown that positive attitudes about EHRs are associated with successful implementation.[12–15] However, to our knowledge, there is no evidence on whether comfort with technology and more positive attitudes about EHRs prior to implementation affect use of EHRs once they are implemented. We hypothesize that providers who are comfortable using computers and who feel optimistic about their potential effects on patient care might use more features of the EHR.

In this study, we used data from a survey of providers who enrolled in the Primary Care Information Project (PCIP). PCIP is a bureau of the New York City Department of Health and Mental Hygiene (NYC DOHMH) that subsidized EHRs for 3,200 providers (most of whom were small practice providers) serving underserved areas of New York City. PCIP, as a nationally recognized regional extension center, currently provides technical assistance to providers to help them achieve meaningful use.[16]

We sought to address two research questions: 1) what were provider levels of comfort with computers and attitudes about EHRs prior to implementation of an EHR and 2) did provider reports of comfort with computers and attitudes about EHRs prior to implementation predict future use of EHR functions?

Methods

Data Sources and Sample

Primary data for the study came from a pre-implementation survey administered prior to going "live" on the EHR. The survey was developed by PCIP staff, and the goal of the survey was to measure providers' comfort with computer tasks (e.g., typing, printing) and expectations about EHRs (e.g., the EHR will improve medication safety, the EHR will disrupt workflow). The survey also solicited demographic data (e.g., how long the provider had been in practice, provider gender), their comfort level with computers, and their attitudes about EHRs. We obtained additional provider characteristics (provider work load, type of provider, provider specialty) for both survey responders and non-responders from SalesForce©, a customer relations management software used for tracking administrative data about participating practices.

The survey was sent to all providers who enrolled with PCIP. Providers were mailed an advance letter describing the survey after they enrolled with PCIP but before they implemented the EHR. Providers with email addresses were sent a web-based survey via SurveyMonkey©. Providers without an email address were mailed a paper survey. If there was no response after two weeks, providers were sent another email or paper survey. If there was no response after four weeks, PCIP staff called providers.

For this analysis, we included only data from small practices (ten or fewer providers). We excluded providers who eventually did not implement the EHR (n=54), were sent a survey after their EHR had been implemented (n=18), were a temporary employee of the practice or resident physician (n=5), were on leave at the time of the survey (n=2), or whose address was incorrect, (n=3). This resulted in an invited sample of 654 providers. Among these 654 providers, 433 (66.2%) received the survey by email and 221 (33.8%) received it by mail. Among the 433 providers who received the survey by email, 227 (52.4%) were sent another email survey after two weeks and 91 (21.0%) were called after four weeks. Among the 221 providers who received the survey by mail, 176 (79.6%) were sent another mail survey after two weeks and 57 (25.7%) were called after four weeks.

Data on measures of use were transmitted directly from the EHRs to PCIP on a monthly basis. An office visit was defined as an encounter in which the provider recorded that the patient both checked in and checked out.

The study was approved by the Institutional Review Boards of Weill Cornell Medical College and the New York City Department of Health and Mental Hygiene.

Variables

The main predictor variables were scores on three indices: comfort with computers, positive attitudes about EHRs, and negative attitudes about EHRs. We chose these three indices because they have face value as indicators of provider attitudes and because there was high internal consistency within each index but low correlation between the indices (correlation coefficients ranged from −.0.02 to 0.28).

The comfort with computers index consisted of five questions assessing providers' comfort completing the following tasks: email, printing, restarting a computer, typing, and searching on the internet. Each question was recoded to a three point scale: uncomfortable, comfortable, and very comfortable. We computed a mean comfort score based on the answers to these five questions. The index had high internal consistency across the five questions (Cronbach's alpha = 0.89).

The positive attitudes about EHRs index consisted of responses to the following five statements: 1) an EHR will improve my access to patient information when I need it, 2) an EHR will improve my ability to make decisions about patient care, 3) an EHR will improve my ability to provide preventative care, 4) an EHR will reduce medication errors and adverse drug events, and 5) I think the benefits of adopting an EHR will outweigh the challenges I have to overcome. Each question was recoded to a three point scale: disagree ("completely disagree" or "generally disagree"), unsure ("don't know"), and agree

("completely agree" or "generally agree"). For this index, we again calculated a mean score based on the answers to these five questions. The scale had high internal consistency (Cronbach's alpha = 0.72).

