EHR Acceptance Factors in Ambulatory Care: A Survey of Physician Perceptions

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Abstract

With the U.S. government calling for electronic health records (EHRs) for all Americans by the year 2014, adoption of an interoperable EHR is imminent in America's future. However, recent estimates for EHR implementation in the ambulatory care environment are just over 10 percent. This second part of a two-part study (see part one here) examines EHR acceptance factors in an academic-based healthcare system.

Innovation diffusion theory and the Technology Acceptance Model provide a combined theoretical framework for this case study. An online questionnaire was administered to 802 faculty, fellow, and resident physicians to explore the factors affecting attitudes toward EHR adoption. In this study, age, years in practice, clinical specialty, health system relationship, and prior computer experience were not predictors of EHR acceptance. In order to facilitate successful adoption of health information systems, social and behavioral factors must be addressed during the EHR planning phase.

Key words: electronic health records, barriers, user adoption, physicians, attitudes, technology acceptance, health information systems, ambulatory care, diffusion of innovations, perceptions

Introduction

The benefits of electronic health records (EHRs) are well documented; however, a number of implementation barriers have impeded their widespread adoption. Prior reports call for the use of EHRs to enhance continuity of care and improve patient safety.[1–3] With the U.S. government calling for EHRs for all Americans by the year 2014, adoption of an interoperable EHR is imminent in America's future.[4,5] However, user adoption is crucial in order for an EHR system to be beneficial, and physician acceptance will determine the overall success of a product's implementation.[6] Some speculate that even with incentives, critical mass adoption by the prescribed deadline is unlikely, and the informatics literature warns that hasty deployment of health information technology may result in implementation failure or unintended consequences.[7-9] Lack of support for the system from physicians and other clinicians is problematic, and resistance hinders initial adoption as well as sustained use.[10]

The purpose of this descriptive study is to investigate the factors that influence physician attitudes toward adoption of an ambulatory EHR system. Using case study and survey methods, this second part of a two-part study examines physician perceptions prior to EHR implementation. This research is important because understanding the reasons why a system may succeed or fail is crucial for successful implementation.[11]

Background

Diffusion of Innovations (DOI) theory and the Technology Acceptance Model (TAM) provide a combined theoretical framework for this case study. Both models have been used extensively in prior adoption studies. While not specific to information technology, DOI research examines the social processes surrounding changes that occur when an innovation-a new idea, practice, or object-is introduced into an organization.[12] Healthcare systems are very complex social systems comprised of individuals with varying backgrounds, experiences, and values. DOI research examines which social characteristics impact an individual's decision to adopt or reject a new innovation and classifies adopters into categories based upon these characteristics.

The TAM focuses exclusively on factors that determine users' behavioral intentions toward using a new computer technology, specifically, perceived usefulness and perceived ease of use.[13] The TAM hypothesizes that a user's intended behavior predicts

actual system use. In many situations, there may be variables besides perceived ease of use and perceived usefulness that predict intention, and an extended model is necessary for explaining factors that impact user acceptance.[14] Commonalities between these two theories include the characteristics of the individual, the technology, and the organizational context. Information systems are made up of users and their work processes, as well as information technologies and data. Therefore, it is important to examine the behavioral, social, and organizational processes that both affect and are affected by clinical information systems.[15,16]

The first part of this study sought to determine which social and technical factors have the largest impact on physician attitudes toward EHR adoption. This second part seeks to correlate the individual physician characteristics with the social and technical factors to better understand the behavioral intentions of this user population. The specific factors explored in this study include physician perceptions of computer skills and training, management support, physician involvement and participation in the process, physician autonomy, the doctor-patient relationship, perceived ease of use, and perceived usefulness. Review of the literature suggests that studies of this nature in service delivery organizations, such as healthcare, are limited.[17]

