

Electronic Medical Records Adoption and Use

Understanding the Barriers and the Levels of Adoption for Physicians in the USA

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Abstract— the aim of this research is to explore the motives behind the adoption or rejection of Electronic Health Records (EHR) systems in the USA by medical offices. The current health care system in the United States suffers from high expenditures and poor quality. The Patient Protection and Affordable Care Act, passed in 2010, attempts to save costs and improve quality of care by offering incentives to use Electronic Health Records systems. Part of the reform by this law is dependent on the use of technology in managing patient medical and health records. The objective is to reduce redundancy and increase quality by sharing medical information amongst different health organizations like hospitals, physician offices, laboratories and clinical institutions. The success of such reform requires the participation and collaboration of all these entities and their patients. Prior research shows that adoption of Electronic Medical Records systems by hospitals and physician offices has been evident but at a rate that is slower than in other countries. Aside from financial barriers, technical, psychological, social/legal and organizational barriers exist. In order to understand the impact of those barriers on the adoption of Electronic Health Records management by small physician offices better, a five-level adoption model is presented to define the stages of diffusion of EHR systems. Fifteen consolidated barriers are mapped to each adoption level. This research concentrates on smaller physician offices because hospitals and larger institutions are more ready and capable of adoption, according to previous research. The Diffusion of Technology Model by Rogers, the Theory of Planned Behavior by Ajzen and Fishbein, and Davis' Technology Acceptance Model are combined and extended. This model will be used to empirically measure physicians' attitudes, knowledge, social and legal influences, subjective norm and systems' ease of use and usefulness amongst other variables. These variables are applied as mediators or moderators of the intention and decision to adopt or move into subsequent levels of adoption with the goal of seeing what drives those decisions.

Keywords—EMR; EHR; Electronic Medical Records; Electronic Health Records; eHealth; Management; Patient Records; Health Care; Adoption; Technology

I. INTRODUCTION

This paper discusses barriers for adoption of electronic record systems in physician's practices. Health Information Technology (HIT) in current medical practices ranges in types and specifications. The specifications and definitions of the

electronic systems differ from one institution to another based on each one's type of work and expectations from the system. The specifications and definitions also differ from one application vendor to another. The classifications of these systems are arbitrary up to this point. The most popular labels to health care records management systems are Electronic Medical Records (EMR) and Electronic Health Records (EHR). Although the two are often used interchangeably, there exists a differentiation between the two. Reference [1] has identified over ten different digital health and medical records management systems that have been the subject of academic studies for two decades. Electronic Patient Record (EPR) system and Computerized Patient Record (CPR) system refer to an electronic or digital record about a single patient from one particular hospital or other medical institution [1]. Either has a specific focus on the type of clinical data they store.

The US federal government refers to the electronic application for managing and tracking health and medical records as Electronic Health Record (EHR) system. The government's expectation of an EHR is to lower the cost of medical expenditure. EHR can lower expenditure if it makes providing and processing medical care more efficient by eliminating unnecessary physician visits, empowering doctors to diagnose a patient remotely, managing prescriptions and drug fulfillment rapidly, detecting early signs of illnesses, and giving care delivery organizations (CDOs) a comprehensive history of any patient to be able to make sound medical decisions without having to produce repetitive clinical procedures and administrative functions. That type of health information technology requires the cooperation and collaboration of all CDOs from the public and private sectors. Unlike EHR, an EMR is a comprehensive computerized medical data repository system owned by one CDO [2]. For managing their EMR, a CDO will depend on a clinical data repository provided by a single organization. While an EMR may have a general focus on medical care, it shares major common criteria and structures with EPR. For simplification and consolidation purposes, the term EMR will be used in this work to refer to any computerized patient medical record management system that is being populated, updated, modified, tracked, and managed by a single CDO for that organization's internal purposes. EMR is an application environment composed of the clinical data repository, clinical decision support, controlled medical vocabulary, order entry,

computerized provider order entry, pharmacy, and clinical documentation applications [2].

An EHR is a comprehensive computerized record for one patient and allows patient input and access [2]. It is composed of multiple CDOs' medical records. An EHR's success is strongly dependent on data exchange between EMR adopters that is real-time and complete. Contrary to the market's understanding of EMR and EHR system, distinction between the two is mandatory for proper understanding of the levels of adoption, implementation and diffusion of each, which has its impact on evaluating an accurate progress of the health care reform plan.

