EHR Adoption in Healthcare Practices: Lessons from Two Case Studies

Completed Research Paper

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Abstract

As electronic health records (EHRs) are becoming an integral part of the American Healthcare System, understanding their adoption processes and the associated barriers is of great importance. This research paper analyzes the status of EHR in two different sites, a large and a mid-sized hospital. We designed a framework to better comprehend their current status of EHR adoption. This framework is comprised of the selection process, the implemented Institute of Medicine (IOM) core functionalities, the meaningful use stages, and the lessons learned and barriers faced for further improvements. The main findings can be concluded in two propositions. First, having a framework to analyze EHR implementations that links IOM core functionalities to the meaningful use criteria can set a benchmark for EHR analysis and assessment. Second, this framework, applied for EHR analysis in two hospitals, helps unveil critical barriers including: technical difficulties, primary integration, and following healthcare rules and regulations.

Keywords
electronic health record, EHR, healthcare, case-study, framework, adoption

Introduction

Electronic health record (EHR) systems hold the promise to increase quality of healthcare services and healthcare practitioners’ performance (Poissant et al. 2005). This is the major rationale behind the national Health Information Technology (HIT) Initiative, started by President Bush in 2004 and strengthened by President Obama in 2009. Under the $19 billion the Health Information Technology for Economic and Clinical Health (HIT) Initiative part of the American Recovery and Reinvestment (ARRA) Act, the main objective is to have every American’s medical records on computers by 2014 (Zhang and Walji 2011). This act was mainly driven by the need to decrease medical errors, reduce unnecessary healthcare costs and facilitate the administrative process. Nonetheless, the journey toward the development and adoption of EHR should be holistic. Moreover, it should integrate all the EHR’s building
blocks that are interconnected to ultimately improve quality of healthcare services (Karim et al. 2011). The
direct incentives embedded in the HITECH Act may have a positive influence on EHR adoption -
especially for hospitals with high Medicare and/or Medicaid caseloads (Shin et al. 2012).

In order to ultimately get improved health outcomes, the Center of Medicare and Medicaid services (CMS)
outlined a fascinating staged plan to achieve meaningful use (MU). This plan aims to assist healthcare
providers embrace EHR systems. Furthermore, it attempts to achieve the ultimate goal of improving
healthcare outcomes and reducing costs for individuals.

In spite of all the benefits EHR can offer conceptually, the use and implementation of EHR in hospitals
tend to face difficulties and obstacles (Karim et al. 2011). The federal insurance efforts to streamline EHR
adoption, through the meaningful program, are well-designed. Integrating the components of the
adoption process with other important factors in order to unify a framework leading EHR adoption is of
great importance. This framework should be generic enough that it can be applied to any healthcare
provider regardless of its size, type or structure. In case of unexpected outcomes, this framework can be
used to trace back and correlate it to the right reason.

Other frameworks for analyzing EHR adoption exist; yet, they focus on other measurements, such as
usability, quality or change management (Karim et al. 2011; McAlearney et al. 2012; Meidani et al. 2012;
Morton and Wiedenbeck 2009; Shin et al. 2012; Weiner et al. 2012; Zhang and Walji 2011). Rather, the
framework in this study emphasizes the MU criteria that would ultimately increase the EHR adoption
rate.

Having a unified framework for analyzing the EHR adoption in medical practices in view of the MU
criteria can be beneficial on several levels. First, it gives a good overview of the decision-making process
whether to make the EHR system in-house or buy it from a certified EHR vendor. Second, is to consider
the core functionalities of the Institute of Medicine (IOM) that are based on EHR primary and secondary
uses (Tang 2003). Third, our framework connects the EHR core functionalities to the objectives of the
CMS meaningful use staged program. Demonstrating MU is central to any EHR implementation process,
and being able to analyze how it is achieved on each stage is valuable for medical practices. The fourth
component of the framework is evaluation with a focus on the lessons learned and barriers faced. This is a
crucial aspect of EHR adoption, as it can help for further enhancement of healthcare processes.

