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INVESTIGATING THE NON-ADOPTION OF ELECTRONIC HEALTH RECORDS IN PRIMARY CARE

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INVESTIGATING THE NON-ADOPTION OF ELECTRONIC HEALTH RECORDS IN PRIMARY CARE

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ABSTRACT

The objective of this study was to investigate the underlying reasons behind primary care centers in the United States not implementing an Electronic Health Record system in spite of looming penalties under the Health Information Technology for Economic and Clinical Health (HITECH) Act. In order to do this, survey was developed and distributed among healthcare providers who have not yet implemented an EHR system at their practice. The questions for the survey were developed after conducting a literature review of the barriers to EHR implementation. In this review, six themes emerged: technical, cost, productivity, change process, privacy and time. These 6 categories served as the foundation for the survey which consisted of 30 questions. The results from the survey were analyzed using SPSS. From the analysis we see what the participants perceive as the most significant of barriers and also see that nurses and doctors are divided in their opinion of the EHRs, where the former perceive them as them as not being useful and the latter seem to think otherwise. Further research may be conducted on determining why this is so.

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INTRODUCTION

The United States Healthcare system faces challenges on many fronts, which include deteriorating levels of quality of care provided to patient, rising costs, and deaths due to medication errors [1]. The Institute of Medicine stated in its "To err is human" report that patient deaths rising due to medical errors range anywhere between 44,000 to 98,000 annually in hospitals. The healthcare system is seeing rising cost of care to patients with the United States already having one of the costliest healthcare systems in the world. To compound this, we are also seeing an increase in medication and treatment errors [71], thus resulting in decreased levels of patient safety and quality of care provided. In order to counter this, policy makers and healthcare providers (HCPs) in the United States are counting on increased Electronic Health Records (EHRs) implementation to improve the quality of healthcare provided to patients. But, as of 2012, the percentage of primary care centers who have not yet implemented EHRs stands at 65.2% [3], this is a problem as primary care is the first access point to healthcare for most patients [72]. This paper aims to understand the reasons behind primary care centers' reasons for not yet implementing EHR systems.

What is an EHR?

To get a better understanding of the current state of literature on EHRs, a literature review was conducted. This review helped us to better understand the definitions used to describe EHRs, their functional capabilities, and the people who interact with EHRs. This literature review in turn helped frame some of the survey questions discussed later on in the paper.

The Institute of Medicine [4] defines an EHR system with the following attributes: a longitudinal collection of health records, providing immediate access to providers with authorization, decision support which enables clinical quality, safety, and efficacy enhancements, and supporting efficiency. Others define EHRs by the advantages they are perceived to provide: "optimizing documentation, reducing errors, collecting data for research, and optimizing revenue management" [8]. Additionally, the Centers for Medicare and Medicaid services (CMS) define EHRs as an Electronic version of a patient's medical history, that is maintained by the provider over time, and may include all of the key administrative clinical data relevant to that persons care

under a particular provider, including demographics, progress notes, problems, medications, vital signs, past medical history, immunizations, laboratory data, and radiology reports [14].

The components of the EHR system include computerized physician order entry (CPOE), and clinical decision support system (CDS). CPOE is a system that allows direct entry of medication orders and instructions for the treatment of patients by a healthcare provider. These orders are then communicated to various other departments such as the pharmacy, laboratory, or radiology. If used efficiently, the CPOE system decreases delay in order completion, reduces errors related to poor legibility of handwriting, provides error checking for incorrect medications or doses and simplifies inventory. Similarly, clinical decision support (CDS) systems are computer applications that are a part of on EHR system, that are designed to aid clinicians in making diagnostic and therapeutic decisions in patient care [9]. They provide the healthcare provider with the data needed to make an informed decision regarding patient care. In addition, the CDS system provides reminders and prompts while dealing with patients, assists with the diagnoses, in entering appropriate orders, and alerts healthcare providers when new patterns in patient data emerge and are recognized [10].

Apart from the above definitions and explanations, there were many different types of EHRs and accompanying definitions reported in the literature (See table 1). Additionally, electronic health record systems (EHRs) and electronic medical record systems (EMRs) were often used interchangeably. Despite this, there is one crucial difference that distinguishes these two systems from each other, that is, the way the electronically stored data is used and shared. In EHRs, patient information is shared across different health providers at different geographical locations. EHRs provide a more comprehensive picture about a patient's medical history by storing clinical assessments drawn from multiple physicians that the patient might have visited. However, EMRs deal with patient information and other clinical data are contained within a single physician or organization. EMRs are of particular importance to this study because, in spite of the differences, EHRs and EMRs are implemented in an identical fashion and also bring along with them, the same kind of barriers to implementation as seen in the case of EHRs. Hence, research papers referencing EMRs were also considered for this review.

