Approaches To Electronic Health Record Implementation

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ABSTRACT

During last few years, healthcare organizations have been increasingly focused on implementation and use of electronic health records. This article identifies the benefits and challenges in implementing electronic health records utilizing service-oriented architecture. The paper also explores the potential of service-oriented architecture in the development of interoperable electronic health records.

Keywords: Service-oriented architectures, electronic health records, health information management, eHealthcare

INTRODUCTION

The digital revolution is increasingly taking an ever-expanding role in the healthcare industry. Early uses of information technology by healthcare providers were for back-office systems, such as patient billing. Significant cost savings were realized by health organizations when they recognized the benefit of electronic business systems. The next wave of information technology in hospitals centered on digitizing the patient tracking process of admitting, discharge and transfer (ADT). These ADT systems, to a large extent, revolutionized the ability of hospitals to locate and keep an accurate count of the patients. In many ways, ADT system records are the precursor of the current issue of electronic health records (EHR).

The electronic health records, at this time, seem to be the major thrust of information development efforts of hospitals and other health-related organizations. To some degree, this is supported by strong reasons, such as reduction in medical errors, cost minimization, data accuracy and integrity, etc. However, digitization brings into view the topic of patient privacy and the ethics involved with sharing patient information. At the forefront of legislated patient privacy in the United States is the Health Insurance Portability and Accountability Act of 1996 (HIPAA).

The full extent and ramifications of HIPAA are enormous; however, limited discussion of HIPAA and its role with protected healthcare information (PHI) is of importance in current context. PHI, in practice, is as significant as the rules, on one extreme, and can be a hindrance for a practitioner or, on the other, a boon for patient privacy. Either way, patient privacy, or the rules that regulate it, is an important topic in an increasingly digitized healthcare industry.

Patient privacy is a major concern in the rapidly developing online healthcare market, in addition to the ethical dilemmas it brings. There is an enormous range of beneficial information, some not so beneficial to the downright nefarious. Additionally, as medical information becomes increasingly separated from practitioners, there is a chance that it might be misused. Further, behind the scenes is a healthcare market dealing with the relationship of medical vendors and hospitals on one end and healthcare plans and participating companies on the other.

The topic of electronic health records has become an increasingly hot item in research. A big push for using EHRs is to reduce medical errors, as evidenced by reports published in the Journal of the American Medical Association. According to the report, as many as 98,000 patients die each year in U.S. hospitals from preventable medical errors, such as receiving the wrong medication. Sometimes patients do not get all the treatments or tests

they should have received (Swartz 2004). Errors such as these can be attributed to several reasons, but one that could easily be mitigated occurs when patients see multiple physicians for treatment who have incomplete pieces of a patient's medical record. This leads to multiple doctors storing different and incomplete records. The incongruent handling of medical record information has a direct effect on the level, quality, and timeliness of patient care.

The reason for the lack of smooth sharing of information is that in many medical facilities, there are various information systems that are not properly tied together. There are many reasons other than reducing errors for using EHRs. One is monetary in that it could save, conservatively, $140 billion a year – that's 10 percent of total spending (Swartz 2004). Another reason is that an Electronic Health Record program will allow physicians to quickly learn important information, such as which drugs are covered by a patient's insurance plan. Information such as this, in many instances, can greatly reduce the cost of medical care for a patient. Additionally, some insurance providers are now giving policy holders the ability to update certain parts of their medical records over the Internet so that they can be provided with better care.

Patients are demanding improved care and the industry is looking for ways to cut costs. The implementation of an electronic health records system could help resolve both of these problems. Many researchers feel the widespread adoption of electronic medical records would result in new efficiencies that are currently unattainable in the medical industry. The existence of multiple payers and providers makes the implementation process extremely complex. In addition to multiple players, certain entities may not be willing to share health-related information in fear of liability due to privacy issues. However, merely having electronic health records is not the overall goal. Interoperability between physicians, labs, hospitals, patients and pharmacies is the objective. The Service Oriented Architecture Model is an approach gaining momentum in the industry. The model recognizes that the industry can be represented as a federation of services (web services) connected by defined contracts that classify their service interface. There are examples in the industry of both failed and successful electronic health systems that have been implemented in the United States.

ELECTRONIC HEALTH RECORDS

Electronic Health Records are "electronically maintained information about an individual's lifetime health condition and healthcare" (Raghupathi and Kesh2007). The use of this technology would practically eliminate paper medical records and the cost of supplies and space to store them. Instead of a facility having to send your medical records, the doctor would be able to access this information externally. This would be comparable to the banking industry doing away with paper statements. The records could include patient demographics, allergies, lab results, images, appointments, billing history, and possibly living wills. Electronic records would not necessarily be limited to internal use but has the possibility to include all entities of the healthcare industry. Physical medical records can be illegible, which can contribute to errors by future doctors and pharmacists. The wide use of electronic records would improve consistency of forms and terminology.

