

Refereed paper

Barriers to ambulatory EHR: who are 'imminent adopters' and how do they differ from other physicians?

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ABSTRACT

Objective Despite existing knowledge regarding electronic health record (EHR) barriers in the ambulatory setting, little is known, specifically, about physicians who are likely to adopt EHR imminently. The current study identifies these imminent adopters and compares their barriers to other physicians.

Design and measurements Mail survey of Florida physicians ($n=14\,921$) about barriers to EHR and adoption intentions. The survey asked respondents to classify themselves as planning to adopt an EHR system within one year (herein referred to as 'imminent adopters'), as planning to adopt an EHR system but not within one year ('interested adopters'), and as not considering an EHR system. Chi-square analysis and logistic regression models were used to identify trends among imminent adopters and to compare barriers among respondents in each of the adoption categories above.

Results A total of 4203 returned surveys represented a 28.2% response rate. Imminent adopters were significantly less likely to be in solo practice (19.6% vs. 40.0%, $P<0.001$) and more likely to be in an urban area ($P=0.044$) or in a multi-specialty

practice ($P=0.023$). Imminent adopters were also more likely to be practising family medicine ($P=0.014$) or obstetrics/gynaecology ($P=0.038$). When compared with their colleagues, imminent adopters perceived EHR barriers very differently. For example, imminent adopters were significantly less likely to consider upfront cost of hardware/software [OR=0.35 (0.30, 0.45)] or that an inadequate return on investment [OR=0.25 (0.19, 0.34)] was a major barrier to EHR. Moreover, imminent adopters differed from their colleagues with respect to numerous other productivity-related and technical-related barriers.

Conclusion Policy and decision makers interested in promoting the adoption of EHR among physicians should focus on the needs and barriers of those most likely to adopt EHR. Given that imminent adopters differ considerably from their peers, current EHR incentive programmes that focus on financial barriers only might prove sub-optimal in achieving immediate widespread EHR adoption.

Keywords: ambulatory EHR use, barriers, diffusion theory, outpatient EHR

Introduction

The widespread use of electronic health records (EHRs) in the United States healthcare system promises to bring with it many benefits.^{1,2} These benefits might include improved quality,³⁻⁵ reduced medical errors,^{6,7} improved provider and patient satisfaction,⁸⁻¹⁰ and improved financial performance.¹¹⁻¹³ Nevertheless, estimates of EHR use in the ambulatory setting,

especially in small practices, remain low and usually in the range of 12.9% to 23%.^{14,15} Despite the promise EHRs hope to deliver, US adoption of this technology lags behind many other industrialised nations.^{16,17}

Many barriers to EHR use have been documented in the literature.¹⁸⁻²¹ Research suggests that physicians are reluctant to adopt EHR for a variety of reasons,

including relatively high upfront costs and ongoing costs of maintenance.^{19,22,23} Financial barriers are important given that under certain reimbursement scenarios, investment in EHRs by physicians might well yield monetary benefits to other entities (such as third-party payers) and not necessarily the physicians themselves.^{20,24} Other previously identified barriers to EHR adoption include a disruption to the office workflow, lack of training and knowledge, discomfort with the use of computers, and a perceived shift in the doctor–patient relationship.^{19,21,25–27} Recent evidence also suggests that the large number of EHR products in the marketplace makes it difficult, especially for smaller practices, to identify which vendor best meets their needs and will be in business for future technical support that will be needed.²⁸

To overcome some of these barriers, numerous organisations, including the US Federal government, have begun to incentivise EHR adoption among physicians.²⁹ Such attempts have included pay-for-performance³⁰ and discounted software programs.³¹ However, given the early and exploratory nature of such initiatives, their success in influencing widespread EHR adoption is still unknown. Diffusion of innovation theory³² suggests that adoption of a given technology typically comes in ‘waves’, and a certain critical mass of adoption first needs to be achieved before a significant increase in future adoption will occur. With respect to EHR, this critical mass, sometimes called ‘the tipping point’,³³ will only occur if efforts to promote EHR adoption specifically target those who are most likely to adopt this technology in the short term. These ‘imminent adopters’ are extremely important from a policy perspective. Minimising barriers for them could enable the next wave of EHR adoption, thus moving the marketplace closer to the critical tipping point.

