Physician beliefs about the impact of meaningful use of the EHR

A Cross-Sectional Study

S. Emani[1]; D.Y. Ting[2]; M. Healey[1,3]; S.R. Lipsitz[1]; A.S. Karson[4]; J. S. Einbinder[1]; L. Leinen[5]; V. Suric[1]; D.W. Bates[1,6]

[1]Division of General Internal Medicine, Department of Medicine, Brigham and Women's Hospital, Harvard Medical School, Boston, MA;
[2]Massachusetts General Physicians Organization, Massachusetts General Hospital, Boston, MA, USA;
[3]Brigham and Women's Physicians Organization, Brigham and Women's Hospital, Boston, MA, USA;
[4]Decision Support Unit, Massachusetts General Hospital, Harvard Medical School, Boston, MA, USA;
[5]Information Services, Partners HealthCare, Boston, MA, USA;
[6]Department of Healthcare Policy and Management, Harvard School of Public Health, Boston, MA, USA

Keywords
Electronic health records, physicians, beliefs, meaningful use, evaluation

Summary
Background: As adoption and use of electronic health records (EHRs) grows in the United States, there is a growing need in the field of applied clinical informatics to evaluate physician perceptions and beliefs about the impact of EHRs. The meaningful use of EHR incentive program provides a suitable context to examine physician beliefs about the impact of EHRs.
Objective: Contribute to the sparse literature on physician beliefs about the impact of EHRs in areas such as quality of care, effectiveness of care, and delivery of care.
Methods: A cross-sectional online survey of physicians at two academic medical centers (AMCs) in the northeast who were preparing to qualify for the meaningful use of EHR incentive program.
Results: Of the 1,797 physicians at both AMCs who were preparing to qualify for the incentive program, 967 completed the survey for an overall response rate of 54%. Only 23% and 27% of physicians agreed or strongly agreed that meaningful use of the EHR will help them improve the care they personally deliver and improve quality of care respectively. Physician specialty was significantly associated with beliefs; e.g., 35% of primary care physicians agreed or strongly agreed that meaningful use will improve quality of care compared to 26% of medical specialists and 21% of surgical specialists (p=0.009). Satisfaction with outpatient EHR was also significantly related to all belief items.
Conclusions: Only about a quarter of physicians in our study responded positively that meaningful use of the EHR will improve quality of care and the care they personally provide. These findings are similar to and extend findings from qualitative studies about negative perceptions that physicians hold about the impact of EHRs. Factors outside of the regulatory context, such as physician beliefs, need to be considered in the implementation of the meaningful use of the EHR incentive program.

Correspondence to:
Srinivas Emani, PhD
Division of General Internal Medicine
Brigham and Women's Hospital
1620 Tremont Street, 3rd Floor
Boston, MA 02120
Email: semani1@partners.org
Phone: 617–732–7063
Fax: 617–732–7072

Appl Clin Inform 2014; 5: 789–801
http://dx.doi.org/10.4338/ACI-2014-05-RA-0050
received: May 11, 2014
accepted: July 18, 2014
published: August 27, 2014
Citation: Emani S, Ting DY, Healey M, Lipsitz SR, Karson AS, Einbinder JS, Leinen L, Suric V, Bates DW. Physician beliefs about the impact of meaningful use of the EHR: A cross-sectional study. Appl Clin Inf 2014; 5: 789–801
http://dx.doi.org/10.4338/ACI-2014-05-RA-0050

1. Background

The evaluation of the impact of the use of health information technology and the sharing and dissemination of the findings of such evaluation are two important components of applied clinical informatics [1]. As the adoption and use of electronic health records (EHRs) grows in the United States, driven primarily by federal incentives [2–3], there is a growing need in the field of applied clinical informatics to evaluate the impact of EHR use. By impact of EHR use, we mean impact in areas such as quality of care, effectiveness of care, and patient outcomes. The impact can be objective in nature and captured through outcomes such as process or quality metrics [4]. Alternatively it can be subjective in nature such as physician beliefs about the impact of EHR use. One qualitative study explored perceptions of academic and private physicians about the impact of EHR use on workflow and patient care [5]. The study did not find differences in perceptions between these two groups: both had negative perceptions of the impact of EHR on workflow and patient care. The same researchers reported that super-user physicians (physicians who were product champions) had similar negative perceptions [6]. A study of pediatric growth charts and EHR use found that physicians who used the EHR had more positive beliefs that electronic growth charts would improve satisfaction and efficiency than those who did not use the EHR [7]. A qualitative study elicited physician beliefs in the categories of performance outcomes, productivity outcomes, and patient outcomes [8]. Both positive and negative beliefs emerged in this study across the different categories. Among the positive beliefs identified in the study were the ease of remote access to medical records, improved quality of performance through real time availability of radiology and imaging results, and timely awareness of patient status. Some of the negative beliefs that were elicited included impacts on work load as a result of additional steps from physician order enter functionality, difficulty in finding information in the record, and information being less complete than hard copy notes.