The negative attitudes about EHRs scale consisted of responses to the following seven statements: 1) using an EHR will decrease the amount of time I can spend talking with patients, 2) using an EHR will cause disruptions to my workflow, 3) using an EHR will cause a patient visit to last longer, 4) the use of the computer in the exam room will interfere with the patient visit, 5) an EHR will generate too many alerts and reminders during the patient visit, 6) using an EHR will limit my discretion as a primary care provider, and 7) using an EHR will make it more difficult to protect patient privacy. Each question was coded using the same three point scale as the positive attitude score, but for this scale a high score equated to strong negative attitudes about the EHR. The scale had high internal consistency (Cronbach's alpha = 0.74).

We standardized the scores for each question in each index by taking the z-score (mean of question score was subtracted from individual question score and divided by the standard deviation of the question score). As a result, scores for each item have a mean of 0 and a standard deviation of 1.

The main outcome measures were four measures of EHR use: 1) the percentage of visits with a documented blood pressure, 2) the percentage of visits where medications were reviewed, 3) the percentage of visits with allergy information entered into a structured field, and 4) the percentage of visits with a prescription generated and the prescription was electronically prescribed. We chose the four measures of use because they were closely aligned with the Stage 1 meaningful use measures and because they were the most reliable measures available from the electronic health record.[17] The use data is at the encounter-level and each encounter was credited to a provider even if staff performed a function. For the first three measures, the denominator was all visits; for the fourth measure (electronic prescription), the denominator was visits in which a prescription was generated. We calculated the outcome measures for the 12 month time period after EHR implementation. We had EHR use data for 302 of 328 respondents (92.1%). Data on EHR use was missing for a limited number of practices due to problems with transmissions.

Analysis

We used the Pearson Chi-square test to compare characteristics of responders and non-responders.

We performed an item-level analysis to evaluate the relationship between provider characteristics and comfort with computers/attitudes about EHRs. By item-level, we mean that we analyzed each individual question that each provider answered. For each index (comfort with computers index, positive attitudes index, negative attitudes index), we estimated a linear regression model in which the z-score for each item in that index was the dependent variable and provider characteristics were the independent variables. To account for variation in item response across providers, the models controlled for the specific items

reported by each provider. For each index, we tested whether item z-scores varied significantly across each provider characteristic.

We then estimated linear regression models to test the association between item-level comfort with computers and attitudes about EHRs and the four physician-level measures of EHR use listed above. Separate models were estimated for each measure of EHR use. All of the items from all the indices (comfort with computers index, positive attitudes index, negative attitudes index) were entered simultaneously into the model to control for the providers' responses to items in the other indices. We generated estimates of the relationship between items in each domain and the measures of use. As before, the models controlled for the specific items reported by each provider. These models also controlled for provider characteristics (workload, provider type, specialty, gender, and years in practice) and the quarter-year in which the practice started using the EHR.

Standard errors for all item-level models were clustered at the provider-level. The data were analyzed using Stata 12.0 (Stata Corp, College Station, TX).

Results

Of the 654 eligible providers, 328 responded (response rate 50.2%). Among providers who received an email survey, 54.0% responded; among providers who received a paper survey 42.5% responded. Even if a provider was initially sent an email survey, they were free to respond to either form of the survey. Responders were more likely to work more than 20 hours per week at the practice (85.4% of responders vs. 70.6% of non-responders, p=0.001), be in family practice (15.5% vs. 10.7%, p=0.02) and pediatrics (28.4% vs. 14.5%) than obstetrics/gynecology (3.7% vs. 5.2%) or other specialties (8.8% vs. 16.0%, p=0.02), practice in an office with only one location (85.1% vs. 77.6%, p=0.01), and be in a practice with fewer providers (mean 2.3 vs 3.3, p<0.001; Table 1).

The majority of providers were comfortable or very comfortable with email (90.5%), printing (89.9%), and searching the internet (85.1%, Table 2). A smaller percentage of providers were comfortable or very comfortable restarting a computer (76.0%) and typing (83.6%). The mean comfort with computers score was 2.37 (SD 0.53) on a scale of 1 to 3 with 3 being the most comfortable.

Overall, providers had positive attitudes about EHRs. For example, 86.9% of providers felt that having an EHR would improve access to patient information and 86.0% felt that the EHR would lead to fewer medication errors. The mean positive attitude score was 2.74 (SD 0.40) on a scale of 1 to 3 with 3 being more positive.