To help us practically analyze the realization of EHR adoption and hence design a better framework, we
used a case study method. For this study, semi-structured interviews were administered with two HIT
representatives from a large and a mid-sized hospital in California, USA.

Our findings suggest that utilizing a unified framework can help healthcare professionals to better analyze
the EHR systems being adopted, understand their current state, and set some realistic future goals.
Professionals can also improve the adoption rate by addressing the lessons learned, hence, better
demonstrate MU and realize improved healthcare outcomes.

Related Work

Although EHR has the potential to significantly improve healthcare quality, we have seen mixed support
program was introduced to outline the necessary functions and outcomes of EHR system implementation
(Blumenthal and Tavenner 2010). Yet, using EHRs that meet MU criteria and have two or more years of
EHR experience were not correlated with reported benefits (King et al. 2013). This indicates that the
relationship between hospitals’ EHR adoption rates and the influence of the federal payer is not fully
understood.

Developing a unified framework that would thoroughly lead the EHR adoption process or analyze its
current state is of key significance. Other frameworks facilitating the adoption process do exist. However,
they are tailored to serve rather specific purposes, such as usability (Shin et al. 2012; Weiner et al. 2012;
Zhang and Walji 2011), quality (Karim et al. 2011; Shin et al. 2012), or change management (McAlearney
et al. 2012). In addition, none of them aims specifically at analyzing the adoption process and providing
tangible criteria for evaluation. A recent published framework (Bisbal and Berry 2011) looks at the kind of
EHR systems being used. It is similar in some aspects to the proposed framework in this paper; however,
it lacks critical components of MU criteria and core EHR functions.
Addressing this knowledge gap can be beneficial to both researchers and healthcare practitioners. It will provide a better understanding of the implementation process and help set future goals and expectations. We focused on four important aspects to bridge this gap, by developing a framework to lead the EHR adoption or analyze its current adoption state:

- Buy-or-make decision;
- IOM core functionalities;
- Demonstration of MU;
- Lessons learned or barriers faced.

In-house or off-the-shelf EHR systems is an important decision as it requires a long-term engagement and solid financial analysis (Groop et al. 2011). This component resonates with the EHR type component presented in an analysis framework (Bisbal and Berry 2011). In addition to the financial aspect of the problem, the core functional capabilities are of key significance when it comes to EHR adoption. To provide proper performance of these functions, the HITECH Act designed MU with the end goal of tracking the performance of the adopted EHR system. By setting some measures or criteria, the EHR system can advance through consecutive stages to reach the desired quality of the healthcare outcomes. The goal of this Act is not adoption alone but significant improvements of care (Blumenthal and Tavenner 2010). Finally, we propose formative evaluation as a critical component in EHR adoption (McGowan et al. 2008).

**Framework Design**

We designed a framework to analyze the EHR adoption process (Figure 1). This framework is comprised of four building blocks: selecting an EHR strategy, applying the IOM core functionalities, achieving MU requirements on three consecutive stages, and capturing barriers or lessons learned to further enhance the meaningfully used EHR systems in the current stage or upgrade it to the next MU stage.

**EHR Selection: Buy or Make**

A critical choice healthcare decision-makers face is whether to build an in-house consolidated EHR model or to embrace an off-the-shelf EHR vendor. Seeking out the fulfillment of the MU requirements, healthcare providers would rather consider a certified EHR, primarily, with the option to customize these systems and/or federate with other subsystems currently in use to have a federated EHR model (Bisbal and Berry 2011). There is a middle ground between the consolidated and federated EHR model, referred to here as materialized EHR, in which part of the EHR data may be materialized in a local data repository.