The medical informatics literature reveals inconsistent findings regarding significant predictors of computer attitudes. Some prior studies have found age, computer experience, and practice site to be accurate predictors, while other studies have not.[18–21] Few empirical studies have evaluated physician attitudes toward EHR adoption prior to implementation. Dansky et al. found perceived usefulness, computer experience, patient care values, and organizational support to positively impact attitudes before implementing an EHR system.[22] Age and gender were not significant predictors of acceptance. Gadd and Penrod assessed physician attitudes prior to and after EHR implementation.[23,24] Findings indicated perceived usefulness to be the significant predictor before and after implementation, and concerns regarding patient privacy, interference with physician-patient rapport, workflow, efficiency, and autonomy were found. One study found computer experience to be the major predictor of acceptance, with age being nonsignificant.[25] A user satisfaction study comparing attitudes regarding EHRs between adopters and nonadopters found prior computer experience and perceived usefulness to impact attitudes.[26]

In the first part of this study, a model for predicting physician attitudes toward EHR adoption was developed and tested using structural equation modeling (SEM). Variables included individual physician characteristics and social and technical (sociotechnical) factors. No significant correlations were observed between the individual physician characteristics and the sociotechnical factors. However, the sociotechnical variables explained more than 73 percent of the variance in attitudes regarding EHRs, and acceptable model fit was achieved. SEM analysis revealed that perceived usefulness had the strongest impact (.63) on attitude about EHR use, with physician involvement (.47), perceived ease of use (.34), and doctor-patient relationship (−.21) making noteworthy contributions. Perceived ease of use did not directly impact attitudes about EHR use as hypothesized. The full framework and detailed SEM results were presented in the first part of the study.[27] This publication, the second part, provides an analysis of the participants and the sociotechnical factors to gain deeper insight into the antecedents of EHR adoption attitudes.

Methods

This case study was conducted at the University of Mississippi Medical Center (UMMC), an academic-based healthcare system in Jackson, Mississippi. This site was selected because it was in the process of choosing an EHR application that would eventually be implemented in all physicians' offices in the system.

Data were collected between August and December 2007. A self-reporting questionnaire was distributed to 802 physicians (325 faculty, 477 fellows and residents) using the Perseus online survey application. Three follow-up e-mail reminders were sent to nonresponders.

The research instrument is based upon a survey developed by Aldosari and incorporates some additional questions developed by Cork, Detmer, and Friedman.[28,29] Both have been validated and tested for reliability in prior studies. It contains 10 sections. Section 1 elicits general information about the respondents. Sections 2–9 collect data regarding eight constructs (unobserved variables comprising multiple survey items):

1. management support
2. physician involvement
3. adequate training

    4. physician autonomy
    5. doctor-patient relationship
    6. perceived ease of use
    7. perceived usefulness
    8. attitude about EHR usage

The final section gave respondents an opportunity to provide comments. All questions, except those in the general information and comments sections, captured responses via a five-point Likert scale ranging from "strongly disagree" to "strongly agree." Copies of the survey are available from the authors.

Data were imported into SPSS 16.0 from the Perseus survey application. Using the SPSS Syntax Editor, scales were created for the eight sociotechnical constructs by averaging the participants' responses (i.e., 1 to 5) for all question items for each construct. Item mean replacement was used to fill in missing Likert scores.

Results

A total of 239 usable responses was obtained, resulting in an overall response rate of 29.8 percent. The faculty physician response rate was 28.6 percent; the response rate of residents and fellows was 30.6 percent.

Respondents

Data collected on individual physician characteristics included gender, age, years in practice, and health system relationship (Table 1). The majority of respondents (71.5 percent) were male, and 38.9 percent were members of the UMMC faculty. Approximately 56 percent of respondents were residents, while 5 percent were fellows. Most physicians were under the age of 40 (66.9 percent), with only 5.4 percent falling into the "60 years and older" category. More than half (51.5 percent) had been in practice for less than five years, with the next larger group (27.6 percent) reporting more than 15 years of experience. This was not surprising, considering that more than half (56.1 percent) of the participants were residents. Responses were received from all 31 specialties. A breakdown by specialty is provided in Table 2.

