

An Evaluation of EHR and the Barriers to Adoption by Small Medical Practices

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Abstract

This paper seeks to demonstrate the reasons for and barriers to adoption of Electronic Health Record (EHR) software by small medical practices. Through a survey of 43 physicians and staff members of small medical practices, we found that information retrieval using EHR systems is generally faster, however, properly configuring data entry to minimize free-text fields is key. Many practices use systems from multiple vendors and will generally switch to a new vendor after five years to take advantage of new features. In terms of barriers, cost and software usability were found to be major concerns.

Keywords: Electronic Health Records, EHR, system implementation

1. Introduction

Until recently, the health records of a patient were solely managed using paper charts. Over time, laws were passed to migrate paper records to an all-digital form. The benefits were an improvement to patient safety and quality of care. With the advent of electronic storage and importance given to patient-centered healthcare, the concept of the Electronic Health Record (EHR) was born (Hoerbst and Ammenwerth, 2010).

EHR provides the potential to improve effectiveness and efficiency by maintaining the privacy of health information, minimizing medical record errors and having health information available in real-time (Razzaque and Jalal-Karim, 2010). EHR supports clinical decision, physician order entry, capture and query information relevant to healthcare quality, and allows for the exchange of electronic health information with authorized sources (U.S. Department of Health and Human Services, 2009). Despite its advantages, adoption of EHR in the US healthcare system has several barriers with respect to cost and quality inconsistency (Zeng, 2008). Technological advancements and research in vendor applications are crucial for widespread implementation of EHR and to overcome these barriers. In the future, cloud computing has the potential to greatly increase the availability of EHRs to small medical practices at an affordable cost.

While several prior studies have examined EHR deployment in large hospital settings, there is little to no research of EHR adoption by smaller medical practices. Our research aims to explore the challenges and hurdles in small practice adoption by presenting a survey of physicians and staff members regarding the usage and problems with EHR software.

This paper is organized as follows. Section 2 is a literature review with a focus on processes involved in adoption of software. Section 3 is our research questions. Section 4 is the system and experimental design which provides the description of the system and the methodology used for

conducting the survey. Section 5 is our Experimental Results and discussion of their meaning. Finally, Section 6 delivers our conclusions, suggested enhancements and future directions.

2. Literature Review

The EHR system emerged as a combination of information communications and knowledge management technology. Its goal is to capture, code, and disseminate health information electronically to enhance care and not simply replace paper. EHRs have enormous potential to improve the flow of information across healthcare systems and information is critical in the effective management of patient care (Mason, 2013). However, not all EHR software solutions are equal. Based on feature sets and costs, medical practices can have a difficult time selecting the software right for them. This is especially true for smaller medical practices that lack an appropriate IT staff to guide them through the process.

2.1. The Importance of EHR

The idea behind converting the paper-based records into digital form is to provide patient records to healthcare professionals which are easily accessible from multiple facilities. EHRs are crucial considering the frequency with which people move for economic reasons, change physicians or when healthcare problems arise during business trips/vacations (Mason, 2013).

In conjunction with efforts to adopt EHRs, hospitals are actively seeking to convert their paper-based records and wholly transform their Health Information Management resources. The reasons for this conversion are many, including more centralized patient records management, the move toward computerized physician order entry, the need for timely access to medical history, improved data privacy and security, regulatory compliance, and more generally, improved operational effectiveness and reduced costs (Hanover, 2011).

Moreover, with paper-based health records, tracking updates or sending records to other facilities happens manually which lacks the speed and reliability of EHR. Paper-based medical

records can also have several disadvantages such as illegible handwriting, ambiguous/incomplete data, and data fragmentation. In addition, paper records often become bulky with time, hence maintaining and tracking paper-based health records can be cumbersome. All these weaknesses could obstruct the continuity and quality of care (Roukema et. al., 2006).

2.2. All about EHR software

It is important for health providers to have an idea regarding how to select software that works best for the needs of their practice. Prior to selection, problems should be identified and proper planning be done in order to design a solution. Once the preliminary stages are complete we can move to examining the adoption process and features supported by the software.

Medical practices need to plan, prepare, and budget for record conversion as a part of EHR deployment. Further activities such as cleanup of the master patient database and eliminating duplicate records need to be performed prior to transition (Hanover, 2011).