There has been a lack of adoption of this technology in the United States. Currently, the healthcare industry only spends 2% of gross revenues on health information technology, while the banking industry spends upwards of 10%. However, the Veterans Healthcare System is one of the largest integrated systems in the world. One hundred fifty-five hospitals and eight hundred clinics rely on one electronic health system. This successful electronic health system is available for public download. In addition, there at least twenty-five competing systems available from vendors. There are plenty of options in the software industry to choose from; thus, it is surprising why health records are not widely electronic so far. There are many barriers to implementing an efficient system. Conversion, storage, privacy, legal issues and costs are key issues when deciding whether implementation of an electronic records system is appropriate for an organization. Dixon recalls how E-health captured a center position on the political stage when the government announced a strategic initiative to radically increase the adoption of EHR systems in the United States by 2014. Congress has sanctioned funds to be used for projects administered by the Department of Health and Human Services (HHS). This government organization listens to the public's case studies and privacy, regulatory, technology and cultural concerns during published meeting times. With 2014 on the horizon, implementation is a must regardless of all the problems associated with convergence.

Most of the electronic health information systems today are proprietary and often only serve one specific department within a healthcare organization (e.g., lab, pharmacy, and nursing). A number of standardization efforts have been made to address the interoperability problem, such as HL7. HL7 is one of the early and most active standards for organizations bringing electronic processes to the healthcare industry. HL7 version 2 is the most widely implemented healthcare informatics standard in the world today. However, being HL7 compliant does not imply direct interoperability between healthcare systems (Bicer 2005). HL7 offers a collection of message formats and related clinical standards that loosely define an ideal presentation of clinical information. Together, these standards provide a framework in which data can be exchanged among communicating partners.

CONVERSION AND STORAGE OF RECORDS

Conversion of old records into the new system is an issue. The time it would take to manually key in old patients' records into a new system could be monstrous. Scanning the documents into the system could be a tedious process. There are programs that can provide character recognition when scanned. However, errors and illegibility can be extensive, even with sophisticated scanning technology. Once entered, preserving the records can cause problems. It is unclear how long records will have to be preserved. It is a fact that electronic records will have longer shelf lives than paper documents. This could create expensive technological storage costs. These additional costs could potentially be offset by the cost savings of the decreased need for physical storage. Filing cabinets, folders and enormous file rooms would be unnecessary. The physical spaces could be used for more profitable means. Electronic archived data would need to be accessible and compatible with other functions.

SECURITY

Virtual and physical security is a major concern for patients. Records stored could have the potential to be created, used, edited and viewed by multiple healthcare arenas. The federal government has set guidelines for health organizations that will have to be followed. In 2007, the government Accountability Office reported there is a jumble of studies and vague policy statements, but no overall strategy to ensure that privacy protections would be built into computer networks linking insurers, doctors, hospitals and other healthcare providers. Individuals will not be willing to turn over personal information if a guarantee to privacy cannot be given. This lack of security of personal information is a setback for implementation.

LEGAL ISSUES

The overarching arm of HIPAA (Health Insurance Portability and Accountability Act of 1996) has had an effect on the health industry, similar to Sarbanes Oxley for the accounting industry. The extensive regulations surrounding the act have the industry wary of implementing new technologies. The act mandates efficiency and security. Critics advocate there should be stricter safeguards and guidelines and should be monitored more closely. Legal actions against the industry could multiply with the adoption of e-health. The fact that the health industry is already volatile in relation to lawsuits does not help.

COSTS

All organizations may not benefit from the adoption of an electronic system. In a survey that estimated cumulative costs to adopt electronic health records, it would cost ninety-eight billion for the hospitals and seventeen billion for physicians' offices to install such systems. A portion of these costs goes to the increased number of computer hardware and workstations needed to employ the system advantageously. Additional information technology staff would also be needed to maintain, update and repair system crashes. These costs have the tendency to be particularly expensive. The U.S. Congressional Budget Office states that the cost savings may only occur in large integrated institutions, not in small physician offices. In some instances, the efficiency of the new system might decrease the income of physicians. This conclusion comes from the premise that tests would not be performed twice because of the ability to look at lab results from other physicians. Thus, the physician, in good conscience, would not perform the test a second time, which would reduce income. The above problems weigh heavy on the health industry, but none are comparable to the issue of implementation.