Table 1: Demographic Distribution of Participants (N = 239)

Respondent Profile	f	%
Gender		
Female	68	28.5
Male	171	71.5
Age		
Under 30 years	78	32.6
30-39 years	82	34.3
40-49 years	28	11.7
50-59 years	38	15.9
60 years and older	13	5.4
Years in Practice		
Less than 5 years	123	51.5
5-10 years	38	15.9
11-15 years	12	5.0
More than 15 years	66	27.6
Health System Relationship		
Faculty	93	38.9
Resident	134	56.1
Fellow	12	5.0

Table 2: Distribution of Participants by Clinical Specialty (*N* = 239)

Specialty	*f.*	%
Anesthesiology	22	9.2
Family/general practice	22	9.2
Medicine, general	19	7.9
Emergency medicine	18	7.5
Surgery, general	18	7.5
Pediatrics	17	7.1
Orthopedics	15	6.3
OB/GYN	13	5.4
Otolaryngology	13	5.4
Cardiology	10	4.2
Pathology	9	3.8
Internal medicine/pediatrics	7	2.9
Psychiatry	7	2.9
Neurosurgery	5	2.1
Urology	5	2.1
Neurology	4	1.7
Ophthalmology	4	1.7
Plastic surgery	4	1.7
Radiology	4	1.7
Infectious disease	3	1.3
Pulmonary medicine	3	1.3
Rheumatology	3	1.3
Allergy and immunology	2	0.8
Cardiothoracic surgery	2	0.8
Endocrinology	2	0.8
Hematology/oncology	2	0.8
Nephrology	2	0.8
Digestive disease	1	0.4
Oncology	1	0.4
Trauma surgery	1	0.4
Vascular surgery	1	0.4

Prior Computer Use, Experience, and Sophistication

Physicians were asked about their prior computer experience (Table 3). Most reported using computers to access their patients' medical information (77.4 percent), e-mail (96.2 percent), and online clinical resources (87.0 percent). The majority of physicians reported using the current UMMC system frequently (91.2 percent), and 35.1 percent had used an EHR system in a healthcare facility elsewhere. (The current UMMC system provides read-only access to real-time patient information via a secure Web-based portal. Physicians do not directly document or enter data into this system.) "Self-guided learning" was the most common form of prior computer experience described, as reported by 87.0 percent of participants, and the majority (43.1 percent) considered themselves to be generally sophisticated computer users. None of the respondents, however, rated themselves as having "extra" training or sophistication in this area.

Table 3: Prior Computer Use, Experience, and Sophistication (N = 239)

Computer Skills	f	%
Personal Computer Use		
Patients' medical information	185	77.4
E-mail	230	96.2
Health/clinical resources, journals, and/or research	208	87.0
Other	15	6.3
Prior UMMC System Use		
Frequent usage	218	91.2
Infrequent usage	19	7.9
Past usage	3	1.3
Never used UMMC system	1	0.4
Past EHR usage elsewhere	84	35.1
Prior Computer Experience/Training		
Formal medical school training	50	20.9
Formal residency/fellowship training	35	14.6
Formal workshops/conferences (CME credit)	11	4.6
Workshops/conferences (no CME credit)	38	15.9
Self-guided learning about computers	208	87.0
None	13	5.4
Computer Sophistication†		
Novice	30	12.6
Technician	60	25.1
General	103	43.1
Advanced	46	19.2
Extra	0	0

† Computer sophistication levels are defined as follows:
- Novice: beginner with limited skills and privileges
- Technician: advanced beginner; dabbler; starting to function creatively and assist others, but without significant expertise
- General: starting to become well-rounded, knowledgeable
- Advanced: experienced, able to assist others independently, critically; usually have completed formal training in computer science, medical informatics or related area
- Extra: seasoned, experienced, the most accomplished in the field; will have completed *advanced training in both medicine and medical informatics* or related area

Factors Affecting EHR Attitudes

Participants' Likert responses (i.e., 1 to 5) were averaged for all question items for each sociotechnical factor construct. Factor means and variances are displayed in Table 4. Means fell between 3, "neither agree nor disagree," and 4, "agree," for all factors except for doctor-patient relationship (mean = 2.13). The items in that particular construct specifically asked about the relationship between physicians and patients being negatively impacted by EHR use, so it made sense that this construct mean would be lower than the others. The lower average for this variable actually means that physicians *did not* anticipate their relationships with patients to be impaired by EHR use. Scale means for the other social factors were as follows: management support, 3.65; physician involvement, 3.83; adequate training, 3.58; and physician autonomy, 3.14. Scale means for the technical factors were 3.65 for perceived ease of use and 3.45 for perceived usefulness. The overall attitude about EHR use was computed to be 3.74 on the five-point scale. Table 5 displays the means and standard deviations for individual survey items.