EHR software can bring significant advances in the quality of patient care by enhancing readability, availability, and data quality. The software should support comprehensive, reliable, relevant, accessible, and timely patient information to each member of the healthcare team, whether in primary or secondary care and whether a doctor, nurse, allied health professional, or patient. The updated medical record should be available concurrently for use everywhere.

The EHR also provides medical alerts and reminders. EHR systems have some built-in intelligence capabilities, such as recognizing abnormal lab results or potential life-threatening drug interactions. Research findings supporting diagnostic tests and the EHR can link the clinician to protocols, care plans, critical paths, literature databases, pharmaceutical information and other databases of healthcare knowledge (Gurley, 2004).

2.2.1. Implementation

The implementation of EHR depends mainly on three T's, which are Team, Tactics and Technology. Team refers to the people in the organization whom will be using the software. The entire team should be aware of the functionalities of the software. Tactics includes the discussion of techniques used in design and setup. Technology is related to the software, hardware and network choices made (Adler, 2007).

Team

Effective implementation of EHR requires a sound team with one or more EHR professionals. The team must include the organization's senior executive whom fully supports the implementation. In addition, an experienced, skilled project manager with change-management principles is needed. For the EHR implementation to succeed, the team must have clear, measurable, and achievable goals.

Tactics

Implementation of EHR software involves a set of decisions that determine the outcome of the implementation. The workflow design plays an important role in answering questions that arise during the implementation phase. Workflow design is a way to conceptually redesign the current paper-based information workflow in order to reconfigure, automate and improve upon less efficient processes. As a starting point, each major office process should be identified and schematically documented along with the current paper processes under it. Next, the process should be streamlined in order to improve its efficiency and reduce process redundancy. Office processes that must be examined include medication refilling, telephone messaging, appointment requests, lab reviews, other testing procedures, prescriptions, patient check-in, health maintenance tracking, referrals, lab and test orders, communicating test results to patients, interoffice messaging, and note charting (Adler, 2007).

Technology

Technology also plays an important role in the success of EHR software implementation. Technological problems such as poorly written software or inadequate hardware resources can cripple EHR implementation. Therefore, selection and cost of IT infrastructure is a critical component in EHR software's overall success. For smaller practices, selecting a good application service provider is also a critical step. Adequate testing and utilization of expert IT advice allows the implementation to be executed smoothly. Daily backups and a sound disaster recovery plan allow the organization to effectively tackle the worst case scenario (Adler, 2007).

Mistakes in EHR implementation may affect patient satisfaction. The impacts of several problems are explained in Table 1 (Dolan, 2012).

Problem	Impact
Lack of necessary infrastructure	Computers are not adequate to the task
Lack of workflow assessment	Important details are missed/not properly documented
Lack of training	Employees not able to operate the software effectively
Not preparing patients	Patients are unable to use the system effectively
Computer not integrated into patient encounter	The use of a computer is viewed as intrusive
Lack of employee buy-in	Employees are unwilling to use the system
Lack of privacy and security policies	Opens practice to possibility of data breaches

Table 1: Impact of Problems

2.2.2. Adopting EHR software

The major stages of adopting EHR software are to investigate, create, plan and evaluate (O'Hare, 2009). These stages are crucial for the successful adoption of EHR.

Investigate

The key points of 'Investigate' are to identify the problem, develop a design brief, and formulate a design specification. The role of information technology in the healthcare industry varies according to the requirements of the practice. Problems such as paper-based patient records, no computerized clinical operations, and a lack of long-term IT strategies are identified. Once

identified a design outline should be prepared. Understanding specified requirements like how far the practice should avail the benefits of IT is helpful in the selection process.

Plan

The key point involved in this phase is to plan a product or solution. Planning is very important for any successful implementation. A project plan should include all the important activities and major updates reflecting the progress and inevitable changes until the end. Timelines and policies should be discussed with the vendor. Vendors should ensure proactive, responsive and available support as needed. Planning should be done carefully to reduce a potential loss of productivity.