Despite these positive attitudes, providers had concerns about EHRs. For example, 58.5% thought the EHR would interfere with patient visits and 55.2% thought the EHR would limit their discretion as providers. The mean negative attitude score was 1.81 (SD 0.54) on a scale of 1 to 3 with 3 being more negative.

Table 3 shows the bivariate associations between physician characteristics and comfort with computers, positive attitudes, and negative attitudes scores. The values show the

standardized difference (i.e., the difference in units of the standard deviation) between the reference category and a given physician characteristic. A higher value indicates a larger difference. No provider characteristic was significantly associated with comfort with computers or negative attitudes about EHRs (Table 3). General internists had less positive attitudes about EHRs than family practitioners (standardized difference = −0.26); gynecologists had more positive attitudes about EHRs than family practitioners (standardized difference = 0.20).

Within the first twelve months of having the EHR, over half of visits had allergy information entered into a structure field (mean 59.5%, SD 32.0), medications reviewed (64.8%, SD 30.0), and blood pressured entered (74.3%, SD 27.5; Table 4). However, less than a quarter of visits in which a prescription was generated had that prescription electronically prescribed (24.5%, SD 28.3).

Table 5 shows the associations between comfort with computers, positive attitudes, and negative attitudes scores and performance on four measures of EHR use in multivariable analysis. The values show the correlation coefficients (i.e., degree of correlation) between scores and measures of use. In multivariate regression analysis, we found no significant relationship between comfort with computers, positive attitudes about EHRs, or negative attitudes about EHRs for any of the measures of use (Table 5).

Discussion

In this study of providers in small practices in New York City, we found that most providers had positive expectations for how the EHR would affect their delivery of patient care. Even with positive attitudes, however, almost a third of providers had concerns about the EHR - particularly about whether it would decrease their time with patients. Contrary to our hypothesis that provider comfort with computers and attitudes (both positive and negative) prior to adoption would predict measures of EHR use after implementation, we found no significant relationship between attitudes prior to implementation and EHR use.

These findings are encouraging given prior reports of concern by physicians about EHRs and prior research showing that positive attitudes correlate with successful implementation.[12,13,18,19] For example, a study by Ancker and colleagues found that in interviews with PCIP providers, positive attitudes about EHRs correlated with successful EHR implementation.[12] Our findings suggest that once an EHR is in place, prior comfort with computers and attitudes about the EHR do not predict future use of that EHR. These findings differ from findings of EHR adoption studies and may signify that once providers have overcome the hurdle of adopting an EHR, their attitudes about it do not affect their future use of EHR functions.

Given the significant amount of resources that have been invested into incentive programs to promote the meaningful use of EHRs, these are optimistic findings for policymakers: providers seem to overcome barriers like discomfort with computers and negative attitudes and use the EHR just as successfully as those who feel comfortable and have positive

attitudes. That being said, we did see unexplained low utilization of EHR functions among all providers.

Our study has some limitations. The providers in our sample volunteered to enroll in PCIP, so there could be selection bias in that the providers enrolled in the program have more positive attitudes about EHR adoption than a random group of practices. There could also be response bias, in that the providers who responded to the survey might have greater comfort with computers and might hold more positive attitudes about adopting an EHR than those that did not respond. This bias may be compounded by the fact that a higher percentage of providers who received the survey by email responded compared with those who received a paper survey. In addition, there was little variation in the comfort with computers and positive attitudes scores. The majority of providers were both comfortable with computers and optimistic about adopting an EHR. As a result, we may not have had enough variation to predict EHR use. However, we did not find a correlation between negative attitudes and use even though the negative attitude score had more variation. Additionally, the questions about comfort with computers were relatively basic. We did not ask questions about experience with data management like familiarity with spreadsheets or ability to create a data table using a word processing program. We also only looked at four measures of use. There may be additional use measures that are important for quality of care but that we did not examine. Finally, the providers in our study practice in underserved areas in an urban setting. Due to this practice environment and patient population, it may be difficult to extrapolate our results to small practices outside of New York City.

All of the providers used one EHR system, e-ClinicalWorks. Though it is also of interest how EHR use may vary across vendors, we do not have access to such data. In addition, the EHR use measures included in this report were derived from queries of structured fields within each practice's EHR system. Variation in documentation workflows across practices may lead to underreporting of EHR use. Though PCIP, in consultation with eCW, designed queries to pull from the most commonly used structured fields when generating EHR use reports, practices and their staff may have chosen to document information in fields not included in the measurement query, such as a free text or history field, or customized or specialized structured fields. The consequence for these practices is that their rates may show up as 'zero' or lower than what is actually occurring in the practice.

