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The Rx for Electronic Healthcare Records: Time, Not Incentives

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Abstract
Rising healthcare costs are a significant US societal concern growing from 7.5% of GNP in 1971 to 15.3% in 2004. Likewise, the number of uninsured Americans has increased to 45.0M (Altman, 2005). The US Department of Health and Human Services estimates that a national health information network could save $140 billion per year through improved care and reduced duplication of medical tests. The heart of the proposed network is the Electronic Health Record (EHR). Despite the purported benefits, EHR remains relatively underutilized in US healthcare. To better understand this reluctance by physicians to implement technology that will arguably improve the efficiency and effectiveness of healthcare, we studied fifteen family medical practices - interviewing decision makers about their consideration of EHR technology to identify significant influences on the adoption decision. These interviews were transcribed, coded, and eventually abstracted into a conceptual model that provides a plausible explanation of the factors influencing adoption. Though the current rate of adoption is proceeding slowly, our findings reveal that under certain predictable circumstances, early career stage physicians are likely to adopt this technology. When coupled with US physician demographics, it appears that a US health information network based on EHR technology is assured. An additional contribution is the observation that adoption theories relying on use intention as a predictor of adoption appear inadequate in circumstances where the adopting user is also the purchaser of the technology. These theories tend to ignore the decision to acquire technology â the heart of the current EHR adoption.

Keywords: Technology Adoption, Technology Purchase, Adopter Characteristics, Unified Model, Intention to Purchase, Inevitability

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Introduction

In April 2004, President Bush announced a public mandate for most Americans to have an electronic health record (EHR) within 10 years. In industries such as banking and transportation, the use of computerized electronic records is widely diffused and essential to business efficiency. In US healthcare however, IT adoption is relatively underutilized. A recent study by the Rand Corporation labels the US Health Care Industry as "the world's largest, most inefficient information enterprise" (Hillestad, Bigelow, et. al., 2005).

Furthermore, potential error reductions in adverse drug reactions due to EHR adoption are projected at over two million events annually. Even traditionally cautious medical societies have endorsed electronic health records. The American Academy of Family Practice asserts that the effective use of such information technology is "essential for the provision of high quality care in the increasingly complex health care field" (Shannon, 2005).

Despite the strong political impetus for and ascribed benefits of electronic health records; however, adoption remains at less than 13% of America's 884,974 physicians (Miller and Sim, 2004). This leads us to question what causes the reluctance of US physicians to embrace technology that is widely acknowledged to make their work more effective, safer, and less costly. What explains how physicians decide to adopt or not adopt electronic health record (EHR) technology?

The objective of this study was to understand the process by which physicians consider EHR and to identify factors that influence the adoption decision. An analysis of related literature in such disciplines as information systems, economics, and sociology led to an early conceptual model based upon economic rational choice theory that included elements of technology adoption, marketing, and collective action theories. We conjectured that certain practice characteristics and certain physician attitudes might influence the adoption decision. These included size, diversity of staff educational levels, and attitude regarding the availability of a national EHR standard. These characteristics, presented in our model as independent variables, emerged from several previous adoption studies specific to information technology in health care and small business settings (Kimberly and Evanisko, 1981; Plouffe, Hulland, et al., 2001). We considered that the effect of these constructs on decisions to adopt or not adopt might be mediated by the presence of positive or negative incentives, the perception of adequate resources, and group expectations about the outcome. We wondered if the physician's adoption decision, as pictured, was the product of economic rational choice or whether it was influenced by other variables that might emerge in phenomenological inquiry. This model guided the design of an interview protocol that allowed us to elicit physicians' perceptions about the theorized variables as well as the freedom to permit other ideas to emerge.

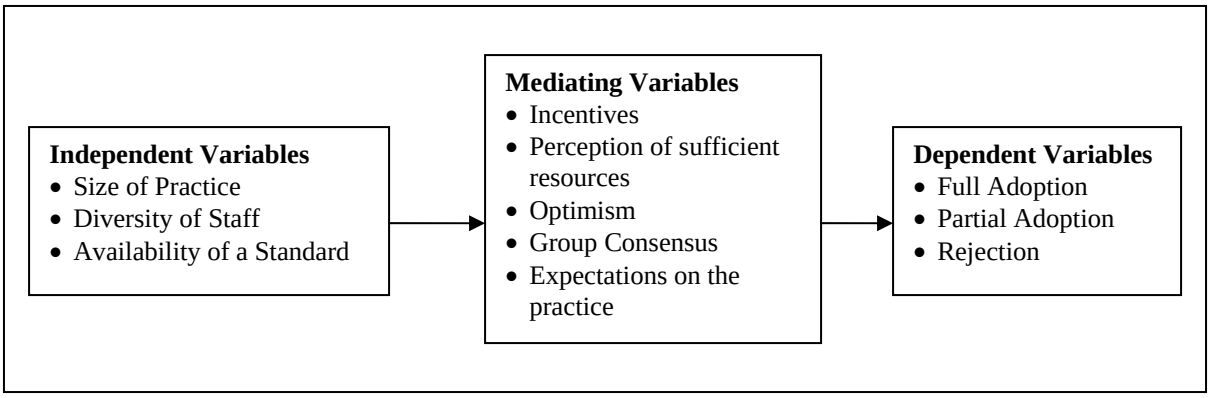

Figure 1. Conceptual model – EHR adoption

Literature Review

Literature from two distinct disciplines – economics and information technology – stimulated our research. EHR is, after all, an information technology (IT). Thus, we turned first to the vast literature that has accumulated in recent years promoting theories of technology adoption. Of particular interest were previous studies concerned with the adoption of IT technologies in healthcare environments. We were drawn, thereafter, to the equally prolific literature on collective action. Significant benefits from EHR use are not accrued until all physicians employ it. Thus, understanding the adoption issues within a framework of collection action theory is vital.

Technology Adoption Theory

Previous studies have documented both the resistance to change and slowness in the adoption of new technology by physicians (Leonard, 2000; Triester, 1998). Generally, studies related to adoption of information technology take one of three approaches: *a diffusion approach, an adoption approach, or a domestication approach (*Vigayan, *Perumal, and et. al., 2005).* Diffusion researchers such as Rogers (1995) characterize the spread of technology as occurring in stages. *Adoption* researchers often apply social theories of decision making to explain adoption decisions. Related models, collectively called the Technology Adoption Theories (TAT) are widely applied to explain adoption of technologies in a number of applications. These latter models typically suggest that an individual's "intention to use" a technology is a reliable predictor of adoption.