Table 4

Factors Affecting Physicians' EHR Attitudes (*N* = 239)

Factor	Mean	Variance
Management support	3.65	1.00
Physician involvement	3.83	1.10
Adequate training	3.58	1.05
Physician autonomy	3.14†	1.26†
Doctor-patient relationship	2.13†	1.14†
Perceived ease of use	3.65	0.997
Perceived usefulness	3.45	1.24
Attitude about EHR usage	3.74	1.19

Notes:
All items were measured on a five-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, 5 = strongly agree).

† Items pertain to negative concepts.

Table 5: Item Analysis of Factors Affecting Physicians' EHR Attitudes (N = 239)

Factor	Survey item	Mean	Standard Deviation
Management support	EHR project is important to top management	4.18	0.874
	EHR project will be introduced to me effectively	3.53	1.033
	Mgt will do an effective job during EHR implementation	3.46	1.011
	Mgt will involve me in EHR implementation	3.15	1.140
	Mgt will provide training that I need to use EHR effectively	3.49	1.003
	I will have easy access to resources to help me use EHR	3.55	1.002
	Mgt expects me to use EHR	4.33	0.747
Physician involvement	My involvement during EHR implementation is a must		
	My involvement during EHR implementation will be effective	3.83	1.052
	My involvement during EHR implementation will make EHR more useful to me	3.61	0.964
	My involvement during implementation will make EHR easier to be used	4.03	0.905
	Overall, my involvement will positively affect my attitude	4.07	0.894
		3.92	0.980
Adequate training	Training will be adequate	3.42	0.964
	I will receive training I need to understand/use EHR	3.48	0.966
	Training will make EHR more useful to me	3.79	0.958
	Training will make EHR easier for me to use	3.83	0.940
Physician autonomy	EHR will increase hospital administration's control	3.73†	0.985
	EHR will increase UMMC's ability to control/monitor physician's clinical practices	3.72†	0.987
		2.92†	1.090
	EHR may threaten physician's privacy	2.89†	1.067
	EHR may result in legal/ethical problems for physician	2.84†	1.138
	EHR may limit physician's autonomy	3.24†	1.057
	Overall, EHR may negatively affect physician's attitude due	3.08†	1.043

	to increased control/monitoring of clinical practices		
	Overall, EHR may negatively affect physician's attitude due to security, legal, ethical concerns		
Doctor-patient relationship	EHR may diminish patient's confidence in physician	2.14†	1.049
	EHR may threaten physician's credibility with patients	2.02†	0.987
	EHR will likely decrease patient satisfaction	2.13†	1.034
	Overall, EHR will likely interfere with MD-patient interaction	2.28†	1.169
Perceived ease of use	My interaction with EHR will be user-friendly	3.39	1.022
	Learning to use EHR will be easy for me	3.63	1.003
	I expect to become skilled using EHR	4.05	0.871
	Overall, I expect EHR will be easy for physicians to use	3.56	1.039
Perceived usefulness	EHR will improve the quality of my work	3.70	1.058
	EHR will give me greater control over my work schedule	3.19	1.095
	EHR will allow me to accomplish tasks more quickly	3.41	1.159
	EHR will allow me to accomplish more work	3.24	1.144
	EHR will enhance my overall effectiveness in my job	3.51	1.040
	EHR will make my job easier to perform	3.37	1.113
	Overall, EHR should be a useful tool for practicing	3.88	0.968
Attitude about EHR usage	EHR will support physicians in providing better care	3.82	0.931
	I will encourage EHR among my colleagues	3.92	0.922
	I need the EHR to provide effective patient care	3.28	1.201
	I am not satisfied with using paper-based patient records	3.61	1.210
	All physicians should learn to use the EHR effectively	4.07	0.830
	Overall, my attitude about EHR usage will be positive	4.02	0.906

Notes:

All items were measured on a five-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, 5 = strongly agree).

† Item pertains to negative concept.

In this study, no significant correlations were noted between the individual physician characteristics and prior computer (PC) use, computer sophistication, or prior computer experience (see Table 6 and Table 7). Therefore, it was not possible to classify physicians into adopter categories (i.e., early adopter or late adopter), as is typically done in innovation diffusion studies.