Beyond beliefs about the impact of EHR use, other factors have been reported in the literature as influencing the adoption and use of EHRs [9–12]. Age and specialty have been found to be associated with adoption of EHRs; specifically, physicians in nonprimary care practices and those 55 and older have been found to lag in the adoption of EHRs [9–10]. Menachemi and Brooks found that younger age was significantly associated with use of EHR but there was no association with race and gender [11]. In a study of family physicians, Xieroli and colleagues [12] found that younger physicians and female physicians were more likely to adopt an EHR.

2. Objective

Beyond the few studies reported in the background section, relatively little is known about physician beliefs about the impact of EHR use. The objective of this exploratory study was to contribute to the sparse literature on physician beliefs about the impact of EHR use in areas such as quality of care, effectiveness of care, and patient outcomes. We also assessed correlates of physician self-efficacy to become a "meaningful user" of the EHR [2].

3. Methods

3.1 Context

The context for this study was the Medicare and Medicaid Electronic Health Record (EHR) Incentive Program introduced in the Health Information Technology for Economic and Clinical Health (HITECH) provision of the American Recovery & Reinvestment Act of 2009 [2–3, 13–15]. The stated aim of the program was to incentivize eligible professionals (EP) and critical access hospitals (CAH) to adopt, implement and meaningfully use certified healthcare information technology (HIT); and because of this goal, the program became widely referred to as the "EHR Meaningful Use Program (MU)." The objectives of the meaningful use of EHR program are to increase the adoption of EHRs as well the use of EHRs to improve delivery of care, decrease medical errors, improve efficiency of care, and enhance patient centeredness of care [2]. The U. S. Congress appropriated $27

billion for the incentive program, and delegated administrative authority to the federal Centers for Medicare and Medicaid (CMS). In turn, CMS, working with the Office of the National Coordinator (ONC), established a strict set of criteria by which EPs and CAHs could achieve meaningful use, and thereby receive the federal incentive.

In broad strokes, the meaningful use of EHR incentive program program was originally designed to take place over three stages from 2011 through 2016 [2]. The first stage was intended to drive the collection of discrete or coded health information. Stage 2 was intended to see the leveraging of those data for computerized decision support. The third stage anticipated actual improvement in clinical care, based on the use of data in the EHR. This staged approach to the meaningful use of EHR incentive program has been considered analogous to the concept of an escalator [2]. With each stage, the program moves upward toward the final goal of achieving improvement in quality, safety, and efficiency of care [3]. The criteria for each stage were rigorous: for example, for Stage 1 physicians were expected to successfully reach targets for 15 core performance measures and 5 of 10 menu measures, as well as report on 6 of 38 clinical quality measures. Foror such achievement, maintained over the six-year, three-stage life of the incentive program, EPs could receive up to $44,000 (Medicare) or $63,750 (Medicaid). Furthermore, beginning in 2016, EPs who failed to achieve Meaningful Use by 2014 would see a reduction of their CMS payments beginning at 1% of total payments, with penalties increasing by 1% per year afterward.