PATIENT PRIVACY

Privacy, in general, is a hot topic in an increasingly digitized and connected environment. However, patient privacy is one of the forefront topics in the privacy and ethical debates. The reason for this is the seriousness of privacy breaches concerning medical records. Many patients view their medical records very private as they contain intimate details of their lives. In fact, for a patient, privacy breaches could mean the possibility of losing employment or even close friends. With the digitization of patient records, it is becoming increasingly easy for patient records to be shared with the appropriate practitioners. However, the question then becomes how can those records be safeguarded against unauthorized intrusions? To some extent, the HIPAA and its associated rules try to deal with privacy of medical record transactions by requiring all healthcare organizations to implement safeguards against the use or disclosure of an individual's identifiable medical records (PHI) without the express written advance authorization of that individual.

The extreme concern over electronic record privacy may be somewhat unwarranted when viewed in reference to paper records as experts claim that electronic records are more secure than paper files because access is more limited and tightly controlled (Swartz 2004). However, in an audit by the Utilization Review Accreditation Commission (URAC) of 300 healthcare organizations, it found just three with comprehensive security management programs that enable them to comply with HIPAA standards. This is an unflattering review by a major hospital accrediting organization.

So what exactly does Health Insurance Portability and Accountability Act of 1996 entail? As concerned with privacy, HIPAA mandates that the U.S. Department of Health and Human Services (DHHS) develop standards for privacy of individually identifiable health information. This affects many different organizations, including hospitals, nursing facilities, rehabilitation centers, home health agencies, hospice programs, social workers, and health labs, etc. Why this is so important is exemplified by the following cases (Buppart 2002): 1) a Michigan health system accidentally posted the medical records of thousands of patients on the internet, 2) a major U.S.-headquartered corporation marketed a list of 5 million elderly women who had been treated for incontinence, and 3) a businessman purchased, at auction, the medical records of patients from a family practice in South Carolina and attempted to sell them back to former patients.

When dealing with HIPAA, there are several things to keep in mind. First, there is the idea of the minimum necessary standard; i.e., the disclosure of only the minimum necessary health information when communicating, unless the provider receives the patient's authorization. Second, a provider must give notice to a patient about the use of their information, their right to access it, their right to amend it, and their ability to limit disclosure. For entities covered under the regulations stemming from HIPAA, there is a variety of penalties for noncompliance ranging from $100 per act to a fine of $250,000 and 10 years in prison. The logistics for uncovering noncompliance seems to be weighted in favor of the providers because, for a fine to be levied, a patient would need to complain, as there are no provisions calling for government auditing of practices or facilities. This leaves glaring gaps because as far as the government is concerned for privacy breach to occur, the somewhat oblivious patients would have to catch it first.

IMPLEMENTATION OF SOA

Electronic records have the ability to expand beyond internal use to all participants in the healthcare process. System designs have mainly been vendor driven. Most of the software available fails to adhere to generalized standards for portability. This failure creates several limitations. Systems are constrained to internal use, for the most part. In addition, there is a lack of multi-function capabilities, such as clinical decision support. Lastly, there is a lack of compliance with open standards. Raghupathi and Kesh (2007) believe the next generation of EHR's must include properties of federation, flexibility, interoperability and openness, as healthcare delivery participants strive to share health information within the context of ethics, privacy, and security constraints. There is need for an overarching architecture that includes all of these elements. Multiple providers and systems make it a difficult process. However, the use of SOA (Service-Oriented Architecture) has the possibility of overcoming some of the above challenges.

A service is generally implemented as a course-grained, discoverable software entity that interacts with applications and other services through a loosely coupled, often asynchronous, message-based communication model (Brown et al. 2005, and Raghupathi and Kesh 2007). Commonly used terms, words, structures, and organizations must be used to build data if interoperability between organizations is going to be accomplished. Interoperability can be achieved by web services that allow several services to run on a range of software platforms and hardware architecture. Many technologies have been defined to support a SOA that functions across multiple machines, standards and platforms and is connected by an extranet or intranet. A list of building-block standards for SOA and web services is as follows:

- XML (Extensible Markup Language) is the basic format for representing data on a web services platform. XML therefore is simply a way of describing and formatting information. Additionally, XML is the basis on which other components of web services (like SOAP and WSDL) are built.
- Simple Object Access Protocol (SOAP) provides the standard mechanism used for invoking or calling web services. It defines the envelope in which applications can deliver web service messages and exchange data with each other; it also describes how these messages should be processed.
- Web Service Description Language (WSDL) is an XML-based grammar that describes web services, their functions, parameters, and return values to their potential consumers (Shohoud 2003).
- Universal Description, Discovery, and Integration (UDDI) is a standard for describing available web services components that allow businesses to register with an Internet directory (like yellow pages). This will help them advertise their services so that companies can find one another and conduct transactions over the web. Microsoft has an alternative protocol, named Disco, that serves a similar purpose as that of UDDI.