Despite the existing knowledge base on barriers to EHR adoption, little is known specifically about these imminent adopters and their current barriers. Previous work examining barriers has not discriminated between individuals of varying adoption intentions. Instead, many studies have examined physicians’ perceptions, as a whole, regarding EHR use. Consequently, identifying the profile of current imminent adopters is an important first step in influencing adoption of EHR in the ambulatory care marketplace. Moreover, if barriers among imminent adopters differ from their counterparts, some of the strategies to incentivise physicians to adopt EHR might be misdirected. The current study represents the first attempt to identify and describe the demographic and practice characteristics of imminent adopters. Moreover, the present study examines current differences in EHR barriers between imminent adopters and other physicians. If important trends emerge, the policy relevance of these findings could be significant.

Methods

The present study is an analysis of data collected in a large-scale study of physicians practising in Florida, conducted during March–June 2005. In the overall study, all primary care physicians and a 25% stratified random sample of clinical specialists (total $n=14\,921$) were surveyed regarding the use of information technologies in the ambulatory setting. Because the focus of the study was the outpatient setting, hospital-based physicians (for example, radiologists, pathologists, anaesthesiologists and emergency physicians) were excluded.

A five-page survey was developed specifically for this study, and mailed to physicians with a clear and active licence to practise medicine in Florida. The list of physicians, including practice addresses, was obtained from the state Department of Health, which maintains this list for licensure purposes. Those with a practice address outside of the state were excluded. The survey was accompanied by a cover letter which was drafted on University letterhead and signed by a physician researcher. Prior to the mailing of the survey, content and face validity were established by soliciting expert advice. Additionally, the draft instrument was pilot-tested with a panel of physicians for clarity and readability.

The questionnaire assessed the use of various information technology applications in the physician’s office practice. Specific questions included whether a given physician currently used an EHR system at their practice. An EHR system was defined as a paperless form of the medical record that requires the provider to enter patient information (that is, clinical notes) into a computer system instead of doing so on paper. Those who did not currently have an EHR system were asked if they were considering getting one.

The survey asked respondents to classify themselves as planning to adopt an EHR system within one year (herein referred to as ‘imminent adopters’), as planning to adopt an EHR system but not within one year (‘interested adopters’) and as not considering an EHR system.

The survey also included a section that assessed how each potential barrier, from a list, might contribute to why physicians did not currently use an EHR system in their office practice. The list was in part derived from the literature cited above and included published barriers to EHR adoption among physicians. Those who suggested they were currently using an office-based EHR system were asked to indicate how each potential barrier affected their decision to continue (or expand) the use of EHR. In addition, current EHR users were asked to indicate the vendor of the system they had installed. This question was asked to get a better sense for the number of vendors currently

servicing physician EHR users in the ambulatory setting. Again, a large number of vendors might be a barrier to non-EHR users who might not have the time or expertise to differentiate between all the products available to them. Lastly, the survey included demographic questions and questions regarding satisfaction with current medical practice, and level of computerisation in the office practice, as well as a question regarding self-perceived computer literacy.

Statistical analyses

Analyses included standard descriptive statistics and Chi-square analysis to detect differences among groups. In addition, logistic regression models were conducted to compute adjusted odds ratios. Each regression model was used to detect the relative difference between imminent adopters and other non-users with respect to their rating of a potential EHR barrier as 'major'. Regression models controlled for practice size, practice type (single vs. multi specialty), location (rural vs. urban) and physician specialty (primary care vs. other).

The categories of practice size included those in solo practice, those with two to nine physicians, 10–49 physicians, and 50 or more physicians. To identify rural physicians, office practice zip codes were used to identify physicians in statutorily designated rural counties, or those practising in Federal rural areas as designated by the Rural Urban Commuting Area (RUCA) codes.³⁴ Physician specialty and practice type were self-reported on the survey.