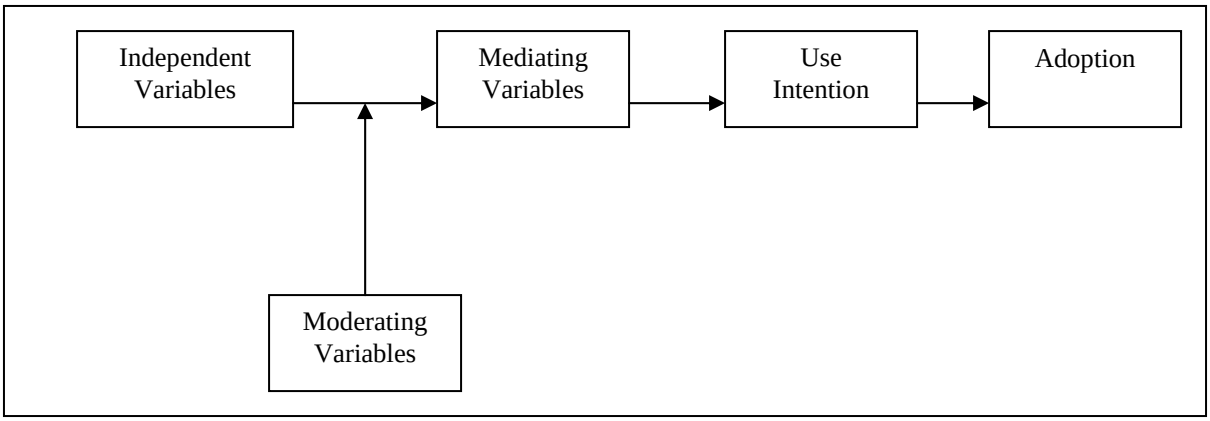

Figure 2. TAT related models

An encompassing and powerful Unified Theory of Acceptance and Use of Information Technology (UTAUT) was proposed recently (Venkatesh, Morris, Davis, et. al., 2003). This study empirically compared eight of the most popular adoption models and their extensions as summarized below:

Theory Name	Reference	Description
Theory of Reasoned Action	TRA	Fishbein and Ajzen, 1975; Davis, 1989
Technology Acceptance Model	TAM, TAM2	Davis, 1985p; Vankatesh and Davis, 2000
Motivational Model	MM	Vallerand, 1997; Davis, 1992; Venkatesh and Speier, 1999
Theory of Planned Behavior	TPB	Azjen, 1991; Mathieson, 1991; Harrison et. al., 1997
Combined TAM / TPB		Taylor and Todd, 1995b
Model of PC Utilization	MPCU	Triandis, 1997; Thompson et. at., 1991
Innovation Diffusion Theory	IDT	Rogers, 1995; Karahanna et. al., 1999

Table 1. UTAUT synthesis of prior technology adoption models

In UTAUT, researchers conducted longitudinal field studies among individuals introduced to a new technology at four organizations. The results were empirically compared to the eight prior models. For every previous model, there was at least one construct that was significant in all time periods and also had the strongest influence. Seven attributes were determined to be significant direct determinants of intention or usage of new technology. These included:

- *Performance expectancy* (PE) – defined as the degree to which an individual believes that using the technology will help to improve job performance.
- *Effort expectancy* (EE) – defined as the degree of ease associated with using the technology.
- *Social influence* (SI) – defined as the degree to which an individual perceives that important others believe he should use the new technology.

- From previous studies (Minton and Schneider, 1980), the researchers expected *Gender*, *Career Stage*, and *Experience* to moderate the influence of several of the variables with *Voluntariness* additionally moderating *Social Influence* (SI).

Using the same data as the previous eight models, UTUAT was able to account for 70% of the variance (adjusted R^2) in usage intention – a substantial improvement over any of the original eight models. UTUAT also integrated 32 variables and four moderating variables into four main effects and four moderators. Thus, UTUAT (Figure 3) has value for its high level of predictability and for its parsimony.