The aim of this paper is to develop a model that can answer some of the questions regarding the progress of electronic health records in the United States as to why the nation has been slower in its adoption progress than other comparable countries, and how the industry and stakeholders can follow a systematic approach to move nationwide EHR system adoption along. The model should provide clarifications on the efforts needed to take the health care records management from its current state of poor technology adoption level to a full digitally backed system. The process of adopting a digital health records management system is complex. It is not a one-step transformation; it is a series of stage developments amounting to meeting milestones of system implementations and functionality and standards achievements. In this paper, we intend to clarify the situational barriers facing the multi-level electronic medical records adoption and diffusion model.

The model serves as the basis for empirical research among physicians by means of a national survey. This research is still in progress and the complete results will be reported shortly.

The plan of this paper is as follows. In section II, a background on the health care reform plans and initiatives the US federal government is provided. Section III identifies the expected benefits of EHR and explains the readiness of medical institutions to adopting EHR. The model, variables and hypotheses are defined in section IV, while the methodology and the preliminary results are highlighted in section V. Finally, section VI concludes the paper with a discussion on the contribution of the model and the research.

II. HEALTH CARE REFORM

A. Government's Initiatives

The United States of America is undergoing a reform in the health care system. An essential part of this reform is the wider adoption of Electronic Health Records (EHR). This wider adoption is pushed by the Federal Government of the USA because the current health care system suffers from high expenditures and poor quality. According to [3], health care expenditures in 2009 reached \$2.5 trillion. This marks an increase of 4 percent from 2008. Although this rate is lower than the 4.7 percent increase in 2008, the health care spending in 2009 was over \$8,000 per person and 17.6 percent of the Gross Domestic Product (GDP), the highest in the world by far [3]. From the federal government's point of view, these are surely high numbers, and they weigh heavily on the overall health of the economy. The evaluation of the advantages and

disadvantages of the current health care system in the United States is not consistent amongst the many system stakeholders including care providers, patients, care sponsors and payers.

In March 2010, the 111th Congress passed the final version of the Patient Protection and Affordable Care Act, as amended by the Health Care and Education Reconciliation Act. The laws set to insure that no one is denied health insurance coverage because of financial circumstances or pre-existing conditions. They include provisions to expand the eligibility for Medicaid and provide subsidies for businesses to offer health care coverage for their workers.

Health care was also addressed in the American Recovery and Reinvestment Act of 2009 (ARRA). Also known as the Stimulus or the Recovery Act, ARRA allocated \$145 billion for health care spending out of the total \$787 billion set forth to promote investment and consumer spending during the recession. In 2008, Barack Obama's presidential campaign was heavily built on the promise of health care reform. Integrating technology is one of the methods that the federal government intends to rely on in order to restructure health care. Over \$19 billion are allotted to modernize health information technology systems in the nation [4]. The government is promoting and supporting the use of technology in managing health records in particular, knowing that the majority of physician offices and clinical institutions still manage their records with pen and paper. Effective and proper usage of electronic records along with its widespread adoption may save up to \$81 billion annually [5].

III. EHR EXPECTATIONS AND READINESS

A. EHR Benefits

Cost savings benefits of EHR systems are achieved by introducing more efficient functionalities that can reduce hospitalization, doctor visits, administrative nurse work, and improve drug and radiology usage [5]. Quality can be improved through having system alerts and reminders, enhanced surveillance and monitoring, decreased medication errors, computerized physician order entry [6], better disease prevention measures and chronic disease management, improved diagnostic decisions [5], and better illness prevention and safety measures. The two benefits of cost savings and improved quality are interconnected. Some of the quality enhancements procedures can lead to increased efficiencies, reduced time, material, and ultimately reduced cost.

Although these EHR benefits are true and supported by a number of experts and researchers in the field, they are one-sided to an extent. Cost savings, which can reach billions of dollars annually, will in the long run benefit the payers of health care. In the United States those are Medicare, Medicaid and insurance companies. Hospitals, physicians, clinics, pharmacies, medical laboratories and other care providers do not benefit from cost savings. Rather they value the social aspects such as life savings and improved quality of care over cost savings. Even for improving quality, some physicians are skeptical. Reference [7] points out that physicians and clinicians are divided in their opinions regarding the benefits of electronic medical records. One of the anticipated benefits is

the reduction of the number of tests ordered by physician due to their convenient access to electronic patient tests from other sources. On the contrary, [8] has learned that convenient access to tests, including electronic imaging results, has actually encouraged physicians to increase their test and imaging ordering where in some cases they are duplicated. Other physicians feel that an EMR system hampers them in their communication with the patients, takes more time, and restricts what is recorded in the file of the patient.