Table 1. 1 Results of literature review for EHR definition

Type of EHR/EMR	Definition/Explanation	Literature
Departmental	Contains information entered by a single department inside a hospital. Departmental EHRs include • Picture archiving and communication system records (PACS) • Anesthesia records • Intensive care records • Ambulatory records • Cardiology records • Oncology records	[30-43]
Interdepartmental	These EHRs contain information from two or more departments within a hospital; for example, obstetric records for inpatient and outpatient clinics, and prescribing systems within hospitals.	[44,45]
Hospital	Hospital EHRs are organization wide EHRs that contain all or most of patients' medical information from a particular hospital.	[46-50]
Interhospital	Inter-hospital EHRs contain patients' medical information from two or more hospitals.	[51]
Electronic Patient Record (EPR)	EPRs and EHRs are used interchangeably. EPRs contain all or most of the patient information from a particular hospital.	[52]
Personal Health Record (PHR)	PHRs are controlled by the patients and contain information that is entered either partly or in full by the patients themselves.	[53-55]
Computerized medical record	Computerized medical record systems perform the same functions as an EHRs. Some research papers refer to EHRs as	[56]

	computerized medical record systems.	
Digital medical record system	Digital medical record systems are very similar to EHRs. The only difference is that the medical record database is stored and operated on a web-based platform.	[10]
Clinical data repository	Clinical data repositories collect information about patients from multiple sources and present it in a single document. They centralize patient information so that physicians and other healthcare providers can access patient information at point of care, minimizing administrative and bureaucratic duties.	[10]
Electronic client record	An electronic client record is a system where data is entered and managed by healthcare professionals other than physicians and nurses; for example, chiropractors and social workers.	[10]

EHR System Users

The EHR system has several grouping of end-users: healthcare professionals [11], upper management [12], and patients and their families [30, 57]. The healthcare professionals who use EHRs include physicians, nurses, pharmacists, radiographers, and lab technicians. EHRs are also used by people in upper management such as department administrators, patient care managers, directors, and other executives [14, 15, 18].

EHR system functionalities

On researching the literature, the following general functionalities of EHRs were identified: record demographics, order prescription, viewing lab results, clinical notes [13], generating list of patients by medication, generating list of patients by demographic information, generating list of patients by diagnosis [14], billing, guideline reminders, patient clinical summaries, viewing imaging results, providing drug warnings, patient allergy list, patient medication list, patient vital signs, and smoking status [15].

EHR benefits and reasons for implementing them

Some of the primary benefits of EHRs observed in organizations that have already implemented them have been identified in the literature, such as improving quality of care provided to patients, conserving physician time, sharing patient information among healthcare practitioners, and improving workflow efficiency [16, 17]. Other benefits include improvements to medical staff's work efficiency and time management, improving patient safety, and decreasing cost of care [18].

With the EHRs, and health IT in general, proving beneficial to both healthcare organizations (in terms of improving workflow efficiency, reducing time per patient [6]) and patients (reduced chance of drug administration errors, reduced costs [10]) it was unsurprising that in the IOM's 1999 report, "To Err is Human: Building a Safer Health System," it recommended the adoption of health safety systems such as the computerized physician order entry (CPOE), clinical decision support system (CDS), among others, to improve patient safety [1]. As a result of this recommendation, an executive task force was created to identify solutions for improving patient safety by means of incorporating information technology. Twenty million dollars of federal funding were allocated to the Agency for Healthcare Research and Quality (AHRQ) with the purpose of improving patient safety and quality of care. As a result, there was a nationwide increase in healthcare IT research and in 2009, the research and the results led to the signing of the American Recovery and Reinvestment Act of which the health information Technology for Economic and Clinical health (HITECH) act is a part of. The former act mandated a nation-wide EHR implementation for all healthcare institutions and the latter mandated the meaningful use measures of a certified EHR system for all providers of Medicare and Medicaid

According to the Centers for Medicare and Medicaid (CMS), meaningful use is defined as using certified EHR technology to improve quality, safety, efficiency, reduce health disparities, engage patients and families, improve care coordination, and maintain privacy and security of patient health information. Provisions under the HITECH act state that providers qualify for financial incentives [5] to help subsidize the cost of the EHR implementation. These incentives are paid annually with the amounts reaching up to $63,750 per provider. Medicare providers that cannot demonstrate meaningful use of the EHR by 2015, however, will be penalized through lower payments or fines.

Meaningful use measures were set in order to in order to:

1) Begin seeing improvements in quality of care provided to patients

2) Quantifying these improvements to show actual improvement
3) Qualify for financial incentives

Meaningful use measures are definitely well intentioned, but the problem is, these measures are the same for all healthcare organizations regardless of its size and scope. Large hospitals with their comparatively larger resources might find it easy to satisfy all or most of the meaningful use measures set forth whereas smaller primary care centers, with their limited resources (both financial and manpower) simply cannot match the bigger hospitals in their ability to satisfy meaningful use measures. Limitations such as these are the focus of the study, to find out if they are significant enough to deter primary care centers from implementing EHRs.

