Integrated Electronic Medical Record Systems: Critical Success Factors for Implementation

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Abstract

Integrated Electronic Medical Record (EMR) systems are becoming an essential part of the fabric of modern healthcare. EMR systems have evolved from pure record-keeping to an integrated, enterprise-wide system that holds the promise of accurate, real time access to patient healthcare data. EMR systems can provide healthcare administrators and clinicians with the information necessary to improve patient care and lower costs. Little research has been done to identify critical success factors for EMR systems implementation. In this paper we treat EMR systems as a type of enterprise resource planning (ERP) system and address EMR implementation issues by drawing on theory and empirical research from both the healthcare information systems and ERP literatures. A theoretical model and propositions are offered, bolstered by data gleaned through structured interviews with health care professionals. Important success factors discussed include planning, consultants, project management, process redesign and the need for a project champion.

1. Introduction

The adoption, implementation, and use of integrated Electronic Medical Record (EMR) systems in the United States is a popular topic in the health care community and in practitioner journals, but there has been little theoretical research devoted to this topic in the mainstream academic literature. This paper will include a literature review and synthesis of both the existing EMR body of research and relevant empirical and theoretical work on enterprise resource planning (ERP) implementation. Our review of the literature helped clarify an important underlying distinction: from an architectural perspective, EMR systems are functionally similar to Enterprise Resource Planning (ERP) systems. We believe that, in fact, EMR systems can be considered medical ERP systems. Based on this literature review, we present a set of theoretical propositions for EMR implementation and offer an initial exploration of these propositions based on structured interviews of health care professionals with experience in EMR systems implementation. Finally, using the results of our qualitative analysis, we offer recommendations for both researchers and practitioners.

2. EMR fundamentals

For the sake of clarity, it is important at this point to provide a general definition of an integrated EMR system. Our literature review found that there was a general consensus that EMRs can be defined as a software suite of integrated functionalities built around a common database [44, 52]. Such functionalities are not limited to, but typically include:

- Electronic Health Records
- Diagnostic Tools
- Patient Billing
- Electronic Prescribing
- Practice Management

These functionalities are often modular and can be purchased at various levels of integration. We found, however that occasionally, the term “electronic medical record” and terms such as “electronic health record (EHR)”, and “computerized patient record” are sometimes used to describe a person’s medical history in electronic form. Thus the term EMR system may evoke thoughts of some type of database of patient medical records with functionality to retrieve and manipulate relevant data. Although such databases are in fact the foundation of EMR systems, the term has come to mean much more. Therefore, for the purpose of clarity, when we employ the term “EMR system” we are referring to an integrated system with the functionalities mentioned above.

3. EMR: The current landscape

978-0-7695-3450-3/09 $25.00 © 2009 IEEE

The healthcare industry in the United States is a massive information enterprise and yet is surprisingly inefficient when it comes to information management [24]. Some estimate that U.S. healthcare lags other industries by decades with respect to information technology (IT) adoption and utilization [18, 40]. Bates [3] reports that the healthcare industry spends 2% of gross revenues on IT, compared to 10% for other information intensive industries. Coile [10] suggests that although healthcare is a knowledge based enterprise, knowledge is not considered part of the value proposition. As a result, academic research into healthcare information systems phenomena has been minimal, compared to other industries. The advent of EMR systems however, and the relatively recent appearance of journals and articles relating to healthcare information systems in general and EMR systems in particular seem to mark a turning point in the focus of healthcare organizations and providers on the value and necessity of integrated information systems. Governmental involvement in this issue also seems to be an important factor. In April, 2004, President Bush announced an initiative to achieve a goal of an electronic health record (EHR) for every American by the year 2014 [47]. Shortly thereafter, the U.S. Department of Health and Human Services announced $140 million in grants to promote information technology use in health care, specifically emphasizing EHRs. While estimates of current EMR use vary, ranging from 5-15% for U.S. practices, Ford, Menachemi and Phillips [18] predict EMR adoption by 90% of U.S. practices by the year 2024. This burgeoning emphasis on healthcare information systems, coupled with the unique characteristics of healthcare professionals, and the often competing imperatives of quality healthcare and profit maximization of the U.S. healthcare model make this a potentially rich and diverse research stream. Raghupathi (1997) suggests that there will be great benefits from the integration of the healthcare and information technology disciplines. For this reason, it is critical that researchers and practitioners work on identifying the factors and practices that will maximize the likelihood of EMR implementation success.