In trying to manage a health care reform, the government relies strongly on the cooperation and collaboration of medical providers in adopting and meeting the HIT standards. Reaching the optimum EHR with information exchange and clinical decision support is a difficult task especially since not all hospitals and physicians are on board with the anticipated benefits of the system. Psychological and practical barriers exist. Through a study in Taiwan, [9] suggests that health care policy makers may have to promote EMR in order for providers to overcome the factors that affect their willingness to adopt it. Offering financial incentives to facilitate care providers' decision to adopt EMR can be beneficial in the short run, but will it sustain their continued support of the system to take it from separate provider-specific electronic management systems to a nationally interoperable electronic medical records sharing and exchange system with real-time clinical decision support?

B. EHR System Readiness

The Health Information and Management Systems Society (HIMSS) has presented an Adoption Model that identifies seven (7) levels of EHR capabilities ranging from the initial care delivery repository (CDR) environment through a paperless system environment, and reaching a fully interoperable EHR system [2]. Ultimately, a widespread level 7 is where America needs to be to effectively benefit from HIT and truly reform health care system. A hospital needs to be in stage 7 to be considered as EHR capable.

What HIMSS's EMR Adoption Model (EMRAM) lacks is the classification of the systems that are ready or aim to support data exchange. Stage 7 of the model means the system is ready to exchange data but not necessarily will be doing that. The government's certifications and meaningful use go beyond HIMSS EMRAM Stage 7. The Department of Health and Human Services (DHHS) has published a set of standards and specifications for EHR. Meeting those standards and specifications will grant a care provider the required certification by the government. To qualify for the incentives offered by ARRA of 2009, a clinical or a medical institution must show "meaningful use" of an EHR [10]. Meaningful use requires meeting the standards and criteria of interoperability [10]. Over 300 medical records application vendors have already been certified.

IV. THE MODEL

The model presented here is developed to define multiple levels of electronic medical records system implementation. Those levels or stages form a diffusion paradigm of the system. To explain the diffusion or lack of diffusion of EMR in the

United States, a set of barriers are identified and mapped along the multi-level EMR diffusion according to their visibility and the impact they have on preventing advancement of the adoption/diffusion from one level to another. The model intends to measure feasibility of achieving a national electronic health records system featuring a paper-free environment and data exchange functionality within the departments of each participating care provider and interoperability with different health care stakeholders from public to private sectors.

Taking into account the HIMSS EMR Adoption Model and published meaningful use standards and certification requirements by the US government, an EMR diffusion model with wider range of advancements is necessary. However, the need for simplification is also necessary to get the full picture of diffusion, from the lowest level of no or minor presence of electronic medical records adoption to the highest level of fully interoperable EHR that meets governmental and national standards. For each of the defined EMR diffusion levels, certain criteria must be present to achieve that level. The stages of the model are developed considering five criteria: 1) the spread of a digital clinical repository throughout an organization, 2) existence of data exchange on an inter-departmental and/or affiliate level, 3) ability of decision making based on digital clinical data, 4) system-driven decision making and recommendations, 5) multi-organization interoperability and data sharing. A five level EHR diffusion model is clear enough to highlight the overall diffusion requirement and can be specific to show distinction between the multiple levels.

A. Adoption Levels

The levels of the system are described below:

EMR 1: At this level, a single care provider is expected to have adopted a partial information system that supports a minimum of one department's needs.

EMR 2: At this level, a single care provider is expected to have adopted an information system in more than one department and set standards and implementation plan to roll out the system organization wide. The departments using the electronic information system are expected to practice digital data exchange and sharing within the organization. The digital data gathered and stored must be used in making medical decisions from diagnosis, test ordering, to test evaluations and the like.

EMR 3: At this level, electronic information system is widely adopted at the organizational level with enforcement to paper-less administration process. The organization-wide system should be capable of presenting information for decision-making as well as automated alerts, suggestions and recommendations.