The size and the setting of the practice as well as the financial aspects are the two leading criteria in this stage. Having the necessary resources makes it even more feasible for larger practices to launch their customized EHR without necessarily worrying about working with third parties. Thus, the in-house option could be more viable and cost-effective than going with the more expensive EHR vendors. However, small practices usually do not have the capabilities and resources to develop in-house EHR systems (Reardon and Davidson 2007). Eventually, the decision whether to buy or build is critical and highly dependent upon the specific requirements of the facility and the needs of the physicians and nurses.
Figure 1. Framework for Analyzing EHR Adoption

**IOM Core Functionalities**

In this framework, we embrace primary and secondary functionalities provided by the IOM’s consensus report (Tang 2003). The holistic list of these functionalities covers almost all primary and secondary uses of the EHR, and is developed to guide the process of identifying core system functionalities. These functionalities have been identified for four major health settings: hospitals, ambulatory care, nursing homes, and care in the community. The core functionalities fall into eight categories. These categories encompass: health information and data, results management, order entry/management, decision support, electronic communication and connectivity, patient support, administrative processes, and reporting and population health management.
support, electronic communication and connectivity, patient support, administrative processes, and reporting and population health management. Following is a short description of each category.

First, the health information and data functionality are not functions per se; yet, they are an essential preliminary step for further EHR uses. They are meant to reflect the ability to capture and hence provide patients’ data in electronic format, such as laboratory test results.

Second is the results management functionality which is based on the previous function to manage electronic health data. For healthcare professionals, accessing the right data at the right time is critical. For instance, in some urgent matters, such as abnormal test results or list allergies, it would be of great significance if these data are provided at the point of care.

Third, order entry/management lies at the heart of the EHR system. The benefits of computerized provider order entry even with little or no decision support capabilities are numerous and have been documented repeatedly in literature (Hoonakker et al. 2013; Kuperman et al. 2007). This is because these functionalities can improve the process workflow by eliminating lost and duplicate orders, and ambiguous illegible handwriting. More importantly, the strongest evidence of the clinical effectiveness of computerized physician order entry (CPOE) is envisioned in medication order entry, as it has been shown to cut the number of non-interpreted medication errors by 83% (Tang 2003).

Decision support is the fourth IOM core functionality. Clinical decision support (CDS) systems concern enhancing clinical performance in prevention, prescribing of drugs, and detection of adverse events and disease outbreak. The evidence of the effectiveness of CDS in the area of the computer-assisted diagnosis and disease treatment and management is small yet growing. That is due to the advancement in sophisticated expert tools, such as artificial neural networks that thrive in this domain steadily.

The fifth core functionality is electronic communication and connectivity among healthcare team members, partners and patients. Electronic connectivity is more vital for patients with chronic diseases who typically have multiple providers in multiple settings, and hence address the needs for continuity of care.

Sixth is the patients support functionality where patients are empowered to control their health and get educated about what should or should not be used for their treatment. Home health agencies can reinforce the notion of patient support where EHR can be integrated to home health monitoring system to receive patient’s data administered by patients themselves.

Seventh, administrative process is the financial healthcare system that should seamlessly feed the clinical subsystems with inpatient and outpatient procedures, appointments, billing and claims. In addition, this administrative subsystem can be used for validation of insurance eligibility and patients’ eligibility of clinical trials. Not only did this seamless integration increase the efficiency of healthcare organizations, but also provided health services to patients in a timely manner.

The eighth and last functionality is reporting and populating health management. This is vital when it comes to public health agencies and programs that require accessing EHR on a periodical basis, such as syndrome surveillance, public health registries, and other CMS public health programs. Providing such functionality can help avoid health data duplication and redundancy in different sites.

**Meaningful Use**

Meaningful use is using a certified EHR vendor to: 1) improve quality, safety, efficiency, and reduce health disparities; and 2) engage patients and family (Blumenthal and Tavenner 2010). This program, established by CMS and associated with financial incentives, aims to achieve two objectives. First, is to encourage healthcare facilities and professionals to adopt EHR systems. Second, is to facilitate this adoption at a gradual pace which ultimately leads to better health outcomes.