UDDI, SOAP, and WSDL are the three most widely accepted Web services protocols, and these protocols are increasingly being adopted by various software vendors in their new product offerings. Figure 1 describes the basic Web services model. All data exchange is performed using XML format over the World Wide Web's hypertext transport protocol (HTTP).

Figure 1 is an example of a service-oriented framework pertaining to the healthcare industry. The framework shows the support of in-house legacy systems for input of data. This is a hurdle that has been a challenge. The middle of the diagram demonstrates the different service components of the industry and their contribution to the overall data. The diagram extends the service structure to include web services that can be accessed by various stakeholders. Web services would enable healthcare providers access to information collected about an individual from all areas of the healthcare industry. Standardized data exchanges would be needed to access the data residing on external systems to make the process possible. The capabilities would allow a doctor to make more informed decisions on behalf of the patient. For example, a physician could look up a patient's healthcare history and a previous physician's communication pertaining to this particular patient via the web. Optimally, the system would be able to be queried and have report generating capabilities. This capability would allow a doctor or hospital to recognize trends throughout the year and provide better health coverage. For example, a report could be generated for how many people came in for allergy shots during a given time period. This query would allow doctors' offices to plan their inventory needs for allergy shots the next year.

BUSINESS CASES

The SOA model explains the how, what, where and when of electronic health records. Business cases can help the industry understand why or why not electronic health records should be introduced into their office. Some of the key points to consider before embarking on a path to successful adoption and the use of e-health are as follows (Dixon 2007):

- Development of a strong business case will lower the risk of adoption, implementation, and use of e-health.
- Successful knowledge transfer must include information about best practices for implementation.
- Workforce development is necessary to equip the organizations for proper use of implemented e-health technologies.

- Financial support from the government and payers is critical for additional providers to make an initial investment in e-health.
- Technical assistance is required to assist provider organizations in successfully implementing e-health and changing the culture of clinical practice.

Healthcare organizations must analyze their return on investment (ROI) in order to justify the expense to their stakeholders, patients, board members, and partners. Obviously, a positive return would be necessary in order for the system to be acceptable. Return on investment should not only be thought of in terms of dollar value. Intangible returns, like patient satisfaction, operating efficiencies, quality of care, and patient safety, are among other characteristics that should be considered. Improved patient satisfaction could increase return visits, thus increasing the return on investment. Patient safety could rise due to the decrease of accidental deaths relating to the mixing of prescriptions. The wait times of patients could be decreased by the office operating more efficiently. Finally, the quality of care would increase because of the increase of knowledge available to the physician.

However, a healthcare organization must plan and analyze thoroughly before buying into a new project. For illustration, Cedars Sinai Medical Center in Los Angeles, California, was forced to scrap a multi-million dollar Central Physician Order Entry system. There were numerous complaints by users, doctors and nurses that the system was slow and they were dissatisfied with the system's performance. Nurses reported that physicians did not like the system because numerous errors occurred and had to be corrected, resulting in embarrassment to physicians. This system was never tested or used outside of Cedars Sinai (Castro 2007). According to some estimates, over thirty percent of electronic health implementation attempts were unsuccessful over the past few years.

Among the major success stories of SOA-based EHR, Canada Health Infoway stands out (SOA Consortium, source: http://www.soa-consortium.org/contest-winners-d.htm). According to the cost benefit analysis performed by an independent organization, the total cost of the electronic healthcare system was $9.9B. The annual benefits are estimated to be $6.1B and $82.4B over a period of 20 years. Another case in point is that of Mercy Health Plan (MHP) in St. Louis, Missouri. The benefits achieved by MHP through the implemention of a SOA-based architecture are reduction in response time, enhanced productivity, leveraging exisitng investments and significant cost benefits (Infosys case study 2006). Beaumont Hospital in Ireland, by adopting a Service-Oriented Architecture, is more efficient, responsive and adaptive to healthcare needs of its stakeholders, in addition to being fully integrated (BEA: Beaumont Hospital Customer Case Study 2006).