EMR 4: At this level, organization-wide digital data exchange is implemented. All departments are interconnected with real-time sharing of information. The adopting organization is expected at this level to have capabilities and actual practices in digital data exchange with external medical organizations.

EMR 5: At this level, all medical organizations have full implementations of electronic medical records systems. All organizations are capable of digital data exchange internally and with any external party. All implemented systems meet federal certification and there exists national standards for implementing and using the system.

B. Adoption Barriers

The list of barriers is derived mostly from [11] and some others. Slight changes to their categories were made. The categories are condensed from eight to four. Social and Legal categories are combined into one category as both categories refer to community and societal influence. Barriers falling under this category are external to the entity deciding on adopting electronic medical records. They are either triggered by or affecting an external party to the implementing organization. Organizational and Change categories are also combined. Change is an organizational activity. It is planned, implemented and reflected on the internal organization. For example, the barrier of “no leader or champion to manage the change” is part of the “organizational culture and strategies”.

C. Theory

The model employs the Theory of Planned Behavior by Ajzen [12]. The theory of Planned Behavior posits that behavior, in this case the behavior of using an EHR, is influenced by the intention to that behavior. Such an intention, in turn, is influenced by the attitudes towards the behavior, the subjective norm (the way the environment influences a person), and the perceived behavioral control, usually identified with Bandura’s concept of self-efficacy. Barriers are introduced because gaps exist between those concepts and behavior. As intentions and behavior can be different at each adoption level, adoption levels are separately considered. Explicit barriers are introduced to model gaps between the constructs and intention or behavior. Barriers are expected to have impact on the formation of intention to adopt EMR as well as the decision to adopt. The model is illustrated in Fig. 1. Additional variables are expected to play a part in the moderation and mediation of the three planned behavior’s determinants: attitudes, subjective norm and perceived behavior control/self-efficacy. Those variables are knowledge, persuasion and voluntariness, along with social/legal and psychological influencers.

Social/legal influences are considered a subset of a group of mediators between voluntariness and subjective norm. The financial, time, technical and organizational barriers are implied to form the barriers variable. Those barriers will play a moderator role between the intention to adopt and the decision to adopt.

Influenced by Rogers’ diffusion model [13], knowledge and persuasion are expressed in this model to have a relation with perceived behavioral control/self-efficacy and attitudes respectively. The two constructs are part of any innovation-decision process and here they can strengthen the implication that perceived behavioral control and attitudes have on the intention to behave. With the introduction of multi-level adoption diffusion, knowledge is mediated by the level of EMR adoption desired. Advancing from one level to another requires the adoption of new system functionalities,

implementation of additional modules or adherence to required standards. Each can make the system more capable of exchanging data and supporting a paperless environment. The process of decision making for each level is distinct and explained through the effect of adoption levels on the system knowledge at the particular level. Different levels of EMR adoption influence the knowledge-perceived behavioral control relation directly and the intention-decision result indirectly.

The factor of voluntariness, which refers to whether the decision to adopt is optional or mandatory, is added as a determinant of subjective norm per the findings of the Technology Adoption Model 2 (TAM2) [14].

D. Hypotheses

From the proposed model, a series of hypotheses follow. Each is targeted to define the impact of the barriers and the multi-level EMR adoption on the intention to adopt and the decision to adopt EMR system. The relation between intention to adopt and decision to adopt is expected to be moderated by the barriers. The barriers variable comprises financial, time, technical and organizational barriers. Each of those barriers is hypothesized to moderate the relation between intention to adopt and decision to adopt.

Hypothesis 1a – Intention to adopt has a direct relation with decision to adopt.

Hypothesis 2a – Barriers moderate the relation between intention to adopt and decision to adopt.

Hypothesis 2b - Financial barriers have impact on decision to adopt.