3.2 Participants

The participants in this study were physicians, or eligible professionals, at two academic medical centers (AMCs) in the northeast who were preparing to qualify for meaningful use. Eligible Professionals (EPs) are providers, excluding fellows and residents, who participate in Medicare or Medicaid, and whose eligible billing comes from office visits. With respect to the AMCs, AMC1 is a 777-bed medical center with 57,000 admissions per year and AMC2 is a 907-bed medical center with 48,000 admissions per year. AMC1 has 101 affiliated outpatient practices with 170 primary care physicians, 1423 specialists, and 769,000 outpatient visits a year. AMC2 has 175 affiliated outpatient practices, with 259 primary care physicians, 1,737 specialists, and 1.5 million outpatient visits a year. At both AMCs, a common home-grown outpatient EHR has been in use since 1998. The home-grown EHR is an internally developed, web-based, fully functioning EHR that includes notes from primary care and subspecialty clinics; hospital discharge summaries; ICD-9 coded problem lists; health maintenance lists; medication prescribing; coded allergies; lab and radiographic results; and results management. The EHR has clinical decision support in the form of reminders for preventative services and management of chronic problems, medication prescribing alerts, and decision support during results management. The adoption and use rate of the outpatient EHR by physicians is 100% across both AMCs as it is a requirement for affiliation with the AMCs.

3.3 Instrument Development

We conceptualized beliefs as outcome expectancies, or *the beliefs that the performance of a behavior will lead to the desired outcomes* [16–17]. Given our context of the meaningful use of the EHR incentive program, the belief items in our survey focused on the impact of the meaningful use of the EHR to achieve outcomes such as improving delivery of care, decreasing medical errors and improving patient centeredness of care. For example, in the case of decreasing medical errors the belief item in the survey was: Meaningful use (of the EHR) will decrease medical errors. The belief items were captured as five-point Likert scales ranging from Strongly Disagree to Strongly Agee. The following List shows the seven belief items developed for this study:

Items on beliefs about impacts of the EHR

1. Meaningful use will improve the quality of care I deliver
2. Meaningful use will improve the patient-centeredness of care I provide
3. Meaningful use will not increase the efficiency of care I provide
4. Meaningful use will not lead to improved patient outcomes
5. Meaningful use will decrease medical errors

6. Overall, I think meaningful use as being measured will help me use the EHR to improve the care I personally deliver
7. Overall, I think meaningful use as being measured will help me use the EHR to improve the care the AMC delivers
Response categories: Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree

In addition to beliefs, we assessed self-efficacy with respect to achieving meaningful use of the EHR. Self-efficacy is a central tenet of social cognitive theory and is the conviction that a person can successfully execute a behavior [18–19]. Lower self-efficacy leads to lower likelihood of the physician becoming a meaningful user of the EHR. Self-efficacy is distinct from beliefs as outcome expectancies in that a physician may believe that the impact of the meaningful use of the EHR is positive but the physician may not have the self-efficacy to achieve meaningful use of the EHR. We defined self-efficacy as the confidence that physicians have for achieving meaningful use and measured self-efficacy on a scale from 1 (Not at All Confident) to 5 (Extremely Confident).

Through our survey instrument, we also gathered data on factors such as physician age, gender, specialty (primary care, medical specialty, and surgical specialty), race, number of outpatients seen per week, number of outpatient hours worked per week, and satisfaction with the outpatient EHR. We recoded physician age into two categories: less than 55 years and 55 years and older. We recoded satisfaction with the outpatient EHR into two categories: Satisfied (defined as satisfied or very satisfied) and Other (defined as very dissatisfied or dissatisfied or somewhat dissatisfied or somewhat satisfied). After developing the survey instrument, we pilot tested the survey with the physician investigators on the study.

3.4 Data Collection

As described above in the section on participants, our subjects were physicians who were eligible professionals at two academic medical centers (AMCs) in the northeast preparing to qualify for the meaningful use incentive program. We administered the survey using the Survey Monkey tool. We sent the initial survey followed by three reminders all of which were completed over a ninety-day period. Ninety one percent of physicians responded within the first thirty days of the initial survey. To enhance the response rate, we offered an iPad to each of three randomly drawn respondents.

3.5 Statistical Analysis

Because all variables of interest in our analysis are categorical, descriptive statistics are presented using percentages. We conducted bivariate analyses using the Pearson chi-square test. A p-value less than 0.05 was considered statistically significant. Since this was an exploratory study, we did not adjust for multiple comparisons. Thus, the p-values should be interpreted cautiously. We employed logistic regression analysis to assess significant correlates of our main outcome of interest: self-efficacy (dichotomized as High (3–5 on the scale from 1 to 5) or Low (1–2 on the scale from 1 to 5). The statistical significance of the covariates in the logistic regression models was evaluated using Wald p-values [20]. All analyses were completed using SPSS for Windows 21.0.