Create

The key points to 'Create' are to manufacture a product or solution, follow the plan, and to use appropriate technology and equipment. Before transitioning to EHR technology, a baseline should be established. Choosing the technology according to the size of the practice plays a crucial role. Selection should be considered for integrated basic functionality such as billing, scheduling and office operations. If the practice needs value-added services, it can go forward and select the software that could support integrated systems, and improve operational efficiency, digital diagnostics, etc. If a practice wants to deliver significant benefits, the software selected should enhance current system handling all aspects of practice operations, management, clinical, and administrative processes.

Evaluate

The key point to 'Evaluate' is to assess the product or solution. Evaluating EHR software should consider questions such as, does the technology have desired functionality and does the vendor meet the needs of the practice? Evaluation can be done best when team and administrative needs are taken into account. At least one member of clinical staff, representatives of the office staff, and the practice administrator should be involved in evaluating the chosen system.

Adopting software is not just a single-step process. Before moving our discussion to challenges and barriers involved in adopting EHR software, we will review the functionality model of EHR software.

The EHR system is software that provides functionality to manage and maintain the health record, and accomplish various clinical research and business requirements. It may be a monolithic system or a combination of systems. The software promises better care to the patients with several functionalities embedded in it. The functional model of EHR describes the functions of EHR software divided into three categories; direct care, supportive and infrastructure, as shown in Figure 1.



Figure 1: The functional model of EHR (HL7, 2004)

Physicians' EHR adoption is slowed by a reimbursement system that rewards the volume of services more than it does their quality. Though EHRs have the potential to improve quality, many practices, especially solo or small group practices, face challenges leading to the slow pace of health information technology adoption (Miller, et. al., 2005). The following sections focus on the challenges, barriers and security aspects of EHR software.

Challenges

When the adopted EHR system achieves optimal benefits, it is a success. Through creativity, commitment, and with trial and error, the practice should address most of the challenges. The

challenges will be discussed along with the derived solutions from a set of strategies that play a crucial role in achieving success (Carroll et. al., 2012).

The successful implementation of EHR lowers the burden on physicians by helping to document more patient encounters in less time followed by accurate coding and higher reimbursement levels. EHR also makes billing simple by uploading the patient encounter information into the billing system which in turn electronically transports it to a clearinghouse (Dolan, 2008).

Barriers

The largest barrier to adopting EHR systems is a lack of financial resources. The cost of integrating patient access to existing EHR is unclear, but it seems likely that ‘retrofitting’ existing systems would entail significant costs. Predictive or operational modeling could provide estimates of some of these potential cost implications (Beard et. al., 2011).

Current concerns of EHR are its ongoing maintenance costs, loss of productivity, and increased time to document clinical information in digital format when compared to paper charts. Physicians who have adopted EHR generally make the transition process smoother by taking advantage of readily available training and technical support from vendors (Glenn, 2012). In addition to cost other barriers are examined in Table 2 (Markle Foundation, 2004).

Barrier to adoption	Explanation
Cost	The cost of software can vary significantly depending on the system features. While some vendors offer inexpensive systems, many practices are finding that these cheaper systems lack desired functionality
Workflow impact	Some processes such as prescription may take a longer time than manual processes
Lack of benefits	Other stakeholders may benefit more from an EHR solution
Integration	EHR systems may not be compatible between practices resulting in problems and/or data loss
Business impact	Installation, process re-engineering, planning and change management in transition from paper systems to EHRs may cause disruptions

Table 2: Barriers of EHR Adoption (Markle Foundation, 2004)

Privacy and Security

The Health Insurance Portability and Accountability Act of 1996 (HIPAA) privacy rule, Public Law 104-191, provides federal protections for personal health information held by covered entities and gives patients an array of rights with respect to their information. At the same time, the Privacy rule is balanced so that it permits the disclosure of personal health information needed for patient care and other important purposes.

The HIPAA privacy rule establishes national standards to protect individuals' medical records and other personal health information and applies to health plans, healthcare clearinghouses, and providers that conduct certain healthcare transactions electronically. The rule requires appropriate safeguards to protect the privacy of personal health information, and sets limits and conditions on the uses and disclosures that may be made of such information without patient authorization. The rule also gives patients' rights over their health information, including rights to examine and obtain a copy of their health records, and to request corrections (U.S. Department of Health and Human Services, 2009).