To do so, CMS establishes three incremental stages over a predefined period of time, each of which is meant to satisfy a group of IOM functionalities by outlining a list of core and menu objectives to fulfill. Eligible professionals, hospitals and critical access hospitals (CAHs) who meet the threshold of these objectives can apply for reimbursement and receive incentives within a certain period of time. If the healthcare facility embraces a certified EHR system in a meaningful way, this facility can be proved eligible for reimbursement by CMS in this particular stage. However, the eligible entity cannot move to
the subsequent stage unless it already met a threshold of the precedent stage objectives. Each stage of the plan emphasizes a main functional area.

The first stage, which was instituted in 2011, focuses on data capturing and sharing where the EHR system can demonstrate the ability to capture and share electronic data for both clinical and administrative use. For eligible professionals, there are a total of 24 meaningful use objectives. To qualify for the incentive payment, 19 of these 24 objectives must be met. 14 of the objectives are core objectives, and the other 5 are to be chosen from a list of 10 menu objectives. Eligible hospitals and CAHs on the other hand, must meet 18 objectives out of 23, 13 of which are core objectives and 5 objectives are to be picked from a list of 10 menu set objectives.

The second stage, which instituted in 2013, is to use EHR systems for advance clinical processes. These requirements include, but are not limited to, measures focused on more rigorous Health Information Exchange (HIE), additional requirements for e-prescribing and incorporating lab results, electronic transmission of patient care summaries across multiple settings, and increased patient and family engagement. Eligible professionals must meet a total of 20 objectives in this stage, 17 of which are core objectives, and 3 menu objectives out of 6. Moreover, eligible professionals must report on 9 Clinical Quality Measures (CQM) out of the approved 64. These measures must cover at least 6 available National Quality Strategy (NQS) domains which include: patient and family engagement, patient safety, care coordination, population and public health, efficient use of healthcare resources, and clinical processes/effectiveness.

For stage two, CMS and the Office of the National Coordinator for Health Information Technology (ONC), jointly established standards and certification criteria for structured data that EHRs must use in order to successfully meet the requirements of stage two. These rules will take effect in 2014. Even if an eligible facility adopts a certified EHR system, there is still a need to embrace preliminary conditions to meet stage two objectives.

The third stage, which the CMS is planning to introduce in 2015, is in essence to ultimately meet the end goal of EHR system, which is to improve outcomes. As of April 2014, CMS has not rolled out any specifications for the core or menu objectives of stage three.

**Lessons Learned and Barriers**

The final building block in this framework aims to capture issues occurring after selecting the EHR vendor. This building block is integrated in this framework for two purposes: evaluation and learning. The lessons learned from the evaluation experience can be harnessed for further enhancements on the current stage or for future improvement that could advance the EHR system to the next MU stage.

**Methodology**

We used a case-study approach to collect data and to analyze the EHR status of two hospitals. We used a qualitative method to gather more information about the organizations. This approach helped us identify practical perspective towards our artifact and ensure it can be successfully implemented in a real hospital environment.

We selected two hospitals in the State of California which were already using EHR systems. We selected two organizations from the same geographic area to assure that the location did not exert influence on the implementation process. We targeted hospitals of different sizes – medium (about 500 beds) and large (about 1,000 beds) to see if the size of the organization had any impact on the EHR implementation.

Semi-structured interviews were the main data collection method. We contacted key individuals who were familiar with the EHR adoption process at these organizations. To provide more consistency, we used an interview guide. To ensure minimal bias, during each interview at least two of the researchers were present and each of them took separate notes. At the end, researchers compared notes and agreed on the data obtained from the key informants.
Case Study Findings

In this section we will discuss the two case studies. The first is of a large hospital (“hospital one”) and the second is of a mid-sized hospital (“hospital two”). Due to privacy issues and to preserve the reputation of the hospitals, we had to keep their actual names anonymous. To gather information on the hospitals, we conducted interviews with key informants from the two organizations. These individuals were directly involved in the implementation process and were very aware of the selection stage.