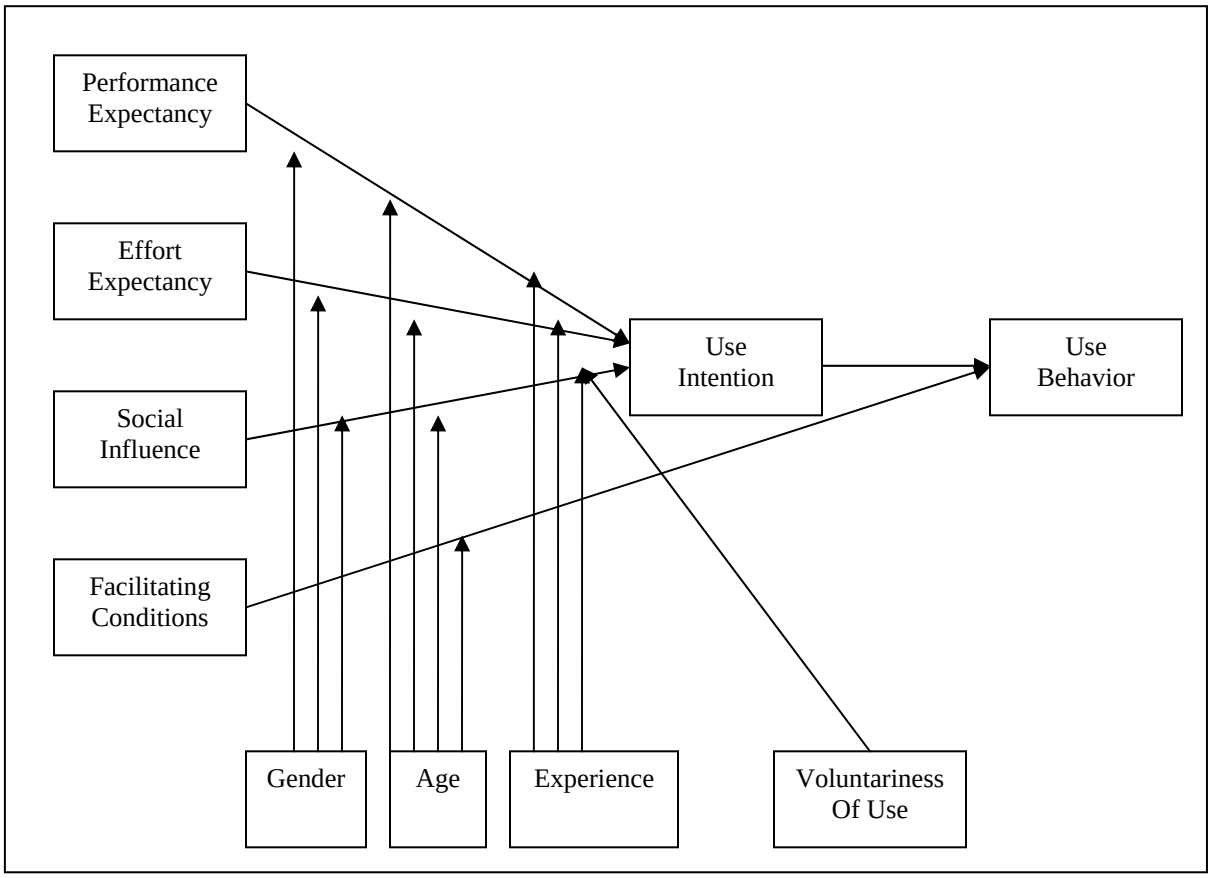

Figure 3. Unified theory of acceptance and use of information technology

UTUAT, however, has only been applied to relatively simple "individual-oriented information technologies in limited applications" (Venkatesh, Morris, et al, 2003). This study applies UTUAT to a broader set of circumstances of increased complexity. It may add confidence to more robust applications of UTUAT or increase our understanding by uncovering instances of anomaly.

Collective Action Theory

Collective action theory attempts to address the basic question of how it is that "rational, self-interested individuals will not act to achieve their common or group interests" Olson (1965; 2). Olson's theory proposes that members of large, heterogeneous groups usually have

conflicting self-interests. Generally, they will not work toward a common good that is characterized by non-excludability unless a selective incentive can be obtained. This can be an economic or social reward or the avoidance of negative consequences.

Olson presents the concept of expected utility as a valuation construct whereby individuals decide if there is sufficient value for the cost of proceeding with an action. He expresses this conceptually as $Ai = Vi - C > 0$, where the Advantage to the individual (Ai) equals the Value (Vi) less the cost (C) and is a positive value. Simply speaking, the benefit must outweigh the cost for adoption to be considered.

There is a fit here consistent with previous technology adoption studies specific to healthcare such as Lorenzi and Riley (1995), Leonard (2000), and Rogers (1983) who found that physicians were slow to adopt new technology without expectations of some overriding specific benefit. A considerable number of academic and trade publications have recently advocated the use of public funds to provide for selective incentives to foster EHR adoption by physicians (Taylor, Bower, and et. al., 2005). This study may add further credence to this impetus or perhaps enter into the debate with additional findings.

Method and Data Collection

A grounded qualitative approach based on semi-structured interviews was selected as the appropriate research methodology for this study (Strauss and Corbin, 1998). This method would allow for the discovery of variables not already recognized and a fuller understanding of the importance of those in our original conceptual model.

In addition, although much has been written recently in popular health care publications about the slow adoption of EHR in the industry, little actual research has been conducted and scant empirical data is available for a detailed analysis of causal factors. Finally, despite concerns with the credibility of qualitative research studies in general, this semi-structured, grounded process was selected because our goal was to build a conceptual model that captured intricate details about the subject – especially related to the decision making process that physicians employ when considering EHR.

An interview script was designed to encourage the EHR decision makers to speak freely of their experiences. Open-ended questions were asked along with somewhat more detailed follow-up questions as physicians touched upon areas of specific interest. The script was tested with health care personnel at two hospitals and reduced to six general questions. We began by asking for background information about the physician (medical school, residency, and graduation date); followed by office statistics (size of practice, size of staff, etc.); then, we introduced the subject of computers and computer use. The intent of these early questions was to lead up to the topic of medical records and to have physicians recount the process by which an EHR adoption decision was made with as little prodding as possible. To accommodate the time pressure on our physician participants, the protocol was designed to be facilitated in 60 – 75 minutes and to be used with equal effectiveness in both telephone and face to face interview environments (see Appendix 1). About half of the interviews were conducted live and half by telephone.

We restricted our sample to family practice physicians to minimize the impact of different fields of specialty. A convenience sample of family physicians in six states was identified using the researcher's professional network in the health care industry. Care was

taken to balance the sample between those who had purchased and implemented EMR systems and those who had chosen not to do so. Only physicians who acknowledged responsibility for the adoption decision were considered. Of the fifteen participants, seven (7) had implemented EHR and were characterized as "full adopters"- meaning that all or all but one of the major portions of an EHR system were in operation. Two (2) were characterized as "partial adopters" and six (6) were characterized as "non-adopters". Five physicians were categorized as early career stage (less than 15 year of practice, two were mid-career physicians (more than 15 but less than 30 years of practice), and eight physicians were in late career (more than 30 years of practice).

Data from the interviews was collected in transcripts and in field notes. It was subsequently categorized and coded using an Excel® spreadsheet following an open coding process as described by Strauss and Corbin (1998). In the case of individual interviews, an initial matrix summarized physician characteristics and demographic data. Some of these attributes were later determined not to be relevant and a refined matrix was created (see Table 2) that summarized the physician's coded identification, EMR implementation status, career stage (based on year of graduation), and whether the office had recently been established or purchased computer hardware.

Physician ID	1	2	3	4	5
EMR Status	Partial	Full	Partial	Full	None
Career Stage	Middle	Early	Early	Early	Late
Greenfield Site	No	Yes	No	Yes	No
Physician ID	6	7	8	9	10
EMR Status	Full	Full	None	Fall	Fall
Career Stage	Early	Early	Late	Late	Middle
Greenfield Site	No	Yes	No	No	Yes
Physician ID	11	12	13	14	15
EMR Status	Fall	None	None	None	None
Career Stage	Late	Late	Late	Late	Late
Greenfield Site	No	No	No	No	No

Table 2. Physician demographics and EMR status data

A second matrix dealt with all of the comments offered by participants as influencing attributes or circumstances relative to their decision to adopt or not adopt EHR software systems. A total of 81 comments were captured (FIGURE 4). A portion of the spreadsheet is presented below (due to size).