According to the HIPAA security rule, healthcare providers must set up physical, administrative, and technical safeguards to protect electronic health information. The software should ensure techniques like access controls (e.g., passwords and PIN numbers) that limit access to information and as well as encryption techniques for safety. An audit trail must also be maintained to monitor record changes and by whom (Rodriguez, 2011).

Privacy of patient data is a significant concern, particularly if the data are accessible outside healthcare institutions and available on the Internet. Leaked clinical data could compromise patients on a variety of levels and expose medical practitioners to lawsuits related to negligence in the care of patient data. The U.S. Department of Health and Human Services, which enforces

national standards for confidentiality and security of electronic health information has received over 400 claims from 2009-2013 for violations. In response to security concerns, a new security architecture for EHR, including multiple data-protection features, such as encryption, remote and protected data storage, monitored exchanges between computer systems, digital signatures, authentication processes and usage audits, have been created (Beard et. al., 2011).

2.3. The Future of EHR

Recent studies have revealed that EHR usage by clinicians and healthcare organizations are continuing to proliferate across the United States in part to federal incentives. While EHRs have been transformational for some large corporations, the majority of the medicine is practiced by small medical groups, with limited finances and little to no IT support. Therefore, there is opportunity for growth with several technological and bureaucratic factors playing a key role in its proliferation (Schoen et. al., 2012).

In addition, the meaningful use requirement of Health Information Technology for Economic and Clinical Health (HITECH) act will also be another primary force in determining the future of EHR in the healthcare industry. Congress enacted the HITECH act in order to move towards an outcome-based model to improve the overall efficiency of the healthcare system and thereby reduce its costs. HITECH authorized incentive payments through Medicare and Medicaid to clinicians and hospitals when they use EHR to achieve specified improvements in healthcare delivery (Classen and Bates, 2011).

Several companies are already updating their clinical processes using cloud-based software in order to provide faster and more accurate billing to individuals, shortening the average time to create a bill from seven days to less than 24 hours and reducing transcription costs by 80%. In addition, associations are developing e-Health cloud to host healthcare applications including

clinical software, decision support tools for diagnosis and management, care plans, referral tools, prescriptions, training, and other administrative clinical services (Kuo, 2011).

2.3.1. Other Information Technology-Based Innovations

There is also evidence that the future might include some change of large shared databases for comparative prescriptions, the use of natural language processing, improved clinical decision support, and greater use and integration of wireless remote outpatient monitoring of patients (Navathe and Conway, 2010). However, current systems are not multifunctional. While such systems may involve compromising the privacy and security of the data, they also provide systems for the next generation of healthcare computing (Cerrato, 2012).

2.3.2. Health Information Exchange and Publishing

Health information exchange and publishing is another area that most likely will have a place in EHR implementation and usage. However, with the breadth of competitors in this space, the exchange of data will be a challenge and data standardization will be key. Notwithstanding, one of the most promising advantages for health information exchange and publishing is improved patient safety. Up to 18% of the patient safety errors and 70% of adverse drug events can be eliminated if the right information about the right patient is available at the right time. Health information exchange makes this possible. EHR will allow improved patient safety, medication information processing, laboratory information processing, radiology information processing, communication among providers, communication between patients and providers, and public health information processing (Kaelber and Bates, 2007).

3. Research Questions

To answer the challenges of EHR adoption in small healthcare practices, we focus on evaluating efficiency and quality of care provided by adopting an EHR system.

1. How does Electronic Health Record (EHR) software improve efficiency and provide better care to the patients?

The structures of the record that are stored electronically are compared to the paper-based system. Advantages such as readability, sharing the information among multiple facilities and smart phone access by physicians are examined.

2. What are the essential financial and technical capabilities required for the implementation of an EHR system?

To answer this question, estimated financial budgets that are planned by the physician's practice are discussed. The estimated budget varies according to the size of the practice and their feature requirements. Training and support offered by the vendor is also discussed.

3. What factors are considered as barriers to the adoption of EHR and how can they be overcome?

Barriers such as cost and a lack of proper training are preventing practices from implementing EHR systems. Possible solutions for these barriers are examined and discussed.