CONCLUSION

Several other countries, like Great Britain, Australia, Canada and New Zealand, have adopted electronic health systems. All of these countries have faced the obstacles that the United States is trying to overcome. The SOA model could help the health industry understand what they hope to achieve through their systems. Problems associated with conversion, storage, privacy, legalities and costs can be overcome. Decreases in medical errors and duplicate testing can facilitate a better patient experience. The increased knowledge of patients will enhance doctors' effectiveness in reaching medical conclusions.

The connected information era of healthcare is rapidly progressing from its infant roots in medical billing to electronic marketplaces. Along the way are valid concerns about patient privacy and integrity of health information passing through the Internet. However, such concerns should not weigh down on the movement as there are enormous potential benefits for the healthcare industry in making full use of the Internet age. In fact, in some cases, such as with current paper records, the digital alternative is fraught with much fewer issues. In many cases, moving to the EHR may mean ditching the antiquated early systems still in use, which, in itself, is a difficult task to rationalize, and develop tomorrow's ideal systems from the ground up. However, in most cases, an organization has to come up with a process that can tie-in the existing systems with new applications and be able to link all interested stake-holders (physicians, pharmacies, clinics, labs, hospitals and insurance companies). SOA seems to offer a relatively easy option to achieve this objective.

AUTHOR INFORMATION

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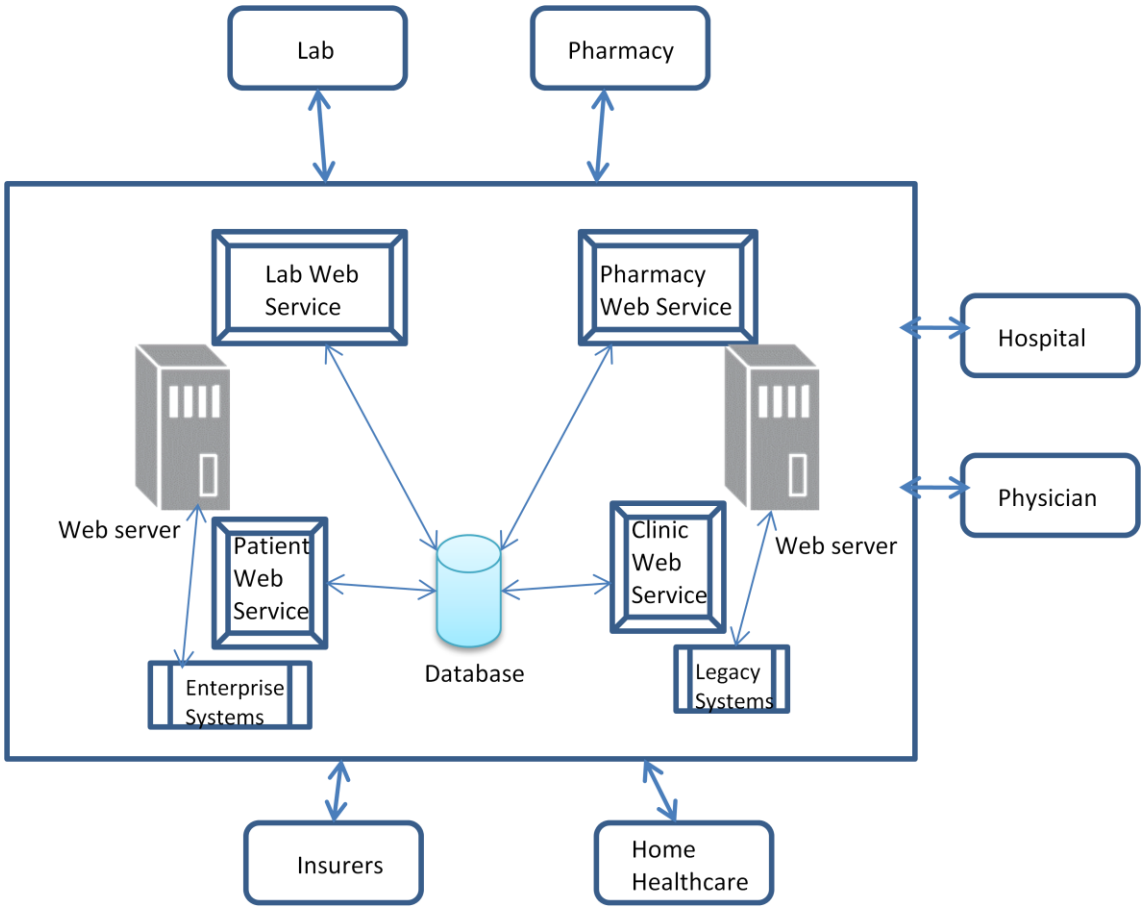

Figure 1: SOA-based Electronic Health system