Physician 1	Physician 2	Physician 3
Key Points	Key Points	Key Points
1. Loss of Control	11. Economic Uncertainty	17. Coercive Directive to put in.
2. 'keep my secrets'	12. Viewed cost as an investment (~$50k)	18. EMR interferes with medicine.
3. EMR interferes with the way I do medicine	13. Viewed as an efficiency gain.	19. EMR not as efficient.
4. EMR not as efficient	14. Inevitable	20. IT comfort level has influence.
5. Older doctors won't go EMR	15. Makes life easier	
6. Doctors "too lazy to change"	16. Helps generate revenue.	21. Other doctors
7. Adaptation and change required		
8. Inevitable		
9. The younger the more likely		
10. Partial not likely		

Figure 4. Thematic concepts from interview transcripts

The transcripts and field notes were reviewed in several iterations to classify the comments into general categories by using color coding. Six categories of influencing variables or circumstances were identified as having a relationship to adoption / non-adoption based upon the number of incidences of occurrence. These initial six categories (and their color codes) are listed below (Table 3). The fourth category, Coercive Directive, was eventually discarded for insufficient supporting data.

B	Greenfield site, new computer, or upgrade to office computer system
G	Career Stage / Time frame perspective on economic payback
Y	Perceived financial payback. Investment-like view.
C	Coercive directive.
P	Expectation regarding ease of use. Expected change effort required.
R	Perceived impact upon time / efficiency.

Table 3. Identified categories from coding

The two matrixes were then combined to look for any apparent patterns between the reasons given for adoption or non-adoption and the demographics and adoption status of the physician (example in Figure 5).

Physician ID	1	2	3	4	5
EMR Status	Partial	Full	Partial	Full	None
Career Stage	Middle	Early	Early	Early	Late
Greenfield Site	No	Yes	No	Yes	No
Staff Size	15	3	Large	Large	Large
High Tech Attitude	No	No	No	Yes	No
IT Resource	No	No	Yes	Yes	No
Main Themes:	Fear Factor	Fear Factor	Coercive Directive	Wanted Ideal	Positive Incentive
	Loss of Control	Economic Uncertainty	EMR interferes with medicine	Long-Term investment	Too Costly
	"keep my secrets"		EMR not as efficient	Lot of years left	
	EMR interferes with medicine	Cost is an investment		Cost will keep others from adopting	Interferes with the way I do medicine
	Not as efficient	More efficient			
	Other doctors will not go EMR quickly	Inevitable	IT comfort level influences others physicians		Not efficient
	Inevitable	Makes life easier			Likely positive impact on quality
	Younger physicians more likely to adopt	Will help generate revenue			Don't want to change

Figure 5. Coded themes and physician demographics

The combined matrixes were reviewed several more times to remove generalized and vague comments; and, comments that were completely contrary to the pro or con adoption decision taken by the physician.

Next, storyboards were created and questions of "how", "when", and "under what circumstances" were asked in an effort to systematically specify content and to find relationships in order to get to higher levels of abstraction. Care was taken to be open to new constructs and to let the data suggest explanations of the circumstances. This process was assisted by writing analytical memos detailing key considerations, ideas, and conclusions in attempts to reach higher

levels of abstraction. Anomalies to the explanations often led to additional literature reviews and consideration of new or refined constructs in order to account for the exceptions.

Eventually, several themes began to emerge from the data depending upon how physicians arrived at their conclusions regarding EHR technology. Deductions led to causality and circumstance tables being created with supporting comments from transcripts. Examples of supporting comments related to the construct of Incremental View include:

- I would highly recommend electronic medical records to any physician thinking about updating their practice or starting a new practice.
- We had to upgrade ...we decided to go ahead and upgrade to a full EMR system. Our old computer was having its final days. We decided to transfer into a new computer system and as part of the transformation...we decided to go fully electronic with electronic medical records also.
- I think largely it was motivated by the need of replacing the old system...the timing most certainly.
- ...had an old computer system...However, that old system did not have the capability to actually access a doctor's notes or physical information. So over the last six months, they introduced a program to gain access to physician / clinical records...and that has served as a bridge into the new system.

Six causality and circumstance tables were created that formed the bases for findings contained in the next section as well as a revised conceptual model.

Findings

The results of this study supported our conceptual structure of economic rational choice within a framework of technology adoption and collective action theory. However, the actual decision process and influencing circumstances were far different than envisioned. Our data reveals that for a variety of reasons, many physicians consider EHR adoption as "inevitable". Examples of supporting comments related to this construct of Perceived Inevitability include:

- Eventually everyone needs to do this.
- The electronic record...is very similar to practice management systems x-number of years ago.
- I think they'll just mandate that we spend the money.
- It makes no sense...for people not to adopt this technology.
- ...eventually...more physicians...will see how much benefit there is.
- I think more and more people's old practice management systems are going under so that they are going to have to upgrade.

This belief in the inevitability of Electronic Health Records goes beyond an "expectation of favorable long-term consequences" (Triandis, 1977; Thompson et. al., 1991). It was widely prevalent among our sample physicians and implies that "intention to use" – the basic predictor of adoption in TAT models - is already present. In such circumstances, TAT suggests that adoption should occur. Yet, physicians are not buying EHR systems.

Our findings did corroborate that Physicians generally go through an evaluative decision making process in considering the purchase of an EHR system. The first step consists of an informal economic cost verses benefit calculation - estimating the financial value of implementation. An excerpt from an interview in New York serves as an example:

> "Now, our practice would not benefit from electronic medical records system. We've done an analysis -- very off the top of our head -- there's no hard numbers. And, if we were to institute it, we would not be able to get rid of a person. We would still need the same number of people that we have if we put in electronic medical records."

Our respondents reported that when they conclude that the financial value is negative, there is little further consideration of other attributes of the technology such as fit or ease of use. Those physicians who did conclude a financial benefit typically proceed to conduct a rough payback calculation on the required investment. A physician in North Carolina stated:

> "Cost is probably the biggest thing that keeps most physicians and other hospitals and other groups away from electronic medical records, right now. The cost to implement these systems is staggering when you look at the return that you get initially. But, it's well worth the long term benefits of the system."