3.6 Institutional Review Board Approval

Approval for the study was obtained from the Partners HealthCare Institutional Review Board.

4. Results

4.1 Response Rates

Of the 1,797 physicians at both academic medical centers who were preparing to qualify for the meaningful use incentive program, 967 completed the survey for an overall response rate of 54%. Mean age of survey respondents was 48.7 years compared to 48.3 years for non-respondents. Re-

spondents and non-respondents differed on gender: Of the 1,063 male physicians in our sample, 545 (51%) were respondents and 518 (49%) were non-respondents; of the 734 female physicians, 422 (58%) were respondents and 312 (42%) were non-respondents (p=0.005). Respondents and non-respondents differed on specialty: Of 341 primary care physicians in our sample, 211 (62%) were respondents and 130 (38%) were non-respondents; of 1,146 medical specialists, 606 (53%) were respondents and 540 (47%) were non-respondents; and of 310 surgical specialists, 150 (48%) were respondents and 160 (52%) were non-respondents (p=0.002). Additionally, 751 (78%) of the responding physicians were Caucasian and 216 (22%) were non-Caucasian. The average number of years since medical school for responding physicians was 21.6 years.

4.2 Beliefs about the impact of meaningful use of the EHR

Thirty nine percent respondents agreed or strongly agreed that meaningful use of the EHR will decrease medical errors but almost the same amount, 40.7%, were neutral whether meaningful use will decrease medical errors (▶Table 1). Less than a quarter (23%) of respondents agreed or strongly agreed that meaningful use will help them use the EHR to improve the care they personally deliver. Just over a quarter agreed or strongly agreed that meaningful use will improve quality of care (27%) and patient-centeredness of care (28%).

Physician demographics (age, gender, and race) were generally not associated with beliefs about meaningful use (▶Table 2). The number of outpatients seen per week and the number of hours worked per week were also not associated with beliefs. Physician specialty was significantly associated with beliefs, with primary care physicians reporting more positive beliefs than medical specialists and surgical specialists across all seven belief items. For example, 35% of primary care physicians agreed or strongly agreed that meaningful use will improve quality of care compared to 26% of medical specialists and 21% of surgical specialists (p=0.009). Satisfaction with outpatient EHR was also significantly associated with all belief items. For example, 45.1% of physicians who were satisfied with the EHR believed meaningful use will decrease medical errors compared to 33.4% in the other group (p<0.001).

4.3 Self-Efficacy

A third of the responding physicians reported that they were very confident (21%) or extremely confident (12.1%) and another quarter reported that they were moderately confident that they can achieve meaningful use. Self-efficacy (defined as moderately confident to extremely confident) was not related to physician characteristics (▶Table 3) .Self-efficacy was significantly related to satisfaction with outpatient EHR (▶Table 3). Almost two-thirds of respondents (65%) who were satisfied with the outpatient EHR had high self-efficacy compared to 55% in the other group (p=0.002). Self-efficacy was significantly associated with all seven belief items (▶Table 4). Across all belief items, more positive beliefs were associated with higher self-efficacy.

4.4 Correlates of Self-Efficacy

We fitted a multivariate logistic regression model to assess correlates of self-efficacy to achieve meaningful use. In this model we only included variables that were significant in our bivariate analyses: satisfaction with outpatient EHR, and all seven belief items. Since this is an exploratory study, we entered all variables into the model rather than choose a forward or backward selection approach. Our p-value for significance was 0.05. The only item that was a significant correlate of self-efficacy was the belief that meaningful use as being measured will help the physician use the EHR to improve the care the academic medical center delivers (OR=2.01, 95% CI: [1.43, 3.08], p=0.001). Physicians who agreed or strongly agreed with the belief that meaningful use as being measured will help the physician use the EHR to improve the care the academic medical center delivers were twice as likely to have high self-efficacy to achieve meaningful use.

5. Discussion

Relatively little is known about physician beliefs about the impact of meaningful use of the EHR use on quality of care, the care the physician and organization delivers, and patient-centeredness of care. While physician beliefs are subjective in nature, they form an important component of the psychological dimension that affects how physicians respond to the adoption of programs that incentivize the meaningful use of EHRs and to have implications for implementation of such programs and associated readiness to change in health care organizations [21]. Only about a quarter of the physicians responding to our survey agreed or strongly agreed that meaningful use of the EHR will improve the delivery of care. This finding emerged across several beliefs associated with meaningful use including quality of care, patient outcomes, and the care the physician personally delivers. Our findings are similar to, and extend the qualitative studies by Grabenbauer and colleagues who found that physicians had negative concerns about the impacts of EHR use in areas like patient care and workflow [5-6].