The benefits of the EHRs, the mandate and the financial incentives to implement EHRs notwithstanding, there is still a large percentage of primary care centers (65.2%) who have not yet implemented them [3]. But this is not the case with large hospitals, which understandably have more resources, financial and otherwise, and hence their implementation rates are much higher (61.9 %) [3] than that of small practices. Moreover, 78 % of physicians in the US practice in groups of eight or less [3] and the majority of patients first visit a primary care center before consulting with HCPs at larger healthcare institutions. For this reason, we focused our research on EHR non-adopters in primary care as they have the widest reach among the US's population. This paper aims to understand the reasons behind primary care centers' hesitation to implement EHRs, despite the mandate, the financial incentives and impending penalties. To better understand the reasons why, we developed a survey to help us identify important barriers to healthcare providers in primary care that prevented them from implementing EHRs in their practices.

METHOD

Survey development:

Prior to writing this paper, two separate literature reviews were conducted. One, to determine the different ways an EHR system was defined in literature (see table 3.1), and two, to identify the various barriers to EHR implementation discussed in literature. Based on these reviews, a survey was developed (see appendix).

Barriers to Electronic Health Record system Implementation

With regards to the EHRs implementation barrier review, papers were included if they satisfied the following criteria:

1. Articles written in English
2. Articles that mainly focused on EHRs or EMRs*. Articles that focused on other systems (e.g., CPOE) and those that discussed Health IT in general were not included
3. Articles related to barriers linked to EHR implementation
4. Empirical studies and published in peer-reviewed journals

*As discussed earlier, EMRs are in fact different from EHRs in the way they operate and exchange patient data, but they are similar to EHRs when it comes to the implementation process (along with the problems faced by the practices when implementing them).

The resulting barriers to EHR implementation were then grouped under six categories through the method of content analysis [87]. Using this method, the mention of barriers to EHR implementation in various research papers were noted down. The barriers that were mentioned the most and those that had significant impact to EHRs implementation were then grouped into the following six categories:

1. Technical reasons
2. Cost reasons
3. Productivity
4. Change process
5. Privacy
6. Time

Using these six categories as a foundation, survey questions were developed for each.

1. Technical reasons:

This category includes difficulties faced by providers when using EHRs. EHRs are hi-tech systems and require a certain level of computer knowledge and skill to operate. Technical barriers include the following:

- Lack of computer skills [57]
- Lack of training [58]
- Lack of computers [59,60]
- Complexity of the system [61]
- Interconnectivity problems [62-64]

2. Cost reasons:

This category includes barriers related to monetary issues faced by practices when purchasing, implementing, and running EHRs. Problems range from, high initial investments, to poor return on investments (ROI), among others.

- High initial investment [3,61,65]
- Inability to calculate return on investment (ROI) [58,62,66]
- High on-going costs [65,67]
- Lack of financial resources [68]

3. Productivity:

This category includes barriers related to health-care providers' perceptions of how EHRs' affect the way they work such as the extra work being done by people to convert old paper records to digital format, having to do more work per patient and so on. They also include the following:

- Limitation of the system [60]
- Extra work to convert paper records to digital format [61]
- Unsatisfactory level of control [69]

4. Change Process:

The change process category includes barriers related to people's reluctance to change from one state to another (in this case, going from a state without EHRs to one where it is implemented). Implementing EHRs is an organization wide process, involving everyone from nurses and technicians to physicians and clinic managers. Without sufficient buy-in from everyone involved, there may be significant opposition to EHRs. Some employees may be apprehensive as implementing EHRs signals a major change for providers and other employees in the way they work. Barriers under this category include,

- Organizational type [3,70]
- Lack of support from organizational culture [71]
- Lack of leadership [69]
- Lack of incentives [72]
- Lack of employee involvement [60]

5. Privacy:

Though there are un-deniable advantages to storing medical information in an electronic format (such as convenience and longevity), it brings along with it concerns about privacy and how well this information can be kept confidential. Some of the barriers related to privacy include the following:

- Lack of belief in digital data security [57]
- Concern about patient privacy [72]
- Concern about physician/employee privacy [73]

6. Time:

Time taken to complete data conversion from paper to digital, time taken to search for an EHR and generally taking more time to complete one's work(as seen in the survey) have all been cited as barriers by previous studies. Barriers under this category include the following:

- Time to select new EHR system [63,69]
- Time to purchase and implement system [12,69]
- Time spent on training [64,68]

Using the above listed barriers as a guide, initially the survey questions generated numbered over 50, but after four iterations the number of questions was reduced to 30 because we anticipated that our participants, being very busy individuals, would not have time for a lengthy survey. The final 30 questions were then sent to an external subject matter expert, for face validation. The 30 questions were divided into six groups:(i) Technical (ii) Cost (iii) Productivity (iv) Change-process (v) Privacy, and (vi) Time.