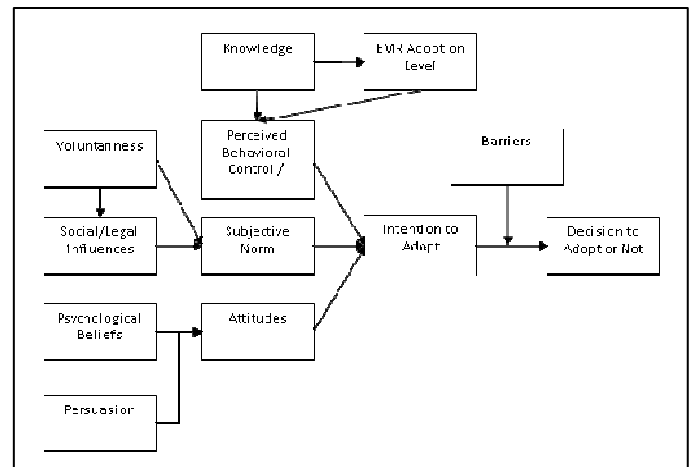
Hypothesis 2c – Time barriers have impact on decision to adopt.

Hypothesis 2d – Technical barriers have impact on decision to adopt.

Hypothesis 2e – Organizational barriers have impact on decision to adopt.

This model supports the findings of TPB and explains intention to adopt as a direct criterion of the three determinants.

Fig. 1. EMR Planned Adoption Model



Hypothesis 3a – Attitudes have direct relation with intention to adopt.

Hypothesis 3b – Subjective norm has direct relation with intention to adopt.

Hypothesis 3c – Perceived behavioral control/self-efficacy has direct relation with intention to adopt.

Rogers' Diffusion Theory [13] explains that for a potential adopter to make a decision on implementing a system, the process starts with knowledge about the system, then persuasion to enforce beliefs and knowledge about the system, then the decision to adopt or not adopt the system. Knowledge is gained from the potential adopters own thoughts, values and beliefs combined with what the social system has to offer in terms of information. The availability of knowledge impacts the level of perceived behavioral control/self-efficacy. The more knowledgeable the decision-maker is on the functionality, standards, use and implementation process of the system the more he/she intends to adopt it. When it comes to EMR, the level of adoption affects the type of knowledge needed. For each level, the format and availability of knowledge differ, and thus knowledge is mediated by the level of EMR adoption anticipated.

Hypothesis 4a – Knowledge has direct relation with perceived behavioral control/self-efficacy.

Hypothesis 4b – Adoption level is a mediator for the relation between knowledge and perceived behavioral control/self-efficacy.

Persuasion is enforced, according to Rogers [13], when four elements exist. First, a system should bring a relative advantage to the potential adopter. In this case that can be financial benefits, time saving, and quality advantages. Second, the system should be compatible with current norms, which in this case refers to minimal organizational obstacles. Third, the system should not be complex to implement or use. Fourth, the adopter is more likely to implement the system if there was a chance to use it, learn it or try it and preferably experience a sample result or outcome before making the adoption decision. All of these persuasion elements play a role in influencing the attitude towards the system. The potential adopter's initial psychological beliefs on the system are moderated by persuasion before they form the attitude towards the intention to adopt the system.

Hypothesis 5a – Psychological beliefs have direct relation with attitudes.

Hypothesis 5b – Persuasion moderate the relation between psychological beliefs and attitudes.

The subjective norm is expected to have a large impact on the intention to adopt EMR and advance it through the levels of adoption. The role of the government is large and the role of affiliate medical organizations and partners will also be noticeable. A series of legal and social pressures will shape the subjective norm including governmental mandates and planned assistance. The level of voluntariness of innovation-decision process will mediate the impact of the legal/social influences on the subjective norm. Voluntariness is defined by whether the decision to adopt is optional, collective or authority driven.

Although the involvement of the government is essential in setting standards and specifications, a successful and a faster system implementation is hypothesized to be due in large to optional and voluntary decision making process.

Hypothesis 6a – Social/legal influences have direct relation with subjective norm.

Hypothesis 6b – Voluntariness is a mediator between social/legal influences and subjective norm.

Hypothesis 6c – Role of government is mandatory in setting system standards.

Hypothesis 6d – Optional adoption decision lead to faster and more successful implementation.

The model assumes that every stage of EMR diffusion requires a decision to adopt or to advance to the next level of system implementation. Each stage is influenced by knowledge, persuasion, voluntariness, attitudes, subjective norm and perceived behavioral control/self-efficacy. Thus, barrier analysis and impact assessment on decision to adopt is distinct. The influence of each category of barriers is different for different levels. Some barrier categories are stronger determinants of decision to adopt at some levels where they are weaker at others. Some of those notable barriers are financial, time, technical and organizational. Financial barriers are noted to be the most widespread barriers to EMR adoption. External financial assistance and subsidies are put in place to mitigate the impact of those barriers. While financial and technical barriers are hypothesized to make larger impacts in the initial stages of EMR adoption, time and organizational barriers are expected to have increased impact in the later stages of adoption.