Buy or Make

Both hospitals relied on outsourced modular solutions. The selection process was similar in some aspects and drastically different in others. In both cases, a number of alternatives were considered before finalizing the selection.

For hospital one, selecting the vendor was a rigorous process. First, a team of experts created a list of well-defined set of requirements. Based on that, three vendors were identified as candidates. Each vendor was vetted carefully by the hospitals. Eventually, hospital one selected the vendor that was well known as one of the leading health IT solutions. One of the factors that heavily influenced this selection was the vendor’s ability and expertise in integrating separate systems. This large size hospital targeted such a modular solution to federate it with its many existing subsystems.

For hospital two, the process was different. Instead of comparing multiple vendors, the organization had its eyes set on a particular vendor. When the hospital started considering a new EHR solution, that vendor seemed a reasonable option since the hospital was already using various tools and applications from it. Moreover, as a mid-size hospital relying on that current vendor was more cost-efficient. While hospital two went with an outsourced solution as well, they also had an in-house development team in order to create interfaces between different applications and to initiate quick fixes.

IOM Core Functionalities

Table 1 represents a comparison between the EHR adoption stage at hospital one and hospital two in terms of the IOM core functionalities.

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<tr>
<th>IOM Functionality being observed</th>
<th>Hospital One</th>
<th>Hospital Two</th>
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<tbody>
<tr>
<td>Health Information and Data</td>
<td>- Health information for patients and population. - Both physicians and patients have access to relevant health information.</td>
<td>- Various ways of capturing health information. - Physicians are able to view details about patients’ history, such as medications they are taking and recent visits.</td>
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<tr>
<td>Results Management</td>
<td>- Interfaces customizable based on laboratories to request and view history of tests.</td>
<td>- Uses a laboratory application to display patients’ tests requests, and their results. - Physicians are also to request tests through the application.</td>
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<tr>
<td>Order Entry/Management</td>
<td>- Physicians e-prescribe medications for their patients and orders get automatically sent to pharmacies.</td>
<td>- The hospital focused on CPOE from early on. - Physicians use an application that facilitates sending requests to pharmacies. - One of the issues is that some of the forms are not computerized yet. Because of that, physicians still need to use paper forms occasionally.</td>
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Decision support
- The vendor is building decision support systems.
- Some of the existing tools include: order sets, providing correct lab information given the patient’s diagnosis and visit navigators.
- Minimal progress.
- The very few decision support tools physicians are using are rather basic.
- One of the tools displays to physicians the recommended action to take when it comes to treating certain conditions.
- Another tool tracks latest development and recent research findings.

Electronic communication and connectivity
- Uses a HIE to share and exchange information with other healthcare entities.
- Mobile solutions are being developed to enable physicians and administrators access information remotely.
- Physicians can send notes to pharmacists and lab technicians. Nurses can also add notes to a patient’s record.
- The organization focuses more on strengthening internal communication between departments within the organization. However, there are issues regarding external communication with other healthcare partners.
- Physicians are able to access the system remotely through PCs and tablets to fill orders or view test results.

Patient support
- Online portal for patients support includes features such as: scheduling appointments, interacting with office administration, and reading educational materials.
- Patients report high satisfaction with the portal.
- Patients do not have online access to their health records through the hospital’s website.
- No educational materials are available on the website.
- Physicians are unable to electronically and remotely monitor their patients.

Administrative processes
- Electronic administration is underway.
- Multiple tools to help fastening administrative processes, such as an electronic scheduling system and an insurance eligibility system.
- Dynamically and electronically verify insurance claims and eligibilities.

Reporting and population health management
- Reporting tools are available. Fine adjustments are being made to reflect the needs of the hospital.
- Advanced and highly customizable reporting tools.