The survey can be seen in the Appendix. For each question, a 5-point likert scale was used with 1 indicating "Strongly disagree,", 2 indicating "Disagree," 3 indicating "Undecided,", 4 indicating "Agree," and, 5 indicating "Strongly agree,", with an additional "Don't Know" option. In the final version, the survey had five questions regarding survey respondent's attitude toward the technical aspects of EHRs (both hardware and software) two questions regarding the financial aspect of EHRs, 10 questions to collect information regarding the respondents' attitude toward the increase or decrease of productivity surrounding EHRs usage, six questions related to the respondents' attitude toward the change process (i.e., the process of going from not having an EHR to implementing it) , two questions regarding privacy of both patients and providers, and

one question regarding the respondents' perception of EHRs' effect on time(time taken to convert paper format to digital). In addition there were four questions in the survey meant to be answered only by people with the power to make decisions for the organization.

RESULTS

Participants:

Participants who were over the age of 18 and worked in primary care centers that 1) serviced patients covered under Medicare or Medicaid and 2) did not have an EHR system, were targeted. An e-mail containing a short description of the study and a link to an online survey was sent out to potential participants around the country. A total of 30 participants took the survey with a 100% completion rate. Eighteen (60%) participants were female and the remaining 12 (40%) were male. There were 13 (43.33%) doctors, 12 (40%) nurses and 5 (16.66%) participants from upper management who took the survey. Every participant had completed formal education of some kind. The participants had at least seven years and at most thirty years of professional experience. All participants had indicated that they work at least forty hours a week. Participants had also indicated that they had at least 4 years of experience working with computers and at most 30 years of experience.

Data Analysis results:

For each of the survey items, means, standard deviations, and percentages were calculated and then separated by profession i.e., doctors, nurses, and upper management. For the second phase of the data analysis, an odds ratio calculation was performed for each of the survey items that showed a statistically significant difference in opinions between doctors and nurses. For the odds ratio calculation, the survey responses (that showed a significant statistical difference) were dichotomized into two groups, namely "No" and "Yes". The average for the "Strongly disagree" and "Disagree" responses for each survey item was taken for the "no" column and similarly the average of "Strongly agree" and "Agree" was taken for each survey item for the "Yes" column. The responses for the "undecided" column were not considered for the odds ratio calculation as they will not change the direction of association in any way, meaning that the final outcome of the calculation will not be affected. By doing the odds ratio calculation, we can observe which group, i.e., doctors or nurses are more likely to accept or reject EHRs implementation for a particular survey item.

For Phase 2 of the data analysis, responses from participants belonging to upper management were not considered as there were only five participants and the sample size was insufficient to perform a statistical analysis.

Phase 1 of Data Analysis: Means and Percentages

Technical:

Under the technical category, there were 4 questions asking the participants about their technical skills or lack of them, with EHRs. Participants rated the item "I lack the necessary computer skills required to use EHR systems" an average of 3.70, with the majority of the participants strongly agreeing (32%). It was observed that 58.3% of nurses and 53.9% of doctors either "agree" or "strongly agree." Participants rated the item "I find EHR systems to be too complex to use," an average of 3.74, with 48% of all participants strongly agreeing. We observed that 75% of the nurses and 23.1% of the doctors strongly agree. Similarly, for the survey item "If implemented, there would be inadequate technical support for the EHR system," participants rated it a 3.97 on average, with 56% of the participants choosing "strongly agree." Seventy-five percent of nurses strongly agreed whereas among doctors, the opinion was divided with 38.5% of them strongly agreeing and 30.8% disagreeing. For the final item under the technical category, "I find EHR systems to be intimidating," participants rated it an average of 3.84, with 48% of the total participants choosing to strongly agree. Following the trend, the majority of the nurses (75%) strongly agreed whereas 38.5% of the doctors agreed and 30.8% disagreed.

Cost:

Three survey items were included under the cost category. Participants rated the item, "My organization cannot afford the start-up costs associated with implementing an EHR system" on average a 3.7 indicating that they agree that initial start-up costs are a barrier to them not implementing an EHR, with 43.3% of all participants strongly agreeing. Analysis of the data showed 66.7% of the nurses strongly agreeing and 53.9%of the doctors either disagreeing or strongly disagreeing. Similarly, participants rated the item "Running costs would be too high to maintain an EHR system in my organization" an average of 3.74 with 43.3% of all participants strongly agreeing. Here, 66.7% of the nurses strongly agreed, but the opinion among doctors again was divided with 30.8% strongly agreeing and 30.8% disagreeing that the running costs would be too high. The item "The cost of implementing an EHR system outweighs the potential benefits of its use" was rated an average of 3.70, with the majority of the participants (53.3%)

strongly agreeing. Among nurses, 75% strongly agreed; and again doctors' opinions were divided with 30.8% of them strongly agreeing and 30.8% disagreeing.