This economic decision making process appears to be a normal day-to-day mind set in the world of family physicians. It is part of their routine to consider the purchase of new medical equipment and to evaluate the impact of a purchase on revenues from reimbursable procedures.

Our coding identified a relationship between Physician Career Stage and the outcomes of this decision making process. Early career physicians in our study presented as far more pro-adoption than their later stage career colleagues. It appears that physicians in an early career stage often take a long range, investment-like view of EHR costs. This long-term perspective acts as a positive influence on the outcome of the cost – benefit analysis. These early career stage physicians – especially those recently setting up an office – shared opinions such as:

> "….if we're going to put the investment into our practice and, you know, take out the loans and everything you need to buy equipment and tables and EKG machines you might as well just incorporate a computer system into it, because of – the best time to do it was when you first start, I think".

> "That year we knew that our contract was only for one year and the hospital was distancing themselves from primary care, as well as private practice ownership. So, once we found out that yes, we are gonna have the opportunity to start our own practice, we decided, well, what would be the ideal practice? And the ideal practice for all three of us was a practice that was technologically advanced as much as possible in today's age, which included electronic medical records."

In contrast, our data suggests that physicians in a late career stage often view the cost of an EHR purchase as an expense – not as an investment - and that this perspective (short term payback horizon) has a "chilling effect" on the adoption decision. For example:

> "I'm 57 years old, and I don't know if I'm gonna pay for it. When I get ready to retire... I'll turn the practice over to somebody. And they may decide they're young enough and it pays for them to do it."

Our interviewees revealed that another circumstance that influences the purchase decision occurs when a physician needs to replace or upgrade an existing office computer system. Physicians then tend to view the cost of EHR as an incremental expense and to bundle its costs and benefits together with the other items in the purchase consideration. Sometimes the expense is viewed as an acceptable cost of doing business whether the cost – benefit analysis for EHR

alone was favorable or not. This incremental view favorably influences the economic value consideration of EHR.

As indicated by our data, if a physician reaches a favorable economic conclusion regarding the purchase of an EHR system, the decision process usually moves on to a consideration of how the system will fit into the way the physician wishes to practice medicine. It is generally accepted in technology adoption theory that ease of use positively influences adoption. Based on the revelations of our study participants, however, the corollary may be true in the case of EHR adoption. Our respondents reported that the more disruptive the technology is perceived to be, the less likely its purchase. This evaluation of the suitability of EHR for the physician's practice appears to be a highly variable and personal one. Interviews included comments such as:

> "Since we are used to having a chart – I'm used to having the chart in my hand, and flipping back and forth at tests and things like that, and we don't have computers set up in each of my examining rooms."

> "...with the doctor watching the patient's face and determining - yes, they understand what I'm explaining to them, they understand what's wrong, they understand what to do about it and what the instructions are. And for the patient - yes, the doctor understands my concern. That's critical, and I think it definitely can't interfere with that. So, it's gotta be done in such a way that it won't detract from eye contact and face to face time with the patient."

> "...the chart gets handed off to another department, so we all are kind of sharing it. It's just that we're used to that."

> ".... I found it to hold me back, and it also interfered, I thought, with my patient relationships. I lost something on the one to one contact, the eye contact. So I went back to the piece of paper and I love it."

Our findings indicated that physicians who favorably evaluate the technology's fit subsequently estimate how much personal effort EHR implementation will require. As a group, our subject physicians profess to heavy workloads and place a high value on personal time outside of the practice of medicine. Respondents reported that even if the consideration of EHR progresses favorably through the first step (positive economic value) and the second step (an acceptable level of change to the practice of medicine), this third criterion is also daunting. Some noted that they are reluctant to give up significant time going through the perceived learning curve to adopt an EHR system or were anxious about it. Most are aware of documented instances of difficult implementation such as described in the following comments:

> "I would probably just reiterate a couple of things. Certainly it's been a tremendous transition. It's been painful. The work was frustrating and painful to transition into the new system. I think after doing it now for probably about six months, I'm probably as transitioned as I'm going to be."

> "And there was a learning curve with learning how to use it, ... Same thing with my partner in the practice, we have both been relieved that it does what it is suppose to do, that it really is, we really can do these things electronically. We were scared there would be big glitches and big mistakes."

In general, we found that when physicians get through these steps of a decision making process with favorable conclusions, an EHR purchase is highly probable.

Discussion

The unanticipated finding of inevitability led to us to challenge our reliance on TAT and our previous conceptual model for they did not explain the absence of adoption in the presence of intention to use. It has been argued that purchase decisions and those of use are different (Quester and Smart, 1998). Although a technology may be used by and affect many people in an organization, the decision for its purchase is typically made by a single individual or a small group of managers. Due to our interest in understanding how physicians decide to adopt new technology, broadening the scope of our conceptual model to consider the determinants of the purchase decision seems not only an appropriate course of action, but an essential one. In doing so, perhaps even more reliable predictors of technology adoption may be discovered.

A revised version – Intention to Adopt EHR Technology – is presented below (Figure 6). Where UTAUT and our original model ignored the purchase of technology, this model considers "Intention to Buy" as a necessary subsequent step to "Intention to Use" in the adoption process.