Results

A total of 4203 surveys were returned, representing a 28.2% response rate. Demographic characteristics of respondents were consistent with known demographics of Florida physicians.³⁵ Briefly, average age of respondents was 50.6 years with a range of 30–86. The majority of physicians were Caucasian (68.4%), male (75.9%), and worked in a single specialty practice (66.3%). A great number of respondents were in either solo practice (30.9%) or had two to nine physicians in their group (54.2%). An additional 9.7% and 5.2% were in groups of 10–49, or greater than 50, physicians, respectively.

Characteristics of imminent adopters

Overall, 3208 physicians (76.3%) indicated that they did not currently use an EHR system in their office

practice. Of those who did not currently have an EHR system, 510 (20.8%) were categorised as 'imminent adopters' because they expressed an interest in adopting EHR within the next 12 months. An additional 844 physicians (34.4%) were categorised as 'interested adopters' for considering the purchase of an EHR system, but not within one year. Lastly, 1101 physicians (44.9%) suggested that they were not considering adopting EHR.

Table 1 summarises the demographic and practice characteristics by the likelihood that respondents plan to adopt an EHR system. Imminent adopters, when compared to other non-users, were significantly less likely to be in solo practice (19.6% vs. 40.0%, $P<0.001$). Moreover, imminent adopters were more likely to be in an urban area ($P=0.044$), in a multi-specialty practice ($P=0.023$), and be practising family medicine ($P=0.014$) or obstetrics/gynaecology ($P=0.038$). No differences were noted between imminent adopters and other non-users with respect to other specialties or gender.

The questionnaire asked physicians to respond on a five-point Likert scale how computer-literate they considered themselves, and overall how satisfied they were with the current medical practice. Findings indicated that imminent adopters were significantly more likely to perceive themselves as 'sophisticated' computer users when compared with other non-users (47.2% vs. 37.8%, $P<0.001$). No differences existed with respect to overall satisfaction with current medical practice between imminent adopters and others. However, imminent adopters were significantly more likely to be dissatisfied with the level of computerisation in their office practice (31.7% vs. 17.1%, $P<0.001$).

Barriers to EHR

The percentage of physician respondents, organised by EHR adoption intention, who rated each potential barrier as 'major' is displayed in Table 2. These univariate results did not differ from the results of the regression models that controlled for practice size, practice type (single vs. multi-specialty), location (rural vs. urban) and physician specialty (primary care vs. other). Invariably, significant differences existed for how each barrier was rated by those not considering EHR, those interested in adopting and imminent adopters, respectively. Responses from current EHR users regarding their barriers to continued and expanded use of EHR are also presented in Table 2 for comparison purposes.

Results suggested that imminent adopters perceived financial barriers to be less pronounced than did other non-EHR users. For example, upfront cost of hardware/software was considered a major barrier

Table 1 Percentage of non-EHR physician users, by adoption intention, in various practice characteristics and demographic categories

	Imminent adopters (<i>n</i> =510) %	Other non-users (<i>n</i> =1945) %	<i>P</i> value
Practice size			
Solo practice	19.6	40.0	
2–9 physicians	67.5	53.7	
10–49 physicians	10.6	5.2	
50 or more physicians	2.2	1.1	<0.001
Training			
Family medicine	23.2	18.3	0.014
Internal medicine	15.2	17.9	0.156
Pædiatrics	16.0	16.5	0.770
Obstetrics/gynæcology	14.4	10.9	0.038
General and surgical specialists	9.8	11.2	0.459
Medical specialists	14.4	15.0	0.744
Other	7.0	9.3	0.037
Geographic location			
Urban	95.7	93.3	
Rural	4.3	6.7	0.044
Practice type			
Single specialty	86.3	90.3	
Multi-specialty	13.7	9.7	0.023
Age			
Less than 40 years	15.5	14.7	
41–50 years	46.3	35.3	
51–60 years	31.0	31.4	
61 years or more	7.2	18.5	<0.001
Gender			
Male	74.5	77.1	
Female	25.5	22.9	0.279

Note: Where applicable, numbers might not add up to 100% due to rounding.

to EHR significantly less often for imminent adopters when compared with other EHR non-users [OR=0.35; 95% CI (0.30, 0.45)]. Moreover, imminent adopters were significantly less likely to indicate that an inadequate return on investment was a major barrier to EHR use [OR=0.25; 95% CI (0.19, 0.34)].