Productivity:

Under the productivity category, there were 10 survey items. The survey item "Using an EHR system would increase my overall workload" was rated an average of 4.24 with the majority of the participants (63.3%) strongly agreeing that using EHRs adds to their workload, an overwhelming majority of the nurses (91.7%) strongly agreeing, and 38.5% of the doctors strongly agreeing as well. Similarly, "Using an EHR system would slow down my work" was rated an average of 4.17 by the participants with the majority of the participants (60%) strongly agreeing. Here, 11 of the 12 nurses (91.67%) strongly agreed and 61.6% of the doctors either agreed or strongly agreed. The participants disagreed with the survey item "I could finish my job quicker using an EHR system" and rated it an average of 2.57 with the majority of the participants (48%) either disagreeing or strongly disagreeing. "My job performance would improve if I used an EHR system" was rated an average of 2.63 with the majority of the participants (30%) strongly disagreeing. The majority of the nurses (58.3%) completely disagreed with this survey item, and among doctors, 30.8% disagreed and 30.8% were undecided. The survey item, "Using an EHR system would make me more productive" was rated on average a 2.63 indicating that the majority of the participants disagreed that the EHR system would make them more productive at their jobs, with 41.7% of the nurses strongly disagreeing and 38.5% of the doctors also disagreeing. Participants rated "There is no need to implement an EHR system in my organization" an average of 3.17. Here we observed that 50% of the nurses strongly agreed and 23.1% of the doctors strongly disagreed. Participants rated "The quality of my work would improve if I used an EHR system" on average a 2.80. We observed that 33.33% of the nurses strongly disagree and 30.8% of the doctors either agree or strongly agree. Participants rated the survey item "Using the EHR system would require me to spend more time per patient" on average a 3.97. Here, 75% of the nurses strongly agreed and 53.8% of the doctors agreed as well. Participants rated the survey item "I am used to the way things work right now in my organization" an average of 4.82. Among nurses, 83.3% strongly agreed and 61.5% of the doctors also agreed with this survey item. "Using an EHR system will make my job harder to do" scored 4.03 on average with the majority of the participants (43.3%)

strongly agreeing. Seventy five percent of the nurses strongly agreed as well, and 61.5% of the doctors agreed too.

Change-Process:

For the survey item, "The culture in my organization is not supportive of an EHR system implementation," participants rated it on average a 4.1 with 50% of all participants strongly agreeing. Among nurses, 83.3% strongly agreed and 38.5% of the doctors too strongly agreed with the survey item. "I would not be motivated to use an EHR" scored similarly to the previous item, with the participants rating it on average a 4.03. Here, too, 83.3% of the nurses and 38.5% of the doctors strongly agreed. Participants rated "I believe using an EHR system would increase the quality of care given to patients" an average of 3.8 with 40% agreeing and 20% disagreeing. Among the nurses, 50% strongly agreed and among the doctors, only 30.8% strongly agreed. Participants rated "I believe there would be fewer errors when using an EHR system" on average a 3.60. Nurses and doctors were divided in their opinions with 58.3% of the nurses strongly agreeing, and 46.2% of doctors either strongly disagreeing. Participants rated "I believe implementing an EHR system would increase patient safety in my organization" on average 2.90 with the majority of the participants (30%) being undecided on this survey item. Here, 41.7% of the nurses strongly disagreed whereas 53.8% of the doctors were undecided. The survey item "I believe my organization would function better overall when an EHR system is implemented" was rated on average a 2.87 with the majority of the participants (30%) disagreeing, 50% of the nurses strongly disagreeing, and 46.2% of the doctors disagreeing.

Privacy:

There were two items under this category. The first "I have concerns about privacy/confidentiality issues regarding patient information while using an EHR system" was rated an average of 4.00 with the majority of the participants (60%) strongly agreeing. Both nurses and doctors voted similarly with 66.7% of the nurses and 69.2% of the doctors strongly agreeing. For the second item, "My privacy would be infringed upon while using an EHR system," participants rated it an average of 4.03 with 63.3% of the total participants strongly agreeing. Here, too, the majority of the nurses and doctors strongly agreed.

Time (Effect of extra workload on time):

The only survey item under this category, "I feel the work to convert existing paper records to digital format would be too much" scored a 4.33 on average with 63.3% of all participants strongly agreeing. Here, 83.4% of the nurses either agree or strongly agree along with 92.3% of the doctors who also either agree or strongly agree.

Phase 2 of Data Analysis: Odds ratio calculation

Upon conducting a test for significance for the each of the survey items, the following survey items showed strong evidence that profession of the participant played a role in either accepting or rejecting EHRs implementation based on that particular survey item:

For the odds ratio calculation, doctors were considered as group 1, and nurses as group 2.