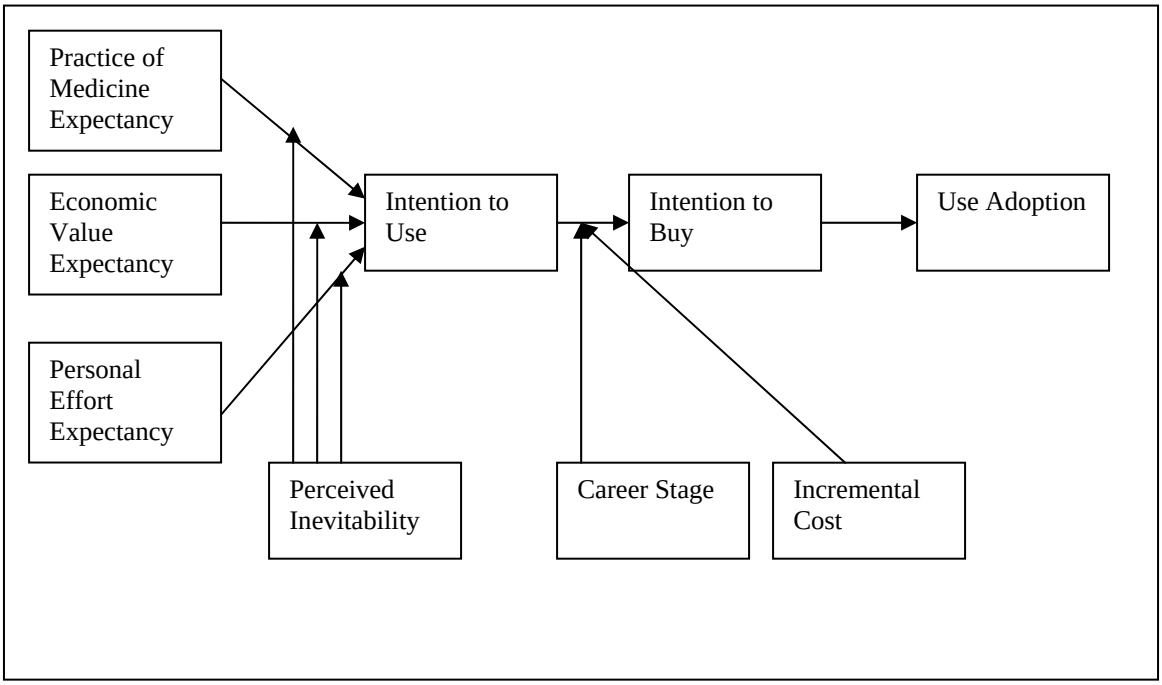

Figure 6. Intention to adopt EHR technology

As an analogy, consider one's purchase of an automobile. Perhaps the current vehicle is becoming a relic – often in need of repair. For this or a multitude of other reasons, an individual decides it is time to buy a new car. Thus he is "in the market" for a car (intention to use) though a specific choice of vehicle has yet to be determined. Typically, something else triggers the actual purchase decision. It may be a set of circumstances such as the old car breaking down again or perhaps a promotional program on a desirable model. This triggering of the purchase decision (intention to buy) is proposed as a more reliable predictor of adoption due to its timeliness.

Subsequent to purchase, there is still the issue of acceptance (technology use). At times, car buyers return new vehicles back to the dealer (buyer's remorse). This is not unlike the rejection of new technology despite the presence of intention to use and purchase.

The first independent variable in our revised model, *Economic Value Expectancy (EVE),* is defined as the perception of the economic outcome of purchasing and implementing an EHR system (the cost / benefit analysis). If the calculation is positive, it will lead to a positive *Intention to Buy* as long as a favorable payback is obtained in the time period of interest to the physician. This variable is influenced by the *Career Stage* of the physician. Career Stage frames the period of time over which an investment in EHR is considered for payback. It is apparent that the later the career stage of the physician, the shorter the perceived investment amortization period and the more onerous the *Economic Value Expectancy (EVE)* calculation (Table 4).

Physician Career Stage	Year of Practice	View of EHR Cost
Early	< 15	Investment
Middle	16 – 35	Mixed
Late	> 35	Expense

Table 4. Physician career stage and cost view

EVE is also influenced in circumstances where the purchase of an EHR system is viewed as an incremental cost – bundled with the acquisition of a new computer or other software. In such cases *(Incremental Purchase),* the cost / benefit analysis for EHR may even be negative, yet the physician will typically buy the EHR system if the total bundled purchase is viewed favorably (Table 5). There were no observed incidences of computer purchases by late career stage physicians. Thus, the impact of an incremental purchase upon the *EVE* of this group is unknown.

Physician Career Stage	Year of Practice	Impact of Computer Purchase on EHR Decision
Early	< 15	Incremental View
Middle	16 – 35	Incremental View
Late	> 35	Unknown

Table 5. Physician career stage and impact of computer purchase on cost view

A second construct has been labeled *Practice of Medicine Expectancy (PME)* but the concept is similar to Ease of Use / Relative Advantage from TAT related theories. It is defined as the amount of anticipated disruption the technology will cause to the way the physician wishes to practice medicine. There is a nuance here in that some change is viewed favorably if it is an improvement to the status quo – even if disruptive. Such a change has relative advantage (Vankatesh and Davis, 2000) and is welcome for it moves the practice of medicine in the direction that the physician wishes to go. If such a change can also be made easily, it is viewed as even more desirable. However, *PME* focuses on the down-side of EHR adoption and is defined as the perceived negative deviation that an EHR system will create versus a physician's idealized practice of medicine. A high *PME* may preclude the purchase of an EHR system.

Personal Effort Expectancy (PEE) is a third construct and an additional hurdle that must be crossed for a favorable decision to adopt EHR technology. Where UTAUT defines "Effort Expectancy" as the degree of ease associated with using a technology, our respondents focused again on the personal cost side of EHR implementation. *PEE* is defined as the perceived amount of personal effort that will be required with a pro-adoption decision. Physicians in our sample generally placed a high value on their personal time. These independent variables are summarized below (Table 6).

Independent Variables	**Definition**
EVE	Perceived consequences of EHR purchase cost / benefit analysis
PME	Perceived disruption due to EHR adoption on the ideal practice of medicine
PEE	Perceived effort required to implement EHR

Table 6. Definition of independent variables

With obstacles apparently holding up the purchase decision by physicians, many have proposed that EHR should be hastened with economic incentives (tax credits, pay for performance systems, or higher reimbursement). Indeed, much of the September / October 2005 edition of the Journal of Health Affairs (Volume 24, Number 5) is comprised of articles calling for public policy initiatives to foster adoption. However, in the case of this research and its subjects, we find that circumstances that foster the EHR "intention to buy" decision are likely to occur. When coupled with a favorable "intention to use" condition (inevitability), these circumstances and physician demographics suggest that public policy incentives are unnecessary. Age data from the most recent American Medical Association Masterfile is presented in Figure 8 below. Over 35% of US physicians are age 55 or older (as of 2004).

Age	<35	35 – 44	45 – 54	55 – 64	>65	Total
Total	142328	210967	219579	149736	162364	884974
% of Total	16.1%	23.8%	24.8%	16.9%	18.3%	100.0%

Table 7. US physicians by age

Interestingly, physician age and career stage (Table 8) do not align well. This is due in part to an increasing number of older graduates entering the US from International and Canadian schools to establish first time practices. Foreign educated doctors now make up over 25% of the US physician workforce.