4. How does the EHR system fare in terms of security and usability?

We examine the security features of current EHR systems and also look at some of the usability aspects from the perspective of end users.

4. System and Experimental Design

We developed a questionnaire on EHR software to survey the performance of the system in small healthcare practices. The results of the survey act as an input to enhance the software. It is designed to complement existing functionalities of the system that support the physicians to provide better patient care. The survey addresses barriers for the wide-spread adoption of EHR, examines possible reasons for switching to a different vendor, and compares their present system in terms of

cost and time to paper-based records. The questionnaire also asks participants to rate their current software and features on a five-point Likert scale. The survey was conducted by physically distributing questionnaire forms to several practices and online means. A copy of the questionnaire can be found in Appendix A.

Survey participants are all active users of EHR. Of the 43 respondents, 30% of participants are physicians, 46% are medical assistants, 20% administrative staff, and 4% business analysts. None of the questions elicit personal data outside of the broad demographics on age and background. Received responses are kept confidential and data retrieved from the survey is reported in the research only as a combined total.

We believe that our survey group is a representative sample of small medical practice users of EHRs in southern New England and that the results can be generalized to practices across the United States. We further believe that the results can provide an insight on EHR adoption criteria which may be helpful for other small healthcare practices considering adoption.

5. Experimental Results and Discussion

Addressing our first research question:

1. How does Electronic Health Record (EHR) software improve efficiency and provide better care to the patients?

Results emphasize that the ability to share medical records across providers and organizations are a big advantage of EHR. The adopted EHR software is expected to achieve quick record retrieval; data entry should be easier and reduce errors. From our 43 respondents, 86% of them stated record retrieval is faster when the health records of a patient are stored electronically. Searching, tracking and analyzing information is easier with EHRs. However, for data entry, 51% stated that EHRs allow for easier data entry. Examining this further, the majority of physicians

responded that EHR data entry is time consuming because of too many free-text fields or a mismatch between the reporting requirements/data storage formats, necessitating data abstraction and manual translation. EHRs are most useful when the needed data exist in discrete fields, so that they can be aggregated, sorted, and manipulated. Data that exist only in free-text fields require manual intervention to extract and analyze. Some practices have been deliberate in structuring data fields to maximize their use and avoid text fields. Others have deferred to their physicians' preferences for free-text fields, and rely on quality review staff to read through clinicians' notes to manually extract usable information. Even those practices that use manual chart review, report that the EHR is an improvement because it eliminates the need to track down paper charts.

Regarding features of EHR systems, 55% reported a copy/paste feature, 60% a search feature and 65% use templates to enter patient data. When asked about how the physician maintains progress notes, 62% maintain a hard copy, 79% scan paper records into EHR, 74% encode transcripts into the EHR, 74% type directly into EHR as free-text, and 79% enter data using templates. In terms of error reduction, 13% of the participants responded that EHR can help to reduce errors. Surprisingly, few medical assistants and administrative staff responded that poor physician's handwriting is now solved by EHR. This result implies that the software did not deliver the results as expected. If the progress notes are scanned into EHR or if they are entered into the EHR by using templates, errors can be reduced and using templates may also save time.

2. What are the essential financial and technical capabilities required for the implementation of an EHR system?

In looking at system selection, 41% of participants are using an EHR system from one or more commercial vendors, 28% from just one vendor, and 30% are using a combination of vendors and internally developed products.

In terms of how long participants have been using their EHR system, 9% for at least a year, 63% for at least three years, 7% for at least five years and 26% for more than five years.

In terms of system longevity, 30% responded that they switched to a different vendor. A majority of physicians using EHR between three and five years did not switch, however, a majority of physicians using EHR more than five years have switched. Some of the reasons practices have switched is a desire to adopt software that supports enhanced features and improved performance. These are two areas where vendors could concentrate their efforts to improve retention.

When we examined training criteria, 37.5% of physicians and 41.1% of staff responded that they were offered training for a period of less than a week, 50% of physicians and 35.2% of staff were offered training for a period of 1-2 weeks, 12.5% of physicians and 5.8% of staff were offered training for a period of 2-4 weeks, 17.6% were offered training for a period of greater than 4 weeks. We feel that a training period of less than a week may not be enough. At least 1-2 weeks of training should be provided. Results imply that physicians cannot afford training more than a week as there will be an impact on their day-to-day activities. However, if physicians could manage enough time to train themselves, EHR could be utilized more efficiently.