Table 1. IOM Functionalities Comparison

Meaningful Use:
Hospital one had successfully met all first stage core objectives and was ready to advance to stage two. Similarly, hospital two successfully fulfilled stage one’s requirements. Moreover, the hospital implemented a plan to satisfy stage two requirements within a specific timeframe.

Lessons learned and barriers
The problems the two hospitals faced throughout the implementation process are similar. The following list summarizes these issues:
Adequate training: Hospital one conducted structured training in classrooms before and after the implementation process. Physicians could be hesitant to commit to training because of their busy schedules. Hospital two trained individuals working in the hospital to lead the training sessions. Hospital two also provided various incentives to employees who attended the sessions.

Resistance to change from users: Hospitals should expect this to happen and be prepared for it. Engaging users in the development and implementation process can minimize the resistance barriers.

Technical difficulties: The system could unexpectedly go down. Hospitals need to negotiate with the vendors back-up plans and to develop business continuity processes.

Integration with other systems: Hospital one had to invest plenty of time and money to safely transition from their legacy systems to the new EHR system. Hospital two had a team of programmers who focused on building interfaces enabling the new system to communicate with other applications.

Following Health Insurance Portability and Accountability Act (HIPAA) rules and regulations: This could slow down the overall development process since organizations must ensure that the requirements are not being compromised.

Conclusion and Limitations

The goal of the current study was to learn more about EHR adoption and how they vary across practices. For that purpose, we conducted a case study in two healthcare sites. Based on our findings from these two cases, we designed a framework to shed more light on the process of improving medical care and providing a number of healthcare services electronically. Although this is becoming the standard in many countries, there is a lack of a unified strategy on how to assess the adoption. By analyzing the EHR adoption, healthcare providers can get a better understanding of the benefits and see in which areas they are lacking sufficient progress. This is a practical implication that can be useful to healthcare managers and providers.

Our findings suggest that having a framework to analyze EHR status can ultimately increase the EHR adoption rate and help healthcare providers set future goals. By focusing on the overall adoption process from the aspect of the initial buy-or-make decision, the IOM functionalities and the lessons learned, the framework can create a good overall perspective of the hospital’s needs and problems in terms of EHR adoption.

The current study contributes to literature in several respects. It summarizes the existing frameworks that focus on the most important characteristics to be covered when it comes to EHR adoption. It also creates a comprehensive and multilevel environment for categorizing the current state of EHR adoption. By examining the barriers to adoption and analyzing the lessons learned, the framework can support future decision making and improve the quality of service provided by hospitals.

There are several limitations to the conducted study. First, we used a case-study method with only two sites. This small sample size creates a potential problem for generalizing the results of the study. To address that issue, we chose hospitals of different sizes and with a different level of experience and adoption of EHR systems. Second, we have to mention that this is a high-level model and it may be perceived as too general for some hospitals. However, our goal was to start a discussion on the problem of analyzing EHR implementations as this is an exploratory study.

Our suggestions for future research are threefold. First, we propose future research to build upon the framework we created and expand its focus. One way to do that is to focus on the buy-or-make decision and look at it from the perspectives of business, technology, and security (Kuo 2011). Another approach suggests expanding the IOM functionalities and defining them in more detail. In addition, the lessons learned and barriers faced stage can also discuss the evaluation and continuous improvement of the EHR implementation. Second, another direction for future research can be to replicate the current study but with increased sample size and include participants from a variety of organizations that differ in terms of size, governance, location and EHR maturity. Engaging various respondents (managers, doctors, nurses, lab technicians, patients, etc.) can give a better understanding of the EHR process from various perspectives.
perspectives and can add value to the proposed framework. Third, this framework can be integrated with other specific-purpose frameworks to provide a holistic framework that is generic enough to lead the EHR adoption process; yet, specific to a fair extent so that healthcare professionals can navigate through its various aspects providing a holistic framework.

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REFERENCES


EHR Implementations in Healthcare Practices