Hypothesis 7a – Financial barriers are stronger influencers on decision to adopt in the early stages of the EMR adoption than the later stages.

Hypothesis 7b – Financial subsidies are less effective in the later stages of EMR adoption than the earlier stages.

Hypothesis 7c – Technical barriers diminish in importance to influence decision to adopt as the levels of EMR adoption advance.

Hypothesis 7d – Time barriers increase in importance to influence decision to adopt as the levels of EMR adoption advance.

Hypothesis 7e – Organizational barriers are stronger influencers on decision to adopt in the later stages of EMR diffusion than the earlier stages.

Hypothesis 7f – The role of champion or leader is a stronger influencer on the decision to adopt in the later stages of EMR adoption than in the earlier stages.

V. METHODOLOGY AND PRELIMINARY RESULTS

The method for proving the suggested hypotheses is carried in a two-stage research approach. The first is a pilot study composed of qualitative semi-structured interviews to gather direct understanding of the possible reasoning and point of view of physicians on electronic medical records adoption and

implementation process. The feedback gathered in the pilot surveys helped shape the questionnaire and survey direction of the larger research. The second is the main research. It is a quantitative research with structured survey questionnaire targeting a larger group of selected physicians.

The audience of the research was selected in a way that can answer some of the knowledge gaps presented. First, small physician offices and practices needed to be represented in the research and not only bigger medical institutions or hospitals. Literature shows that hospitals and bigger organizations are faster in adopting EMR and decisions are usually made by directors, not the medical staff. Including smaller medical providers as participants of this research helped identify the reasons or the obstacles that smaller practices are facing in keeping up with the adoption rates of the larger medical organizations. Second, the research distinguished between physician offices and physicians practicing in the eastern part of the country and physicians practicing in the western part. More emphasis will be applied to physician practices in the eastern part of the country. Previous data show that medical organizations in the west seem to be quicker in adopting EMR and the rate of adoption is higher there than in the eastern USA. Differentiating between the regions of physician practices will clarify the barriers that the eastern part of the region has in comparison to the rest of the nation.

A. Pilot Study

In the pilot study, a semi-structured qualitative series of interviews were prepared. The questions in the interviews were designed to capture feedback regarding subjects that can add to the development and support of the model.

The pilot interviews as a whole confirmed that doctors are split in their support of Electronic Medical Records systems. The opposite opinions are clear. Some physicians do not see a benefit to the system in its current or future state, while others believe that their jobs wouldn't be possible without the EMR system. One doctor blames the issues with her EMR system mostly on technical limitations, but she does feel that there is a positive potential to the overall national adoption if everyone collaborates. This variance in opinions can be attributed to multiple factors that were addressed in the final quantitative survey composed of 39 main questions.

B. Final Results

The final survey was distributed via three channels: direct mail, electronic mail and social media. A total of 382 responses were captured over a span of eight weeks. The majority of the participants (58%) practice specialty medicine. 17% are in the surgical medicine. 11% are primary care – family medicine physicians, and 7% specialize in internal medicine. Only 5% practice emergency care and less than 2% are hospitalists. Over 55% of the physicians are full-time employees. 34% are either solo owners or part owners (12% solo, 22% part). 6% are part-time employees while independent contractors make up the remaining 5%. These results support the findings of [15] where more and more physicians are electing to work as employees at hospital-owned facilities than owning their private practices.

Although the results are still being analyzed at the time of this publishing, the following are some significant findings to date:

1) EMR Adoption Level

Interestingly enough, 93% of the physicians who answered the survey say that their practices have some type of an EMR system. Only 7% don't have any form of EMR system in their practice. 87% have a system that supports and integrates with other electronic activities like e-billing, e-scheduling, and e-prescription. More surprisingly, the largest group of physicians (over a third) is part of practices with EMR systems that already meet government standards and are capable of sharing or exchanging data with other practices and medical institutions nationwide. 36% said that their practices have a level 5 EMR system.