In addition to differences in financial barriers, differences existed in productivity-related and technical-related barriers as well. For example, imminent-adopter physicians were significantly less likely than other non-users to suggest that they lacked the time to acquire and implement an EHR system [OR=0.37; 95% CI (0.29, 0.49)]. Furthermore, imminent adopters were significantly less likely to suggest disruption to

the workflow of their office's physical layout was a major barrier to EHR [OR=0.37; 95% CI (0.27, 0.50)].

Number of EHR vendors

Of the 995 physicians who indicated that they currently used an EHR system, 551 specified the vendor of their system. Among the specific vendors' products, The Department of Veteran's Affairs VIST-A system (9.3%) was most common; this was followed by in-house or 'home-grown' systems (8.7%). Next, 12 individual vendors represented between 6.2% and 2.9% of the respondents' EHR systems. An

Table 2 Percentage of Florida physicians, by adoption category, rating each potential barrier to EHR adoption as a 'major barrier'

Potential barrier to EHR adoption	Not currently using EHR			Current EHR users ² (n=995) %
	Not considering EHR (n=1101) %	Interested in adopting (n=844) %	Imminent adopters ¹ (n=510) %	
Financial				
Upfront costs of hardware/software are too high	70.3	68.6	44.7	25.8
Ongoing maintenance costs would be too high	57.3	42.1	24.9	15.6
Inadequate return on investment	57.1	40.3	19.9	12.9
Productivity				
Entering data into computer can be cumbersome	57.8	44.8	35.6	25.0
Lack of time to acquire/implement such a system	53.8	42.2	28.7	14.7
EHR might slow me down	42.7	26.8	22.6	19.0
Temporary loss of productivity and/or revenue during EHR system implementation phase	39.6	27.7	22.2	10.4
No time to learn how to use such a system	30.4	17.1	15.7	9.2
Disrupts workflow and/or office's physical layout to accommodate going to a computerised system	40.3	22.6	15.3	8.5
The system would be difficult to use	25.2	12.2	9.8	7.4
Technical				
Lack of uniform data standards within the industry	46.9	47.6	33.6	23.9
Temporary loss of access to patient records if computer crashes or power fails	49.7	37.4	23.2	20.4
Products available do not meet my needs	31.5	24.1	20.9	15.3
Me and/or my staff don't have any technical knowledge	18.3	8.6	4.8	4.5
Patients				
Privacy/confidentiality concerns	28.1	17.5	8.6	6.0
Patient resistance or not wanting their physicians to use EHR	10.4	3.2	3.0	1.8

Note: Using Chi-square test, all *P* values less than 0.001.

¹ Imminent adopters are current non-users who indicated a desire to adopt EHR within one year.

² Current EHR users were asked how these barriers affect their decision to expand using EHR; they are included for comparison purposes.

additional seven vendors had between 2.0% and 1.1% of systems. Lastly, 104 individual vendors represented less than 1% of physician EHR systems among respondents.

Discussion

Numerous experts^{2,36} and policy makers³⁷ have called for the widespread use of EHR in the US ambulatory

setting. However, the current rate of adoption has been slow and will likely take longer than the 10-year horizon originally projected.¹⁶ In order to spark the sorely needed catalyst necessary to propel the overall EHR adoption curve forward, policy efforts should target the barriers of individual physicians who plan to adopt EHR imminently. But the question remains: who are these individuals and how, if at all, do their barriers differ from other physicians? The current study was designed to answer these questions by understanding the barriers to EHR adoption among physicians likely to adopt EHR within one year.