Table 6: Pearson Correlations between Individual Physician Characteristics, PC Use, and Sophistication

	Gender	Age	Ethnicity	Years in Practice	Clinical Specialty	Health System Relationship	PC Use Patient Medical Info	PC Use for E-mail	PC Use Health/ Clinical Resources	PC Use Other	PC Sophis.
Gender	1										
Age	.102	1									
Ethnicity	−.025	−.002	1								
Years in Practice	.000	.861**	.026	1							
Clinical Specialty	−.063	−.071	.025	.006	1						
Health System Relationship	.032	−.673**	.004	−.672**	−.083	1					
PC Use Patient's Medical Information	.125	.169**	−.025	.145*	−.110	−.198**	1				
PC Use for E-mail	.021	.044	.051	.099	.038	−.002	.208**	1			
PC Use Health/ Clinical Resources	.060	.167**	−.049	.162*	−.041	−.120	.387**	.447**	1		
PC Use Other	.048	.154*	.009	.103	−.037	−.088	.099	.051	.049	1	
PC Sophis.	.110	−.052	−.070	−.023	−.057	.023	.036	.148*	.100	.143*	1

* $p < .05$
** $p < .01$

Table 7: Pearson Correlation between Individual Characteristics and Prior Computer Experience (*N* = 239)

	Gender	Age	Ethnicity	Years in Practice	Clinical Specialty	Health System Relationship	UMMC System Frequent Use	UMMC System Infrequent Use	UMMC System Past Use	UMMC System Never Used	EHR Elsewhere
Gender	1										
Age	.102	1									
Ethnicity	−.025	−.002	1								
Years in Practice	.000	.861**	.026	1							
Clinical Specialty	−.048	−.050	.021	.022	1						
Health System Relationship	.032	−.673**	.004	−.672**	−.095	1					
UMMC System Frequent Use	.066	−.136*	−.088	−.116	.028	.127	1				
UMMC System Infrequent Use	−.020	.048	.034	.052	−.026	−.070	−.838**	1			
UMMC System Past Use	−.095	.221**	.127*	.167**	−.015	−.131*	−.363**	−.033	1		
UMMC System Never Used	−.103	−.014	−.026	−.004	.078	−.075	−.209**	−.019	−.007	1	
EHR Elsewhere	.056	−.164*	−.073	−.071	−.083	.176**	.012	.010	−.083	−.048	1

* *p* < .05
** *p* < .01

Discussion

The literature shows conflicting evidence that individual physician characteristics may play a role in predicting attitudes toward use of a new technology. This study sought to determine if social factors mediate between individual characteristics and the TAM variables. None of the physician characteristics in this study correlated with any of the other model variables. These findings could be reflective of a homogenous sample and are consistent with findings observed in several prior studies.[30-37]

Respondents in most of these prior studies tended to be younger in age and scored high in computer literacy. The majority of respondents (67 percent) in the current study were under the age of 40, which could signify a broad exposure to computers prior to their medical practice experiences. Detmer and Friedman did observe differences in computer attitudes based upon specialty, age, and computer experience; however, they also noted a lack of formal computer training in their respondents.[38] They believed this result was the effect of education rather than the demographic variables on attitudes. Most respondents in the current study use computers regularly, and 91 percent use the current UMMC system frequently. The majority (62 percent) self-rated their computer skills as generally knowledgeable or advanced. Only 5 percent reported no formal training on computers, but this could be reflective of the age of the majority of the respondents. It is likely that younger respondents obtained formal computer training prior to attending medical school, such as in an undergraduate program or in elementary or high school.

O'Connell et al. studied EHR satisfaction in pediatric and medicine residents.[39] Age, years in practice, and prior computer experience were not correlated with EHR satisfaction; however, differences in specialty and prior EHR experience were significant. They concluded that this variance was due to the medical residents' extensive experience with the Veterans Affairs (VA) hospital's Computerized Patient Record System (CPRS), with which the pediatric residents had no experience. Virtually all of the users in the current study had prior experience with CPRS, which could contribute to the lack of correlation

between individual characteristics and EHR attitudes. All physicians completing a residency at UMMC rotate through the G. V. Sonny Montgomery VA Medical Center. Residents are trained on the VA's CPRS on the first day of rotation, and approximately 50 percent of the residency experience is spent practicing at the VA. The fact that only 35 percent of survey respondents reported use of an EHR product elsewhere is an inconsistent finding. Narrative comments provided by respondents substantiate their exposure to CPRS. The low percentage reported could be related to the timing of the survey distribution, as all physicians begin their residencies on July 1 of each year. It is possible that many respondents had not yet rotated through the VA system at the time the survey was completed.