Inference of the results:

If odds ratio = 1, then the event (agreeing with survey item) is equally likely in both group 1 and group 2.

If odds ratio > 1, then the event is more likely in group 1 (Doctors)

If odds ratio < 1, then the event is more likely in group 2 (Nurses)

Table 3.2 Results of the odds ratio calculation

Survey item (#)	Odds ratio	Inference
I find EHR systems to be too complex to use (2)	0.32	Nurses are more likely to agree to this survey item than doctors
My organization cannot afford the start-up costs associated with implementing an EHR system (5)	0.55	Nurses are more likely to agree to this survey item than doctors
Using an EHR system would increase my overall workload (8)	0.034	Nurses are more likely to agree to this survey item than doctors
Using an EHR system would slow down my work (9)	0.04	Nurses are more likely to agree to this survey item than doctors

Using an EHR system would make me more productive (10)	4	Doctors are more likely to agree to this survey item than nurses
My job performance would improve if I used an EHR system (11)	5.625	Doctors are more likely to agree to this survey item than nurses
I could finish my job quicker using an EHR system (12)	5.624	Doctors are more likely to agree to this survey item than nurses
Using an EHR system would require me to spend more time per patient (15)	0.3	Nurses are more likely to agree to this survey item than doctors
I am used to the way things work right now in my organization (16)	0	Nurses are more likely to agree to this survey item than doctors
Using an EHR system will make my job harder to do (17)	0.909	Nurses are more likely to agree to this survey item than doctors
I believe there would be fewer errors when using an EHR system (24)	0.22	Nurses are more likely to agree to this survey item than doctors
I believe implementing an EHR systems would increase patient safety in my organization (25)	2.667	Doctors are more likely to agree to this survey item than nurses
I believe my organization would function better overall ,when an EHR system is implemented (26)	1.33	Doctors are more likely to agree to this survey item than nurses

DISCUSSION

Under the technical barriers category, both doctors and nurses were aligned in their perception. Nurses seem more likely to agree that EHR systems are complex and intimidating and the participants also believe that they would not have adequate technical support for the EHR system at their primary care center. A study by Gans et al., also found that one of the top barriers in not implementing EHRs in primary care centers was a lack of technical support for EHRs. Although EHRs can be seen as complex and intimidating, they have undergone several iterations and are currently easier to use and more useful. They still need more iterations, but EHRs are heading in the right direction in terms of usability, as a subsection of the health informatics industry focuses solely on EHRs improvement, both in the operating software [74] it uses as well as the hardware. A study by Meade et al, showed that many older physicians received their qualifications before IT programs were introduced and hence explain older

providers' reluctance to use EHRs. Healthcare providers were also reported to lack typing skills to enter patient information in the EHRs. The federal government can initiate programs that can help educate the physicians and other health providers about current EHRs and provide training sessions for them. This may help change their perceptions of the technical aspects of EHRs as being barriers to implementation.

When it comes to barriers related to cost, the majority of the participants strongly agree. The average estimated up front cost for an EHR system per provider is $33,000 [2], with yearly running costs of $4000 on average [70], but most physicians fail to calculate the return on investments (ROI) for them. According to Miller et al., upon performing ROI calculations for solo or small group practices, it was found that they were able to recover cost of implementation within 2.5 years and then received on average approximately $23,000 per year(combination of Medicare/Medicaid pay outs and internal revenue), per provider. Additionally, time saved per patient will lead to more patients coming in and hence more revenue. People within the organization who are familiar with finances can take it upon themselves to educate their peers about the long term financial benefits of EHRs. This may help ease their perceptions of the financial aspects of EHRs as barriers to implementation. The odds ratio results seem to indicate that nurses do not believe that their organizations can afford the cost of implementing EHRs whereas doctors do.

The majority of the participants strongly agreed with most of the barriers listed under productivity. In fact "Using an EHR system would increase my overall workload" received the second highest mean score of 4.23. But in many studies, EHRs have been shown to increase productivity of the doctors and nurses [18] and not decrease them as perceived by the majority of the participants. But it also has to be stated that EHRs have a steep learning curve and older health providers with little to no computer skills will more likely reject EHRs on account of finding it more difficult than some of their younger peers. A training program or a workshop about EHRs may help ease the apprehensions of these health care providers. It should be noted here of the clear division between doctors and nurses regarding their perceptions of EHRs when it comes to productivity. All health care providers must share the burden when it comes to switching to and using EHRs. A single group or minority must not thrust with the entirety of the work. A macro ergonomic approach might be followed here, ensuring equal justice among all employees by making sure that every group is given the same amount of work and ensuring that the situation will not change even in the future. The onus is on the health informatics industry,

usability engineers and user experience researchers to design an EHR system that users of various ages and computer literacy can use easily.