In summary, we found that comfort with computers and attitudes about EHRs did not predict future use of the EHR. Despite reports of negative attitudes about EHRs and prior findings that attitudes predict successful implementation of EHRs, our findings suggest that meaningful use of the EHR may not be affected by these attitudes. If so, programs such as the meaningful use program may not need to overcome this hurdle and as a result may hold more promise to be effective.

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Table 1

Characteristics of responders and non-responders

	Responders, no. (%)(n=328)	Non-responders, no. (%)(n=326)	p-value
Provider work load (hrs/wk)			**<0.001**
<20	48 (14.6)	96 (29.5)	
≥ 20	280 (85.4)	230 (70.6)	
Type of provider			0.48
MD or DO	284 (86.6)	275 (84.4)	
Non-MD (PA, NP)	44 (13.4)	51 (15.6)	
Provider Specialty			**0.02**
Internal Medicine	143 (43.6)	142 (43.6)	
Family Practice	51 (15.5)	35 (10.7)	
Pediatrics	93 (28.4)	80 (24.5)	
Obstetrics and Gynecology	12 (3.7)	17 (5.2)	
Other	29 (8.8)	52 (16.0)	
Type of Survey			
Paper	94 (28.7)	127 (39.0)	**0.005**
Web	234 (71.3)	199 (61.0)	
Practice Size, mean	2.3	3.3	**<0.001**
Years in Practice			-
0–5	60 (19.9)	-	
6–10	102 (33.9)	-	
11–20	69 (22.9)	-	
>20	70 (23.3)	-	
Gender			-
Female	123 (39.8)	-	
Male	186 (60.2)	-	
Practice Size			
1 to 2 Providers			
3 or more Providers			
Comfort with computers , mean score (SD)	2.37 (0.53)	-	-
Positive attitudes about EHRs, mean score (SD)	2.74 (0.40)	-	-
Negative attitudes about EHRs, mean score (SD)	1.81 (0.54)	-	-

Table 2

Providers' comfort with computers and attitudes about EHRs

Comfort with Computers (n=328)				
	Uncomfortable, %	**Comfortable, %**	**Very Comfortable, %**	**Missing, %**
Comfort with email	3.7	41.1	49.4	5.5
Comfort with printing	3.4	43.3	46.6	6.7
Comfort restarting a computer	18.9	40.9	35.1	5.2
Comfort typing	11.3	48.2	35.4	5.2
Comfort searching on the internet	4.0	40.9	44.2	11.0

Positive attitudes about EHRs (n=328)				
	Disagree, %	Unsure, %	Agree, %	Missing, %
The EHR will improve access to patient info	3.7	6.1	86.9	3.4
The EHR will improve ability to make decisions	18.3	9.8	68.0	4.0
The EHR will help me provider better preventative care	6.7	8.5	80.8	4.0
The EHR will lead to fewer Rx errors	5.2	5.8	86.0	3.1
The benefits of the EHR outweigh the challenges	6.1	11.3	79.0	3.7

Negative attitudes about EHRs (n=328)				
	Disagree, %	Unsure, %	Agree, %	Missing, %
I will have less time with patients	39.9	17.7	38.7	3.7
The EHR will disrupt my workflow	35.1	16.2	45.1	3.7
Visits will be longer	37.2	17.1	41.5	4.3
The EHR will interfere with the patient visit	27.1	11.3	58.5	3.0
There will be too many alerts	32.0	26.2	39.0	2.7
The EHR will limit my discretion as a provider	18.9	21.0	55.2	4.9
The EHR will be more difficult to protect patient privacy	19.8	15.6	61.6	3.1

Note: Percentage may not add up exactly to 100% due to rounding.