While it does appear the respondents may be homogenous in their beliefs about EHR attitudes, the lack of correlation of clinical specialty with the other model variables may be due to an underrepresentation of some specialties in the study. Responses were received from all 31 specialties, but about half (16) of the specialty categories had fewer than five participants. Most of these were smaller programs with fewer physicians overall; however, members of some specialties appeared to be more motivated to participate in the study than others. This could be due to a variation in the amount of encouragement provided by some residency program directors and coordinators to participate. Future studies might focus on eliciting better participation from some of the lesser represented specialties.

In this study, the social and behavioral factors were accurate predictors of EHR attitudes and are discussed in the first part of the study.

Implications for Professional Practice and Future Research

Individual user characteristics are not always accurate predictors of attitudes, as was demonstrated in this study. Use of sound project management techniques will be necessary to ensure successful design and implementation of EHRs. Creative change management strategies will be essential. Health information management (HIM) practitioners can promote EHR diffusion by providing expertise before, during, and after implementation.

By working closely with physicians, HIM professionals can develop information management plans that support user needs and facilitate workflows, while meeting accreditation and regulatory documentation requirements. By assessing the information needs of physicians and other EHR users, practitioners can help develop criteria for evaluating and selecting EHR systems specific to their users' needs. Opportunities exist to provide consultation regarding e-discovery implications, assist providers in defining the legal health record, and help physicians understand documentation requirements to avoid billing fraud and abuse.

HIM and information technology (IT) professionals should engage physicians in the planning and promotion of initial and ongoing user training programs. Respondents in this study not only desired flexibility in the timing and structure of training programs but also believed that clinician trainers would help promote initial and sustained EHR acceptance. HIM professionals are experienced in working closely with physicians and often serve as a liaison between IT and clinicians. These professionals can organize and provide user training sessions and also function as the "go to" contact for problem resolution, for which participants in this study voiced a need.

Understanding the needs and attitudes of the medical staff will help organizations to facilitate a smooth EHR implementation. These findings may be useful to EHR system developers in designing products to accommodate multiple clinical specialties and user skill levels. While this study was conducted in an ambulatory environment, these recommendations may be applicable for inpatient settings as well.

Limitations

This case study is limited to one large healthcare system, and results may not be reflective of attitudes found in other physician populations. Many members of this user group had prior experience using EHRs in other healthcare institutions as well as retrieving data from clinical information systems. More than half of the physicians receiving the survey (59.5 percent) and completing the survey (56.1 percent) were residents, so it is possible that the perceptions of a younger research population may have impacted study results. The research is also constrained by the use of an anonymous survey for data collection. The small sample size is a shortcoming of the subjects' willingness to participate, and some clinical specialties were underrepresented. In addition, some prior TAM studies have shown a shift in perceived usefulness, perceived ease of use, and attitudes post implementation.[40] It is possible that attitudes will differ after the EHR system is used.

Conclusion

Due to the initiation of the U.S. government's accelerated health information technology agenda, the number of EHR implementation projects is on the rise. However, success rates for clinical information system implementations are still estimated at only a mere 28 percent. The complexity of the system, as well as the healthcare environment, cannot be underestimated. In this particular study, individual physician characteristics did not correlate with attitudes regarding EHRs. It cannot be assumed that physicians of a particular age, clinical specialty, affiliation (faculty/resident), or computer skill level will be more or less resistant than other physicians. Unsuccessful implementations have been attributed to problems with communication, complexity, people, organization, technology, planning, and leadership. In order to facilitate successful adoption of health information systems, social and behavioral factors must be addressed during the EHR planning phase.

A measure of preimplementation attitudes is a first step toward assessing system readiness for EHR adoption. Ongoing evaluation will be necessary to determine the EHR's impact on users and overall effects on patient care.

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