3. What factors are considered as barriers to the adoption of EHR and how can they be overcome?

Examining barriers, 67% of the participants responded that cost is a major barrier of adoption. The largest of these costs are startup and maintenance. Small and medium-sized practices have significantly fewer opportunities to achieve financial gain through EHR adoption. The cost of software varies based on the system features. Apart from software purchase it is a burden for a small practice to bear the costs of installation such as process re-engineering, and change

management cycles that occur during transition from paper systems to EHRs. Moreover, several physicians have noted that their system frequently freezes which leads to loss of productivity.

Other barriers such as learning and transition were reported as a barrier by 44% of participants. Better implementation procedures can overcome this barrier. This requires modifications in clinical practice, to have the proper staff to keep systems current and running.

Another barrier, usability, was reported as a barrier by 30% of participants. Adequate training can help to overcome this barrier. Vendors need to improve interfaces to address this concern.

4. How does the EHR system fare in terms of security and usability?

Paper records are bulky, take up space and require labor-intensive methods to maintain, retrieve and file. Unlike paper records, EHR provide easier access at times of emergency and can be backed up easily to avoid loss during times of disaster, especially when linked into a health information network.

Further results found that 77% use ID and password for user authentication. Just like paper records, EHRs must comply with HIPAA in regard to protecting patient privacy. EHRs can be encoded so that only authorized individuals can view them. Table 3 details some reported security features by EHRs.

Feature	Count
Automatic logoff, session timeout	37
Minimum password configuration rules	39
Periodic password change	37
User awareness of password non-sharing policy	38

Table 3: Features related to security

In the event of power outage or damage to the system where it is inoperable, 33% of participants responded that they have planned backup and 65% of participants responded that they will wait until the system is fixed.

Fifty percent of participants responded that the practice allows outside entities access to the EHR technology remotely and 39% allow outside entities access on-site. Forty-six percent of participants responded that users have limitations on the ability to export, transfer or print EHR documents.

To test usability of the current EHR software, we focused on learnability, data entry, accessibility and satisfaction. These features convey efficiency of software and how easy it is to learn. Table 4 shows the further details on rating given by physicians and staff on these four areas.

Feature	Physicians	Staff
Learnability	3.33	3.45
Data Entry	2.83	3.45
Accessibility	3.50	3.70
Satisfaction	3.17	3.60

Table 4: Usability ratings of current EHR systems

On a final note, we asked participants how well they like their current EHR software. The average rating given by physicians is 2.92 while administrative staff rated their EHR system 3.7 on a scale of 5 (1=Poor, 5=Excellent).

These results clearly show the importance of EHR and support for its adoption. Future EHR software design should focus on reducing barriers and increasing user-friendly features. To reduce the reluctance level among physicians, government can help small practices through incentives and subsidies to open access to EHR systems at a reasonable price.

6. Conclusion and Future Directions

Though EHRs have potential benefits to patients, caregivers and organizations, it needs some enhancements. Widespread adoption and use of EHRs will not be possible unless the software can provide perceptible value to the users. Survey results show non-interoperability, not user-friendly, and complex data entry as three major problems.

Interoperability within an EHR is crucial as it needs to connect patients, providers, referral providers and other key personnel. It should also support a synchronized view of the patient health history that is shared among multiple facilities. Benefits can be realized if and only if the government and medical device manufacturers join together to promote the development and adoption of interoperable devices.

Many physicians in our survey responded that data entry is not quick and software is not user friendly. Physicians often use keyboard shortcuts to save time when charting. Sometimes this may lead to medical errors and improper billing. When erroneous data is carried from one progress note to another medical records lose clarity. Adequate staff training and interoperable technology together can help prevent adverse events and data entry errors.

Future EHR implementations will likely involve vendor applications that are more focused on flexible system architecture and patient-directed functions based on each user group's specific task-oriented requirements. Vendors will have to add new features and functionality, and healthcare organizations are changing their implementations to focus on achieving meaningful use. To help vendors understand how to improve the design of their products, post-marketing surveillance could be used.

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