Among socio-demographic characteristics, we generally did not find gender, age, or race to be associated with beliefs. Specifically our study did not find a difference between physicians 55 years and older and those younger than 55 in either beliefs or self-efficacy to achieve meaningful use. Some studies have reported that physicians 55 and older have lagged in the adoption of EHRs and that younger physicians are more likely to be ready for meaningful use [10]. One possible explanation for our finding is that once EHRs are adopted and physicians are using them, age-related differences may not exist at least with respect to beliefs.

In contrast to socio-demographics, physician specialty and physician satisfaction with the outpatient EHR were strongly associated with beliefs about the impact of meaningful use of the EHR. In particular, primary care physicians had greater positive beliefs than medical specialists or surgical specialists across all the belief items. Our finding is similar to that of DesRoches and colleagues [22] who found that primary care physicians reported more positive effects than specialists regarding the use of the EHR on quality and efficiency of care. This is not surprising, as primary care physicians have been using EHRs much more intensively and longer than specialists in the United States, who are finding meaningful use to be much more disruptive to existing workflows. In a study of adoption rates of the EHR between 2002 and 2011, Decker and colleagues [10] found that not only did the adoption rates of EHRs increase more quickly for primary care physicians than for specialists but that the gap in adoption rate had also widened over this period. Furthermore, some specialties such as psychiatry and opththalmology have unique workflows and functionality that may not be addressed by traditional EHRs. For example, in the case of opththalmology traditional hand-drawn anatomic drawing or opththalmologic vital signs (such as intraocular pressure) may not have equivalent functionalities in traditional EHRs [23].

Physician satisfaction with the outpatient EHR was also significantly associated with beliefs, with physicians in the satisfied group reporting more positive beliefs about the impact of meaningful use of the EHR. At the same time satisfaction with the EHR may not be sufficient to meet physician expectations about the impact of the use of the EHR. One study that examined physician expectations in transitioning from an old EHR system to a new one found that although satisfaction with the new system was high, physician expectations post-transition were significantly lower than pre-transitions with respect to medication safety, efficiency, and quality of care [24]. Additional studies are needed to explore the relationships among satisfaction, beliefs, and expectations about the impact of EHR use.

Finally, our multivariate model showed that only one belief item was a significant correlate of self-efficacy to achieve meaningful use of the EHR. Physician beliefs about the impact of EHR use such as decreasing medical errors, improving patient outcomes, and improving quality of care did not emerge as significant predictors of self-efficacy in the multivariate model. There are several possible explanations for this finding. The physicians in our study were long-term users of the EHR. Because of their experience with the EHR physicians could be confident about achieving meaningful use even if they have negative beliefs about the impact of the meaningful use of the EHR. The relationship between beliefs and self-efficacy may be different in recent adopters of the EHR who are seeking to achieve meaningful use. A second possible explanation is that other types of beliefs or factors may be related to self-efficacy. For example, beliefs about the degree to which a behavior

(achieving meaningful use) is controllable may be stronger correlates of self-efficacy [8]. Other factors that may influence self-efficacy include education, training, audit and feedback of individual performance around the criteria for becoming a meaningful user of the EHR.

6. Limitations

This study was conducted in the setting of two academic medical centers in one region. Thus, the study findings may not apply to other settings, including different practice types or regions. However, many of the physicians evaluated do practice in the community. Moreover, physician beliefs are likely to be much more negative in other settings, such as small physician practices, than even those reported here as the challenges posed by meaningful use are greater in such settings. Given the lack of data on beliefs and self-efficacy with achieving meaningful use in such settings, there is a need for further research on this subject. The study design was cross-sectional in nature and measured physician beliefs at one point in time. Finally, the study did not include factors such as practice size or physician perceptions of educational and training campaigns related to meaningful use which may also impact beliefs and self-efficacy.

7. Conclusions

We conducted a cross-sectional survey of physician beliefs about the impact of the meaningful use of the EHR and their influence on physician self-efficacy. Our research contributes to the two components of the field of applied clinical informatics identified at the beginning of the paper: evaluation of the impact of the use of the EHR, and the sharing and dissemination of the findings.