2) Intention and Decision

SPSS results show a strong relationship between intention to adopt or use an EMR system and the decision to adopt or use an EMR system, $r=-0.747$, $n=141$. This relationship is statistically significant with $p<0.0005$, zero to 3 significant digits. The negative relationship is caused by having the "adopt" value set to be 1 while the "not adopt" value was set to be 2. Therefore, the higher the intention to adopt and use an EMR system, the more likely the user will adopt an EMR system. This finding support Ajzen's TPB model [16] and hypothesis 1a.

3) Planned Behavior, Knowledge and EMR Adoption Level

Attitude and Intention: There is a strong positive relationship between attitude on EMR system adoption and the intention to adopt EMR system, $r=0.667$, $n=207$. This relationship is statistically significant with $p<0.0005$, zero to 3 significant digits. This finding supports hypothesis 3a.

Subjective Norm and Intention: There is a moderate positive relationship between subjective norm (captured by the attitude on EMR adoption of peer physicians and colleagues) and the intention to adopt an EMR system, $r=0.394$, $n=198$. This relationship is statistically significant with $p<0.0005$, zero to 3 significant digits. This finding supports hypothesis 3b.

Perceived Behavioral Control/Self-Efficacy and Intention: There is a moderate to strong positive relationship between perceived behavioral control/self-efficacy (captured by the level of confidence in adoption of an EMR system) and the intention to adopt an EMR system, $r=0.600$, $n=207$. This relationship is statistically significant with $p<0.0005$, zero to 3 significant digits. This finding supports hypothesis 3c.

With a correlation $r<0.300$, $n=230$, preliminary results do not show a clear relationship between knowledge and perceived behavioral control/self-efficacy. Thus neither hypothesis 4a nor 4b are supported. However, there is a direct moderate positive relationship between current EMR adoption level and perceived behavioral control/self-efficacy, $r=0.403$, $n=230$. The latter relationship is statistically significant with $p<0.0005$, zero to 3 significant digits.

4) *Psychological Beliefs, Persuasion and Attitudes*

Psychological beliefs were captured by the physician's attitude on digital gadgets and applications in general. Persuasion focused on the physician's level of confidence that EMR system adoption will improve quality and reduce cost of health care in general. SPSS correlation analysis showed a moderate positive relationship between psychological beliefs and attitude towards adopting an EMR system, $r=0.331$, $n=230$. This relationship is statistically significant with $p<0.0005$, zero to 3 significant digits. Also, the analysis showed a moderate to strong positive relationship between the persuasion that EMR system adoption will improve overall health care quality and attitude towards adopting an EMR system, $r=0.590$, $n=226$. This relationship is also statistically significant with $p<0.0005$, zero to 3 significant digits. This finding supports hypotheses 5a and 5b.

5) *Legal/Social Influences, Voluntariness and Subjective Norm*

Further analysis is required to identify the relationship between these variables. Preliminary data suggest that legal and social influences are two distinct influencers and should be analyzed as such instead of being combined.

6) *Adoption Barriers and Intention to Adopt*

With about 13 components addressing the four adoption barriers categories (financial, time, technical and organizational), principal component factor analysis is being carried to reduce those components into reliable factors. Preliminary results do not support hypotheses 2a, 2b, 2c and 2d that financial, time, technical and organizational barriers have a direct relationship with the *decision* to adopt an EMR system. The preliminary results rather do show a statistically significant relationship between each of those barriers and the *intention* to adopt an EMR system or *perceived behavioral control/self-efficacy*. Additionally, the relationship between the barriers and perceived behavioral control/self-efficacy is stronger than the relationship between the barriers and intention or decision to adopt the system as it was indicated in the group 7 of the hypotheses. In addition, there are clear correlations between the four categories of barriers themselves. Further factor analysis and regression testing is necessary to clarify the strength of those relationships.

VI. DISCUSSION

The EMR Planned Adoption Model presented helps identify the specific adoption barriers for each one of the five adoption levels. A nationwide adoption of electronic health records system requires the attainment of level 5 by all medical offices and institutions in the US. Having 36% of medical practices at level 5 EMR system adoption is a considerable advancement over the last two years. However, there are still 64% of the practices that need to attain that level in order for the national health care industry to practice under a single interoperable system supporting real-time medical data sharing. Understanding what barriers are present at what levels of the EMR adoption will help the management of medical organizations and physician offices set the proper mitigation plans to overcome relevant barriers and expedite the implementation and adoption of the system.

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