Year	Prior 1940	1940-1949	1950-1959	1960-1969	1970-19798	1980-1989	1990-2004	Total
Total	4670	29353	65189	106903	161745	219121	297993	884974
% of Total	0.5%	3.35	7.4%	12.1%	18.3%	24.8%	33.7%	100.0%
Career Stage		Late	Late	Late	Middle	Middle	Early	

Table 8. Physicians by year of graduation

While age would intuitively seem to be an influence in the adoption of new technology (and well recognized in UTATT and earlier adoption theory), physician graduation date appears to have more power in the purchase consideration. This is especially true in new office start-ups but it is also apparent that physicians have IT outlooks that are generally aligned to those of their classmates. IT tools such as PDAs, laptop computers, and databases are becoming standard fare at most US medical schools. Residency programs are supplementing medical school curriculum with EHR information. Professional societies within the American Medical Association (AMA) are increasingly establishing support groups for Electronic Medical Record (EHR) consideration (see Figure 7). Consequently, physician "career stage" is the influencing variable of interest rather than age.

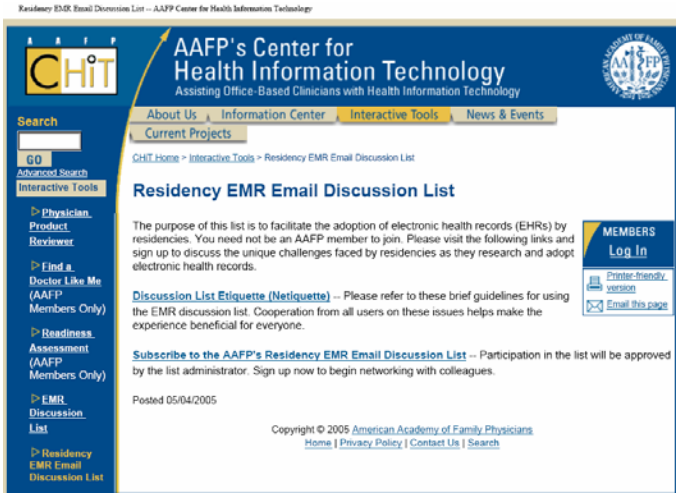

Figure 7. EHR support group

Future projections of physician demographic data are difficult. In a November 6, 2005 address, President Jordan J. Cohen of the Association of American Medical Colleges stated that present trends will soon culminate in a significant shortage of physicians and called for an expansion in medical school capacities by 15% over the next ten years. He also added,

> "As Yogi Berra is famously credited with saying, 'prediction is a risky business'. Nowhere is that adage more apt than in trying to predict our country's future need for physicians".

Equally challenging are extrapolations of the number of foreign schooled physicians that will enter the US workforce. With these caveats, the growth estimates below (Table 9) strive for relevancy as opposed to precision.

Year	1940-1949	1950-1959	1960-1969	1970-19798	1980-1989	1990-2004	2005-2014	Total
Total	7000	42000	95000	165000	225000	310000	226000	1070000
% of Total	0.7%	3.9%	8.9%	15.4%	21.0%	29.0%	21.1%	100.0%
Career Stage		Late	Late	Middle	Middle	Early-Mid	Early	

Table 9. Projected physicians in 2014

Based on estimates of physician retirements and the number of new physicians expected to enter practice, about one-half of US physicians will be in or have transitioned through the early career stage category between the President's announcement and the 2014 goal. We conclude that if physicians as a population resemble our small research sample that a very high percentage of these early career doctors will adopt EHR technology due to a long-term, investment like view of the cost / benefit calculation.

Additionally, EHR adoption by early career physicians will be augmented by physicians who will upgrade office computer systems in the next five years (a replacement rate similar to that of universities and small businesses). This circumstance generally prompts a decision to acquire EHR technology due to a reframing of the cost of EHR acquisition as an incremental one.

Moving from an individual unit of analysis framed by Technology Adoption Theory to a group one of Collective Action, Granovetter's threshold model links individuals' behaviors to their perceptions of the aggregate level of action (Granovetter, 1978). The probability distribution of everyone's thresholds determines whether an entire group reaches the critical mass (tipping point) required for rapidly escalating and widespread collective action. Conceptually, it is as if thousands of individual Prisoners' Dilemmas are underway in the medical community as physicians wait for assurance of sufficient benefits for EHR adoption to outweigh the costs (Axelrod, 1997). Prospect Theory (Kahneman and Tversky 1979) builds upon the expected utility construct and suggests that choices that have associated risk change the valuation. In such cases, people underweight outcomes that are merely probable to those that are certain.

EHR adoption carries with it an inordinate amount of effort and risk for the early adopter. Not only are initial costs high, but early adoption may necessitate additional conversion costs to reformat records prior to interfacing with disparate systems (since national standards are yet to be established). Best practices for implementation are not commonly known. Early adopters will conduct the pioneering work of establishing EHR processes and the benefits of these efforts are non-excludable. Physicians who choose to defer action and wait for others to work through these difficulties will enjoy the benefits of standards, well described implementation processes, and minimal hassle. In addition, the major benefits of EHR adoption accrue outside of a physician's practice in the form of less duplicate testing by alternative health care sites (hospital, doctor's office, lab, etc), fewer errors (drug interactions and record errors), and improved data

for controlling insurance expense. This implies fewer procedures by physicians and ultimately less income.

Granovetter's framework is helpful for understanding the current low level of compliance with the President's call. Prospect Theory helps explain the even lower level of adoption among late career physicians who have a risk associated with time frame for recouping an investment versus a known cost. Selective incentives to adopting physicians would be one way to tilt the *Economic Value Expectancy (EVE)* variable in our model to promote greater and faster adoption of electronic health records.

However, when the predictable circumstances and demographic trends highlighted in the study are taken into account, additional economic incentives are unnecessary to meet the President's objective of providing an Electronic Health Record for every American by 2014. It is simply a matter of time. The widespread belief by physicians in the "inevitability" of EHR suggests a relatively low critical mass requirement. Granovetter's additional concept of the power of "weak links" purports that the denser the network links in related groups, the higher the potential for collective action. A low tipping point threshold is again inferred - for US physicians are typically rich in social and professional networks. Of interest is a November 15, 2005 article in Health Leaders News indicating that networks of physicians are buying medical record systems in bulk. This hints at the beginning of critical mass. Adding further credence to this notion is a reference in the American Academy of Family Practice Workshop on Quality Hearing (November 18, 2005) that a "tipping point in EHR use among family physicians may be here." Thus, market forces are pushing EHR adoption along a well described diffusion process as depicted below (Rogers, 1965).