From the results of the odds ratio analysis, we can see that nurses are more likely to agree to the following:

- Using an EHR system would slow down my work
- Using an EHR system would require me to spend more time per patient
- I am used to the way things work right now in my organization
- Using an EHR system will make my job harder to do

Whereas, in contrast, the doctors are more likely to agree to the following:

- Using an EHR system would make me more productive
- My job performance would improve if I used an EHR system
- I could finish my job quicker using an EHR system

Nurses seem to have a negative opinion about the usefulness of the EHRs in their work and do not see them as being productive, but the doctors on the other hand seem to believe that EHRs will make them more productive, improve job performance and also help finish their job quicker. Further research may be done to determine why this is so.

Under the privacy section, the opinion was very clear as the majority of the participants strongly agreed that they see this as an important barrier to implementing an EHR at their organization. True, digital data is vulnerable, especially in small practices without a dedicated information technology department, but they can learn from bigger practices and hospitals and invest in an IT professional to safeguard the network of data. Currently, the onus of safe guarding the data is being shifted to Health Information Exchanges (HIEs) [73] that are being set up in each state. HIEs serve as a digital repository of patient information from all over a particular state. Steps are being taken to move all data out of hospitals and into HIEs. Provided that HIEs do a good job in protecting patient information, this barrier might be overcome soon.

Under the change process category too nurses and doctors were divided in their opinion. Nurses are less likely to believe that EHRs would increase patient safety and are also less likely to believe that their organization would benefit from an EHRs implementation. A common change management principle is “employee buy-in” [70]. By involving all of the employees of a primary care center, keeping them informed about all the benefits that an EHR might provide will

create a sense of ownership and belief. This includes even deciding what EHRs will suit the organization the best. Inclusion in these phases will impart ownership of the process to the employees thus making it less likely to reject change in the organization. Employee buy-in will be useful even after an implementation as it will encourage them to use the EHRs more as opposed to an EHR system that they did not even want in the first place.

LIMITATIONS

This study was initially proposed to be focused only on the state of South Carolina. Despite numerous phone calls, visits, and e-mails, response rate was still low. We then expanded the focus to include any state in the US. Even after doing so, the response rate was still not as high as we would have liked, with the total participants numbering 30. Another potential limitation is that the survey responses are all self-reported data that cannot be independently verified. These self-reported responses could contain potential sources of bias such as selective memory, telescoping and exaggeration.

CONCLUSION

From the results of the study, we observed that the majority of the participants do not perceive an increase in their productivity while using EHRs to be productive, to increase patient safety or make their jobs any easier. This opinion appears to be more prevalent among nurses as compared with doctors. Future research may focus on why nurses perceive EHRs are generally less productive and less useful than doctors. The responsibility also lies partly with the health-informatics industry in coming up with EHRs that are far more usable, useful and able to store and secure data more efficiently than current EHRs. Vendors must provide several options to the health care providers so they may purchase one that better suits their budget and not be forced to pay for an EHRs that is expensive and that they might not even need for a small practice. Educating people who have not implemented EHRs yet about the potential benefits, and creating targeted training and seminars for nurses might help mitigate the negative perceptions held by non-implementers and thus increasing the percentage of primary care centers that have EHRs implemented.

APPENDICES

Appendix A

EHR Non Adoption Survey

Contents

Section A

About this survey:

This Survey is intended to help researchers at Clemson University better understand healthcare organizations' decisions surrounding Electronic Health Record System (EHR) implementation and use. All responses will be kept confidential. No individual information will be collected and no one at your organization will see your individual responses. Completed surveys can only be accessed by researchers at Clemson University. Your participation is strictly **voluntary**.

When completing this survey, you should think about how you feel and what you think, based on your experiences. **Please select only one option per survey question.** If you think a survey question does not apply to you, if you don't know the answer or if you choose not to answer them, please select the "Don't know" option.

Some questions may appear similar to others, but please try to answer all the questions. Your responses will be completely confidential; nobody at your organization will have access to your individual responses. The survey will take about 10 minutes to complete. Please note: **you have the option of opting out of the survey at any time.**

Section B Contact Information

For any questions or information regarding this survey, please feel free to contact:

1) Dr. A. Joy Rodriguez

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Phone: 864- 656- 3114

2) Saravanan Ramdoss

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Phone: 864-207-0306

Please Note:

For the entirety of the survey**,**

EHRs stands for **Electronic Health Record Systems**

Section C- Survey

		Strongly disagree	Disagree	Undecided	Agree	Strongly agree	Don't Know
1	I lack the necessary computer skills required to use EHR systems	□	□	□	□	□	□
2	I find EHR systems to be too complex to use	□	□	□	□	□	□
3	If implemented, there would be inadequate technical support for the EHR system	□	□	□	□	□	□
4	I find EHR systems to be intimidating	□	□	□	□	□	□
5	My organization cannot afford the start-up costs associated with implementing an EHR system	□	□	□	□	□	□
6	Running costs would be too high to maintain an EHR system in my organization	□	□	□	□	□	□
7	The cost of implementing an EHR system outweighs the potential benefits of its	□	□	□	□	□	□

	use						
8	Using an EHR system would increase my overall workload	□	□	□	□	□	□

		Strongly disagree	Disagree	Undecided	Agree	Strongly agree	Don't Know
9	Using an EHR system would slow down my work	□	□	□	□	□	□
10	Using an EHR system would make me more productive	□	□	□	□	□	□
11	My job performance would improve if I used an EHR system	□	□	□	□	□	□
12	I could finish my job quicker using an EHR system	□	□	□	□	□	□
13	There is no need to implement an EHR system in my organization	□	□	□	□	□	□
14	The quality of my work would improve if I used an	□	□	□	□	□	□

	EHR system						
15	Using an EHR system would require me to spend more time per patient	□	□	□	□	□	□
16	I am used to the way things work right now in my organization	□	□	□	□	□	□
17	Using an EHR system will make my job harder to do	□	□	□	□	□	□
18	The culture in my organization is not supportive of an EHR system implementation	□	□	□	□	□	□

		Strongly disagree	**Disagree**	**Undecided**	**Agree**	**Strongly agree**	**Don't Know**
19	I would not be motivated to use an EHR system	□	□	□	□	□	□
20	I have concerns about privacy/confidentiality issues regarding patient information while using an EHR system	□	□	□	□	□	□
21	My privacy would be infringed upon while using	□	□	□	□	□	□

	an EHR system						
22	I feel the work to convert existing paper records to digital format would be too much	□	□	□	□	□	□
23	I believe using an EHR system would increase the quality of care given to patients	□	□	□	□	□	□
24	I believe there would be fewer errors when using an EHR system	□	□	□	□	□	□
25	I believe implementing an EHR systems would increase patient safety in my organization	□	□	□	□	□	□
26	I believe my organization would function better overall ,when an EHR system is implemented	□	□	□	□	□	□

Please answer the following question :

Are you in a position to make decisions for the organization?

(For example: You have the authority to make large scale purchases for your organization)

- ☐ Yes*
- ☐ No

*If you answered YES to the above question, please answer questions 27-30. If you answered NO, please proceed to SECTION D DEMOGRAPHIC INFORMATION

And complete the rest of the survey.

		Strongly disagree	Disagree	Undecided	Agree	Strongly agree	Don't Know
27	I do not have the time to select a new EHR system for my organization	☐	☐	☐	☐	☐	☐
28	Upper management will not support the implementation of a new EHR system in my organization	☐	☐	☐	☐	☐	☐

29	I cannot find an EHR system that suits my organization's needs	□	□	□	□	□	□
30	I do not know about the different types of EHR systems that are available	□	□	□	□	□	□

Section D Demographic Information:

1. What is your Job Title or Position?

❒ Doctor/Physician

❒ Physician's assistant

❒ Nurse

❒ Clinical Manager

❒ Pharmacist

❒ Pharmacy Tech

❒ Clinical dietician

❒ Clinical nurse manager

❒ Other(please specify)

8. Are you of Hispanic or Latino origin?

❒ Yes

❒ No

9. What is your age?

❒ 18 to 29 years old

❒ 30 to 39 years old

❒ 40 to 49 years old

❒ 50 to 59 years old

❒ 60 years old or older

_____

2. How many hours do you work **at your job here** in an **average week?**

   _____ hours per week

3. How many years have you been in your occupation
   (For example: 2 years, 3 months)

   _____ years _____ months

4. How long have you been with your current employer?
   (For example: 2 years, 3 months)

   _____ years _____ months

10. Highest education level you have <u>completed:</u>

(CHECK ONLY <u>ONE</u>)

- ❒ Grade school or less
- ❒ Some high school
- ❒ Completed high school / GED
- ❒ Some tech/trade school
- ❒ Completed tech/trade school
- ❒ Some college
- ❒ Completed college
- ❒ Graduate/professional school
- ❒ Other (please specify):

_____

5. How many years of computer experience do you have?

(for example: 2 years, 3 months)

____ years ____ months

6. Gender:

❒ Female

❒ Male

7. What is your racial background?
(CHECK ALL THAT APPLY)

❒ American Indian / Alaska Native

❒ Asian

❒ Native Hawaiian

❒Pacific Islander

11. Are you in a position to make decisions for the Clinic?
(For example : You have the authority to make large scale purchases for the clinic)

□ Yes *

□ No

*If you answered yes, please make sure you filled out questions **27 – 30**.

❒ Black / African American

❒ White

❒ Other (PLEASE SPECIFY):

_____

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