Our study has two implications for the implementation of the meaningful use of EHR incentive program. First, we agree with Gold and colleagues that factors outside the regulatory context but crucial to the success of meaningful use, such as beliefs, self-efficacy and readiness to change, need to be addressed [25]. These are factors that are not addressed in regulations and policies or that have traditionally been captured in studies on adoption and use of EHRs. However, they are likely to play a crucial role in the implementation of meaningful use of EHRs especially if beliefs about the efficacy of meaningful use are ambivalent [26].

Second, our study has implications for the "escalator" concept in the implementation of meaningful use. [2] Through its three proposed stages, the meaningful use program ascends like an escalator toward the ultimate goal of achieving improvement in quality, safety, and efficiency of care. At the same time, proponents of the program acknowledge the need for calibrating the speed of the escalator to account for technological and resource limitations in the real world [2]. We believe that the escalator concept also needs to account for psychological and behavioral factors that may influence the adoption and meaningful use of the EHR across all three stages. Specifically the extent to which factors such as beliefs and self-efficacy act as barriers and impede the speed of the escalator in achieving meaningful use, particularly in small and medium practices, needs to be considered in further detail in both empirical and policy research. Finally, there is a need for additional research on the psychological and behavioral factors related to physician use of EHRs. Our study focused on beliefs as outcome expectancies and was exploratory in nature. Other types of beliefs that could be examined include beliefs about controllability and normative beliefs [8]. There is also a need for longitudinal studies that examine whether beliefs change over time or whether new beliefs arise as physicians become more experienced with EHR use and specifically with achieving the meaningful use of the EHR to improve quality of care.

Clinical Relevance Statement

Given that few physicians had positive beliefs about the impact of the meaningful use of the EHR, we agree with previous studies that financial incentives alone may not be sufficient to achieve the goals of the meaningful use of EHRs [5–6]. Our study also suggests that organizations implementing meaningful use should devote strategies and resources to promote positive beliefs about mean-

ingful use among physicians as well as enhance self-efficacy with respect to the use of the EHR to achieve meaningful use.

Conflict of Interest
The authors report no conflicts of interest in the research.

Human Subjects Provision
The Partners HealthCare Institutional Review Board approved the study.

Acknowledgements
Funding for this study was provided by the Partners-Siemens Informatics Research Council (PSRC).

Table 1 Physicians' beliefs about impacts of meaningful use of the EHR. Notes: 1. Likert Scale coded as: 1=Strongly Disagree, 2=Disagree, 3-Neutral, 4=Agree, 5=Strongly Agree

Variable	Strongly Disagree		Disagree		Neutral		Agree		Strongly Agree		Mean	S.D.
	Number	%	Number	%	Number	%	Number	%	Number	%		
Meaningful use will decrease medical errors	46	4.8	145	15.2	388	40.7	316	33.1	59	6.2	3.2	0.94
Meaningful use will **not** increase the efficiency of care I provide	33	3.4	148	15.5	289	30.2	307	32.1	180	18.8	3.5	1.0)
Meaningful use will improve the patient-centeredness of care I provide	87	9.1	219	22.9	373	39.1	237	24.8	39	4.1	2.9	1.00
Meaningful use will not lead to improved patient outcomes	36	3.8	250	26.2	410	43.0	183	19.2	75	7.9	3.0	0.96
Meaningful use will improve the quality of care I deliver	97	10.2	207	21.8	390	41.1	221	23.3	35	3.7	2.9	1.00
Overall, I think meaningful use as being measured will help me use the EHR to improve the care I personally deliver	129	13.6	261	27.4	341	35.9	200	21.0	20	2.1	2.7	1.01
Overall, I think meaningful use as being measured will help me use the EHR to improve the care the academic medical center (AMC) delivers	82	8.6	148	15.6	358	37.6	320	33.6	43	4.5	3.1	1.00

Table 2 Physician characteristics and beliefs about meaningful use (Percent of respondents). Notes: 1. Only significant p-values are shown; 2. * p<0.05; ** p<0.01; *** p<0.001