The area of healthcare information systems is still emerging as a mainstream field in the academic literature. As the importance of information technology and information systems grows in the healthcare area, practitioners should be able to look to academic researchers for sound theoretical and practically relevant research to guide them in the adoption, implementation, and use of such systems. We argue that many aspects of EMR research can leverage existing ERP research, a fairly rich field in a limited way. That is, although the context in which these systems are deployed are different, architecturally, ERP and EMR systems are similar. Both rely on real-time access to a common database, on a platform that aims to systematize, integrate, and streamline business processes and workflow. Both systems are based on improving the speed and accuracy of data sharing, reporting, and planning functions [26].

Leveraging existing ERP research to arrive at theoretically sound and practically relevant EMR research is especially important because unlike other industries which utilize information systems, what is at stake is not just people's livelihoods, but in fact their lives. To illustrate; in 2004, the American Medical Association reported 98000 preventable deaths per year due to information errors [47]; errors which could well be reduced or avoided with properly implemented integrated information systems.

Many of the recent articles about EMR systems tout the potential benefits of such systems. Estimates of the potential savings in healthcare costs from EMR systems range from $81 billion to $162 billion annually [48]. Proper use of EMR systems is also believed to have the potential to improve the quality of medical care and save lives [47, 50]. Time and workflow efficiencies are also a proposed benefit of these integrated systems , along with patient benefits such as individualized health guidelines and reminders [3, 38]. Warehousing of EMR data and data mining techniques may allow mining for information that will allow healthcare providers to predict risks and measure medical care against benchmarks [10]. As with any information system, there are negative attributes and perceptions involved with EMRs. While some workflow efficiencies may be realized, time efficiencies may suffer, especially directly after the implementation [38]. There are also privacy and security fears associated with having people's medical records and history electronically accessible, [22, 44, 49] although the relative newness of the technology means that little data exists regarding actual security breaches in these systems.

4. Cross-pollinating the EMR and ERP literatures

The literature for this review was drawn from two main areas: The EMR literature, and the enterprise resource planning (ERP) literature. The EMR literature comes mainly from healthcare specific journals, as is to be expected. The EMR literature goes back about ten years but the vast majority of articles located come from

the last three or four years. The ERP literature resides primarily within the IS discipline but also extends to other disciplines such as technology management and operations management. One primary difference to keep in mind is that of project scope. Many U.S. physician practices utilize only a handful of people, whereas most ERP projects are undertaken in much larger organizations [1]. To narrow the research scope even further, issues relating to EMR and ERP implementation were the primary focus of the literature search. The implementation literature was chosen because the implementation process is often viewed as one of the most important factors in the success of enterprise system projects [26]. Physicians, healthcare organizations, patients, insurance companies, pharmacies, and all other stakeholders in the healthcare value chain have a vested interest in successful implementation of these enterprise software systems.

Researchers have a vested interest in conceptualizing and empirically testing new theoretical models for these systems. The theoretical propositions resulting from this study will be focused on EMR adoption by medical practices, rather than hospitals. Hospitals and medical practices are very different types of organizations in terms of size, complexity, business processes, etc. Integrated enterprise software adoption by hospitals, and ultimately the integration of practice and hospital systems will be topics for additional research. Some of the information used to develop the propositions will come from physicians who have implemented EMR systems and from EMR vendors.

The EMR literature comes mainly from practitioner journals and few articles have any kind of theoretical foundation, although this situation is changing. Keyword searches of electronic journal databases for "electronic medical record (EMR)", "electronic health record (EHR)", and "computerized patient record (CPR)" yielded over 200 results. Many of the articles tout the promised benefits and advantages of EMR systems and a few emphasized the drawbacks of such systems and the obstacles to adoption. In our quest for theoretical underpinnings for our research, analysis of abstracts allowed us to eliminate most of the articles. In cases where abstract analysis did not yield enough information to render a decision, the entire article was reviewed. Of the theoretical articles, most utilized some reconceptualization or extension of Davis' [16] technology acceptance model (TAM). The technology acceptance model posits that perceived usefulness (PU) and perceived ease-of-use (PEU) are positively correlated with behavioral intention to use (BI) a particular technology. Dansky *et al*., [13] extend the TAM model backward to look at the antecedents of perceived usefulness, and tested the model empirically with surveys in 14 medical practices, both private and group. They found the constructs of computer experience and organizational support to be significantly and positively correlated with perceived usefulness. They found computer anxiety and valuing a close patient relationship to be significantly and negatively correlated with perceived usefulness. Likewise, Ma and Liu [28] extend the technology acceptance model backward to examine the role of internet self-efficacy (ISE) on perceived usefulness, perceived ease-of-use, and behavioral intent to use web-based EMR systems. Their methodology was controlled experimentation using senior clinical trainees and staff members as subjects. They found ISE to be significantly and positively correlated with PU, PEU, and BI. One could argue that computer anxiety and computer self-efficacy [11](from which ISE was derived) are the positive and negative perspectives of the same construct. Bates et al., [3] and Berner et al., [4] also suggest that greater computer literacy will be a facilitator to greater EMR adoption and that physician's attitudes can be a facilitator or obstacle. Physicians, especially those in private practice, are often overbooked with patients and may see the learning curve of an EMR system as too great a hindrance to workflow. In a conceptual paper, Hennington and Janz [23] apply the Unified Theory of Acceptance and Use of Technology (UTAUT) [53] to physician adoption of EMR technology. The authors propose that physician's expectations of EMR performance, expected effort required, social influences, and facilitating conditions such as financial and time constraints will all affect their behavioral intent to use the technology. Davidson and Chiasson [14] and Davidson and Heslinga [15] use a technology-use mediation (TUM) perspective to examine the adoption and use of EMR systems. TUM is defined as the *"deliberate, ongoing, and organizationally-sanctioned intervention within the context of use that helps to adapt new communication technology to that context, modifies the context as appropriate to accommodate use of the technology and facilitates the ongoing effectiveness of that technology over time"*[34](p. 424). Both studies found support for efficacy of TUM activities in the context of the adoption, implementation, and use of EMR systems. These results speak to the need for healthcare organizations to be willing to changes processes to accommodate the new technology if necessary. The studies also found that small practices face significant challenges to the use of TUM activities for EMR adoption with regard to resources and experience. They suggest that small