Data are presented to suggest that the next likely group of physicians, in Florida, to implement EHR include computer-literate individuals who are dissatisfied with the level of computerisation in their practice. Certainly, being more computer-literate could increase one's sensitivity to the potential capabilities^{38,39} and documented benefits^{2,11,12,36,38,40} of EHR and might therefore lead to dissatisfaction with current levels of computerisation in one's practice. This finding seems to confirm early work that suggested that the breadth and depth of computer experience among providers directly influences perceived barriers toward EHR.⁴¹

Nevertheless, those in small group practices (two to nine physicians), those practising either family medicine or obstetrics/gynaecology, those practising in urban areas, or those who are part of multi-specialty practices were all significantly more likely, in the current study, to indicate a desire to adopt an EHR system within one year. Knowing this, stakeholders interested in promoting EHR use, such as third-party payers, IT vendors and the federally designated quality improvement organisations, should focus their limited resources where they are likely to bear the most fruit.

Another important finding of the current study is that even though imminent adopters frequently rank barriers similarly to their other physician colleagues, their overall perceived barriers to EHR are quite different. For example, a majority of those actively considering investing in EHR within the next year did not consider overall financial issues as a major barrier whereas those not considering EHR did. Furthermore, when compared with other physicians, imminent adopters had significantly less pronounced financial barriers overall. In fact, there appeared to be a 'dose-response' relationship between EHR contemplation and the perception of financial issues as a barrier. That is, the more seriously you were considering adopting EHR imminently, the less you believed that either the upfront cost of the system or the ongoing maintenance costs would be too high. This pattern held true for every type of barrier examined including technical-related and productivity-related barriers as well as privacy and other patient-oriented barriers.

These findings also suggest that monetary incentives alone, such as pay-for-performance and discounted software programs, might not ultimately achieve the next big wave of EHR adoption by physicians. This finding is particularly applicable to other nations, including the UK,³⁹ who are concerned with widespread EHR implementations. In the present study, barriers such as the *lack of available data standards* and *the lack of time to acquire and implement such a system*

were each ranked higher by imminent adopters than some financial barriers. Therefore, in addition to alleviating costs, other means of addressing barriers should be pursued. One such activity includes plans to 'certify' EHR products,⁴² which has been successfully done in the UK.³⁶

Certified products will help guarantee to physicians that a minimum level of EHR functionality, including interoperability, will be present in key products. The availability of certified EHR products will also considerably minimise the issue of having to select a viable and sustainable EHR product from among hundreds of vendors in the marketplace. Indeed, in the present study, over 100 EHR vendors were operating in Florida alone. Even though the present study did not specifically assess if the large number of vendors was a direct barrier, previous work²⁸ has noted that it could be a hindrance to physicians who lack the time needed to carefully compare each available product. Lastly, the issue of how entering data into a computer can be cumbersome was ranked as the second highest barrier among imminent adopters in the current study. This barrier does not seem to be addressed in the current strategies employed by many of those trying to spur EHR adoption in the US. Alternative means of facilitating data entry, as described by Walsh,³⁹ include the use of speech and handwriting; these modalities must be examined and tested.

Notwithstanding the important contributions of the current study, several limitations are worth mentioning. For example, it is recognised that the survey response rate could be a limitation. However, upon employing common methodologies used to detect bias,⁴³⁻⁴⁷ we failed to identify the presence of response bias in our sample.⁴⁸ To do this, known demographics of respondents and non-respondents were compared. In addition, survey answers from early respondents were compared with late respondents on questions that were likely to influence participation in the survey. Additionally, the survey did not capture information from each physician regarding their role and financial stake in the EHR adoption process. While most physicians, particularly those in solo or small practices, exert some influence about this decision, those who are salaried or in large practices may not directly participate in adoption decisions. Lastly, given that the current study had a cross-sectional design and represented individuals' responses for a single state during one point in time, generalisability to other locales should be done with caution. More research should examine barriers and adoption intentions of physicians and determine how they change over time.

Conclusions

In conclusion, the purpose of the current analysis was to identify and better understand the barriers of those likely to adopt EHR. By doing so, it is hoped that the discussion in the literature regarding EHR barriers can be expanded. Failing to recognise the unique perspective of imminent adopters risks further delay in the proliferation of an important technology that will enhance quality and patient safety. Future work should continue to explore imminent adopters and the unique challenges they face as they contemplate investing in an EHR system. Armed with such information, health-care leaders and policy makers can design incentives in such a way as to have the maximum positive effect.

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CONFLICTS OF INTEREST

None.

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