Physician characteristics	Decrease medical errors	Not increase effectiveness of care	Improve patient-centered care	Not improve patient outcomes	Improve quality of care	Improve care personally delivers	Improve care the AMC delivers
	Agree or Strongly Agree						
Gender							
Female	38.4	49.4	27.0	22.7**	25.8	22.4	36.9
Male	40.0	52.1	30.4	30.5 (p=0.007)	27.8	23.7	39.2
Specialty							
Primary Care	44.3*	44.3*	36.8**	16.8***	34.8**	30.3**	42.3*
Medical Specialties	39.6	51.4	27.8	26.5	25.6	22.4	39.2
Surgical Specialties	30.8 (p=0.04)	58.2 (p=0.03)	21.9 (p=0.006)	44.1 (p < 0.001)	21.2 (p=0.009)	15.8 (p=0.005)	28.1 (p=0.02)
Race							
White	39.1	52.6	28.2	28.2	26.7	22.6	38.0
Non-White	40.0	44.9	31.2	23.0	28.0	25.1	38.9
Age							
< 55 years	37.5	50.7	27.6	26.5	24.4	22.0	38.3
≥55 years	43.4	51.4	31.9	28.4	32.8** (p=0.008)	25.9	37.8
Satisfaction with outpatient EHR							
Other	33.4***	56.6**	22.3***	32.7***	22.3**	16.8***	30.0***
Satisfied	45.1 (p < 0.001)	47.6 (p < 0.001)	35.4 (p < 0.001)	22.1 (p < 0.001)	32.5 (p < 0.001)	29.9 (p < 0.001)	47.2 (p < 0.001)
# of outpatients per week							
≤30	41.1	48.6	29.1	27.1	29.0	24.3	39.0
>30	36.9	55.0	28.4	27.7	24.6	21.2	36.3
Hours worked outpatient							
≤20 hours per week	38.0	48.8	27.4	27.6	26.8	21.6	36.8
>20 hours per week	39.7	55.3	30.2	27.3	27.2	24.6	39.0

Physician characteristics	Self-Efficacy (Moderately to Extremely Confident)
Gender	
Female	55.6
Male	60.7
Specialty	
Primary Care	58.5
Medical Specialties	60.4
Surgical Specialties	50.7
Race	
White	59.0
Non-White	56.6
Age	
< 55 years	58.8
≥55 years	57.8
Satisfaction with outpatient EHR	
Other	54.5**
Satisfied	64.6 (p=0.002)
# of outpatients per week	
≤30	60.2
>30	56.8
Hours worked outpatient	
≤20 hours per week	58.5
>20 hours per week	58.1

Table 3 Physician characteristics and self-efficacy (Percent of respondents). Notes: 1. Only significant p-values are shown; 2. * p<0.05; ** p<0.01; *** p<0.001

Beliefs	Self-Efficacy (High self-efficacy)
Decrease medical errors	
Other Agree or Strongly Agree	51.6% 69.4%*** (p < 0.001)
Increase effectiveness of care[1]	
Other Agree or Strongly Agree	54.3% 77.1%*** (p < 0.001)
Improve patient-centered care	
Other Agree or Strongly Agree	54.9% 67.8%*** (p < 0.001)
Improve patient outcomes[1]	
Other Agree or Strongly Agree	53.8% 69.5%*** (p < 0.001)
Improve quality of care	
Other Agree or Strongly Agree	53.8% 72.4%*** (p < 0.001)
Improve care personally delivers	
Other Agree or Strongly Agree	53.8% 73.9%*** (p < 0.001)
Improve care the AMC delivers	
Other Agree or Strongly Agree	49.7% 73.1%*** (p < 0.001)

Table 4 Beliefs and self-efficacy (Percent of respondents). Notes: 1. Original item recoded to reflect positive scale here; 2. * p<0.05; ** p<0.01; *** p<0.001