Table 3

Association between physician and practice characteristics and comfort with and attitudes about EHRs

	Comfort with Computers		Positive Attitude about EHRs		Negative Attitude about EHRs	
	Standardized Difference	**p-value**	**Standardized Difference**	**p-value**	**Standardized Difference**	**p-value**
Provider work load						
<20 hours/wk	ref	0.27	ref	0.87	−0.08	0.41
≥20 hours/wk	0.14		0.02			
Type of provider						
MD or DO	ref	0.47	ref	0.20	ref	0.41
Non-MD (PA, NP)	0.20		−0.21		−0.11	
Provider Specialty						
Family Practice	ref	0.78	ref	**0.02**	ref	0.29
Adult General Internal Medicine	−0.02		−0.26		−0.26	
Pediatrics	−0.08		−0.03		−0.04	
Obstetrics and Gynecology	−0.07		0.20		0.03	
Other	0.17		−0.47		−0.04	
Years in practice						
0–5	ref	0.08	ref	0.21	ref	0.14
6–10	−0.08		0.19		−0.13	
11–20	−0.32		−0.02		−0.20	
>20	−0.17		0.03		−0.11	
Gender						
Female	ref	0.27	ref	0.15	ref	0.31
Male	−0.11		−0.11		−0.07	

Note: Standardized difference is difference from the reference category on scale of the standard deviation. A higher absolute value signifies a larger difference from the reference category.

Table 4

Measures of use in the first year after implementation

	Mean percentage (SD) (n=302)
Visits with allergy information entered into a structured field	59.5 (32.0)
Visits with medication reviewed	64.8 (30.0)
Visits with BP entered	74.3 (27.5)
Visits with a prescription generated where the prescription was e-prescribed	24.5 (28.3)

Table 5

Association between comfort with computers and attitudes about EHRs and measures of use in the first year

	Dependent variable							
	Percentage of visits with allergy information entered into a structured field, coefficient	**p- value**	**Percentage of visits with medication reviewed, coefficient**	**p- value**	**Percentage of visits with BP entered, coefficient**	**p- value**	**Percentage of visits with a prescription generated and prescription was e-prescribed, coefficient**	**p- value**
Comfort with Computers Score	1.49	0.35	0.09	0.95	1.11	0.40	1.56	0.19
Positive attitudes about EHRs Score	−1.09	0.44	−0.56	0.70	0.57	0.64	0.98	0.39
Negative about EHRs attitudes Score	−0.69	0.55	−0.11	0.92	0.50	0.56	0.93	0.37

Note: Coefficient is the association between a one standard deviation increase in each scale score and the dependent variable. All models controlled for provider characteristics (workload, provider type, specialty, gender, years in practice) and the quarter-year in which the practice started using the EHR.

Appendix A

Association between physician and practice characteristics and comfort with and attitudes about EHRs (non-standardized)

	Comfort with Computers		Positive Attitude about EHRs		Negative Attitude about EHRs	
	Difference	**p-value**	**Difference**	**p-value**	**Difference**	**p-value**
Provider work load						
<20 hours/wk	ref	0.31	ref	0.86	-0.07	0.40
≥20 hours/wk	0.09		0.01			
Type of provider						
MD or DO	ref	0.46	ref	0.21	ref	0.37
Non-MD (PA, NP)	−0.06		−0.16		−0.10	
Provider Specialty						
Family Practice	ref	0.77	ref	**0.009**	ref	0.31
Adult General Internal Medicine	−0.01		−0.20		−0.25	
Pediatrics	−0.05		−0.02		−0.04	
Obstetrics and Gynecology	−0.04		0.15		0.03	
Other	0.11		−0.36		−0.04	
Years in practice						
0–5	ref	0.09	ref	0.23	ref	0.18
6–10	−0.05		0.13		−0.12	
11–20	−0.21		−0.02		−0.18	
>20	−0.11		0.02		−0.10	
Gender						
Female	ref	0.29	ref	0.14	ref	0.35
Male	−0.07		−0.07		−0.07	

Appendix B

Association between comfort with computers and attitudes about EHRs and measures of use in the first year (non-standardized)

	Dependent variable							
	Percentage of visits with allergy information entered into a structured field, coefficient	**p- value**	**Percentage of visits with medication reviewed, coefficient**	**p- value**	**Percentage of visits with BP entered, coefficient**	**p- value**	**Percentage of visits with a prescription generated and prescription was e-prescribed, coefficient**	**p- value**
Comfort with Computers Score	1.98	0.22	0.31	0.83	1.21	0.36	1.47	0.23
Positive attitudes about EHRs Score	−0.73	0.60	−0.31	0.83	0.85	0.48	1.05	0.37
Negative attitudes about EHRs Score	−0.26	0.83	0.05	0.96	0.60	0.48	0.69	0.52

Note: All models controlled for provider characteristics (workload, provider type, specialty, gender, years in practice) and the quarter-year in which the practice started using the EHR.