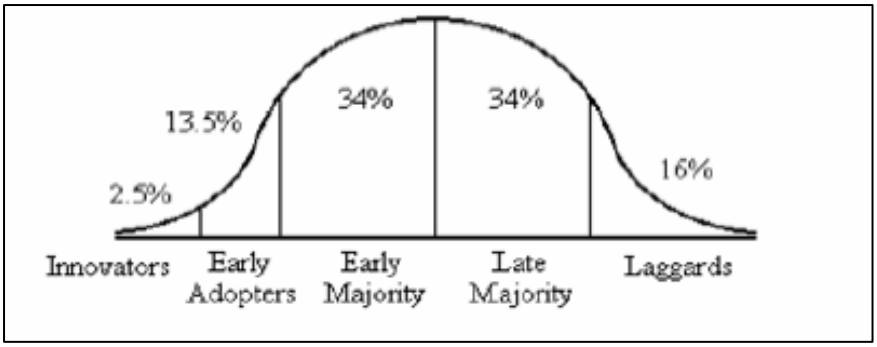

Figure 8. Hypothesized adopter categories

Furthermore, providing incentives to promote EHR adoption before the development of a complementary infrastructure may well be an imprudent thing to do. If past great technological innovations are any indication, public policy might be more useful in first addressing the "commons" issue of EHR inter-operability such that the benefits of the technology can be maximized (Ostrum, 1990). Examples include electricity and the electric grid, the automobile and the interstate road system, and computers and the World Wide Web (Bijker, 1995).

Challenges and Future Research

Caution is required regarding the findings of this research and the resultant conceptual model. The grounded theory building approach that serves as the strength of this study is also its limitation (Mehan, 1979). It is well documented that there is the risk of disparity between the discourse of subjects in an interview and their actual actions (Fielding and Fielding, 1986) as well as the struggle to keep the researcher's assumptions and potential biases at bay (Silverman, 1993).

With a sample size of fifteen family practice physicians from six geographic regions and the self-reporting basis for the research data, these findings can only be seen as tentative, at best. Further research is needed to judge both causality and relevant circumstances of EHR adoption.

There is urgency to the issue of Electronic Health Record adoption and opportunity costs in the billions of dollars of public and private monies potentially at risk. A large scale study has the potential to evaluate the hypothesized relationships between constructs in this conceptual model and could help provide more generalized findings and insights. Such a study could ultimately help in the determination of efficient and cost effective public policy to optimize the value of EHR by the US healthcare industry.

Conclusions

Technology adoption, marketing, and rational choice theories converge into something new when prospective users of a new technology are also the purchase decisions makers. The consideration is more than the intention to use a technology by the many but also the prospective circumstances of the acquiring few.

We have tried to make sense out of the current state of affairs with family practice physicians and their slow take-up of new information technology in the form of electronic health records. The federal government is championing its adoption. Professional groups are endorsing it. Insurance experts and patient quality of care advocates are touting its benefits. And yet, even though physicians generally acknowledge its use as being inevitable, fewer than 13% of family practice physicians have purchased it. This seems counter to adoption research models. We have a puzzle.

However, our study revealed that in certain predictable circumstances, adoption is readily occurring. It is simply early in the diffusion curve. A high percentage of early career physicians are purchasing EHR systems. In addition, it appears that as many as half of all physicians may be expected to acquire EHR systems when buying, replacing, or upgrading their office computer systems. When these predictable instances are coupled with physician demographic trends, widespread adoption appears likely to occur well within the government's ten year guideline. Despite pending legislation in the US Congress for financial assistance and tax credits, the Rx for Electronic Health Care Record Technology is time, not incentives. Adoption is underway.

Final Reflections

Our investigation suggests that studies of technology adoption would benefit from distinction in research models of intention to use and intention to buy as distinctively

differentiated variables. Additional inquiry into the construct of perceived inevitability and its influence on technology adoption in situations where the adopter is also the acquiring entity bears further investigation. Furthermore, perceived inevitability as a facilitating factor on adoption on a national scale may have public policy path dependency implications and the use of the "bully pulpit" by high ranking national leadership.

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Appendix 1
60 Minute Interview Protocol Guide
Interview Script

Research Topic: The Adoption of Electronic Medical Record Technology by US Physicians
Objective: To determine the main influencers on the decision by US physicians to adopt or not adopt electronic medical record technology.
Interview Introduction:
Thank you for agreeing to meet with me today. As a reminder, my research interest is about practices in the physician's offices involving the use of computers and software. The transcript of this interview will be kept confidential and summarized with the data received from other sites.
Do you have any questions or requests before we begin?

1. Could you tell me a little about yourself please – where you grew up, attended Medical School, where you completed your Residency, or anything you would like to share about your background?
2. Would you tell about your office (type of practice, size or staff, number of patients, etc)?
    a. Could you explain briefly about the types of jobs and who is responsible for the various activities in your office?
3. Are there any computers in use in the office?
    a. How are they used?
    (note: listen closely for Information Technology in the areas of patient scheduling, prescriptions, medical records, billing, etc.
    b. Is there anything more you can tell me more about the use of computers here? Do they interface with any outside computers or networks?
4. Are there other systems in use in your practice for storing or collecting information? Please tell me about any of them.
    a. How did they get started?
    b. Why do you have them?
    c. How are they used today?
5. What can you tell me about your medical records system?
    (note – listen closely for the dependent variables -i.e. – the scope of adoption)
    a. How did your medical records system get started?
    b. Why do you have the type (paper / digital) of medical records system that you have today? (note – listen closely for what was important)
    c. What were the things that influenced you to (put in / not put in) the type of medical records process that you currently use?
    d. Are you considering any changes in your computer use or medical records system in the future?
    e. If so, why and what kind of changes do you anticipate making?
6. What else would you think it might be helpful for me to know about your practice and your medical record system?

Interview Closing: Thank you again for participating in this interview and research project.

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