References

1. Kim GR, Lehmann CU. In search of dialogue and discourse in applied clinical informatics. Appl Clin Inform 2009; 0: 1–7.
2. Blumenthal D, Tavenner M. The „meaningful use" regulation for electronic health records. N Engl J Med 2010; 363(6): 501–504.
3. Buntin MB, Jain SH, Blumenthal D. Health information technology: laying the infrastructure for national health reform. Health Aff (Millwood) 2010; 29(6): 1214–1219.
4. Linder JA, Ma J, Bates DW, Middleton B, Stafford RS. Electronic health record use and the quality of ambulatory care in the United States. Arch Intern Med 2007; 167(13): 1400–1405.
5. Grabenbauer, L, Fraser R, McClay J, Woelfl N, Thompson CB, Cambell J, WindleJ. Adoption of EHR – a qualitative study of academic and private physicians and health administrators. Appl Clin Inform 2011; 2: 165–176.
6. Grabenbauer L, Skinner A, Windle J. Electronic health record adoption – maybe it's not about the money: physician super-users, electronic health records and patient care. Appl Clin Inform 2011; 2: 460–471.
7. Soares N, Vyas K, Perry B. Clinician perceptions of pediatric growth chart use and electronic health records in Kentucky. Appl Clin Inform 2012; 3: 437–447.
8. Holden RJ. Physicians' beliefs about using EMR and CPOE: In pursuit of a contextualized understanding of health IT use behavior. Int J Med Inform 2010; 79(2): 71–80.
9. Hsiao CJ, Decker SL, Hing E, Sisk JE. Most physicians were eligible for federal incentives in 2011, but few had EHR systems that met meaningful-use criteria. Health Aff (Millwood) 2012; 31(5): 1100–1107.
10. Decker SL, Jamoom EW, Sisk JE. Physicians in nonprimary care and small practices and those age 55 and older lag in adopting electronic health record systems. Health Aff (Millwood) 2012; 31(5): 1108–1114.
11. Menachemi N, Brooks RG. EHR and other IT adoption among physicians: Results of a large-scale statewide analysis. J Healthc Inf Manag 2006; 20(3): 79–87.
12. Xieroli IM, Phillips RL, Green LA, Bazemore AW, Puffer JC. Factors influencing family physician adoption of electronic health records (EHRs). J Am Board Fam Med 2013; 26(4): 388–393.
13. Jha AK. Meaningful use of electronic health records: the road ahead. JAMA 2010; 304(15): 1709–1710.
14. Abbett SK, Bates DW, Kachalia A. The meaningful use regulations in information technology: what do they mean for quality improvement in hospitals? Jt Comm J Qual Patient Saf 2011; 37(7): 333–336.
15. Hogan SO, Kissam SM. Measuring meaningful use. Health Aff (Millwood) 2010; 29(4): 601–606.
16. Cabana MD, Kim C. Physician adherence to preventive cardiology guidelines for women. Womens Health Issues 2003; 13(4): 142–149.
17. Cabana MD, Rand CS, Powe NR, Wu AW, Wilson MH, Abboud PA, Rubin HR. Why don't physicians follow clinical practice guidelines? A framework for improvement. JAMA 1999; 282(15): 1458–1465.
18. Bandura A. Self-efficacy: Toward a unifying theory of behavior change. Psychological Review 1977; 84(2): 191–215.
19. Bandura A. Social foundations of thought and action: a social cognitive theory. Englewood Cliffs, NJ: Prentice-Hall 1986.
20. Hosmer DW, Lemeshow S. Applied Logistic Regression. New York: Wiley 2000.
21. Holt DT, Helfrich CD, Hall CG, Weiner BJ. Are you ready? How health professionals can comprehensively conceptualize readiness for change. J Gen Intern Med 2009; 25(Suppl. 1): 50–55.
22. DesRoches CM, Audet A-M, Painter M, Donelan K. Meeting meaningful use criteria and managing patient populations. Ann Intern Med 2013; 158: 791–799.
23. Chiang MF, Boland MV, Brewer A et al. Special requirements for electronic health records in Ophthalmology. Ophthalmology 2011; 118: 1681–1687.
24. Zandieh SO, Abramson EL, Pfoh ER, Yoon-Flannery K, Edwards A, Kaushal R. Transitioning between ambulatory EHRs: a study of practitioners' perspectives. J Am Med Inform Assoc 2012;19:401–406.
25. Gold MR, McLaughlin CG, Devers KJ, Berenson RA, Bovbjerg RR. Obtaining providers' 'buy-in' and establishing effective means of information exchange will be critical to HITECH's success. Health Aff (Millwood) 2012; 31(3): 514–526.
26. Harle CA, Huerta TR, Ford EW, Diana ML, Menachemi N. Overcoming challenges to achieving meaningful use: insights from hospitals that successfully received Centers for Medicare and Medicaid Services payments in 2011. J Am Med Inform Assoc 2013; 20(2): 233–237.