practices may need to be supported by consultants and external funding. While these theories are related to adoption and acceptance rather than implementation, one can see how computer self-efficacy/ literacy, can be influential during an implementation process. Also, depending upon the size of the medical practice, "physician support" may well equate to "organizational support" in smaller private practices, which has been shown to be an important factor for information systems implementation projects. There were two articles identified specifically regarding EMR systems implementation. Paré [36] uses a multi-case study approach to formulate theoretical propositions regarding successful information systems implementation in healthcare organizations. One of the cases was an EMR implementation in a hospital. The author suggests that healthcare information systems implementation is a reflective and often unpredictable process. Successful implementations will be characterized by socially constructed goals, anticipated challenges and exploited opportunities. The skills, beliefs, and motivations of the key actors in the process will affect the effectiveness of the implementation strategy (p. 85). Lapointe and Rivard [27] examine the issue of physician resistance to EMR implementation in a multi-case study of 3 hospitals. They suggest that resistance is an evolutionary process throughout the implementation, beginning with individual physician resistance to perceived threats from the new system, escalating to group level resistance as the perceived threat from the system evolves into a threat from the significance and organization-wide implications of the system. They suggest that the best time to deal with resistance is during the initial stages when it is still at the individual level.

As we can see, since increasing use of integrated EMR systems is a relatively recent phenomenon, theory regarding the implementation process is sparse. The issue of IS implementation has greater representation within the ERP literature. Much of the research into ERP systems has focused on critical success factors (CSFs) for ERP implementation [41]. We suggest that the similarity in purpose and function between EMR systems and ERP systems allows us to look to the ERP implementation literature to inform our study of EMR implementation. ERP systems are integrated suites of business software modules built around a common database, accessible in real time. ERP systems are designed to support most common processes of a typical business enterprise such as production, procurement, accounting and human resource activities, to name some [29, 43]. Likewise EMR systems are integrated software suites of common healthcare process functions built around a common database of patient health information [44, 52]. As with ERP systems, EMR systems implementations require a significant investment in money and time, as well as process change and training, all of which carry a great deal of risk for the organization [2, 45, 52]. The range of critical success factors for ERP implementation in the extant literature is wide and varied, but there are a number of factors where researchers are in general agreement. Enterprise systems are expensive, disruptive technologies. Organizations that adopt and implement them should have a clearly defined business case for doing so [6, 19]. Due to the significant outlay of financial and human capital resources, and the organizational risk involved, top management commitment to the implementation project is essential [5, 19, 20]. Because of the pervasive organizational reach of enterprise systems, success or failure hinges upon full organizational commitment and a willingness to reengineer business processes. For this reason, a project champion is more crucial to this type of implementation than with other information systems [19, 37, 42]. A detailed implementation plan is necessary to carry the process through to a successful completion [26, 37]. Very few organizations implement enterprise information systems without the use of a implementation partner or consultant [1, 43]. Consultants will often be able to provide project management and change management expertise, which are both critical for ERP systems implementation [19, 37]

As has been mentioned, the scope of an EMR implementation is likely much smaller than a typical ERP implementation. Therefore some typical ERP CSFs may not be applicable, such as the need for an implementation team [19, 26, 37].

5. Theoretical model / propositions

While the literature contains much about the critical success factors for ERP implementations, that same literature is vague as to the definition of ERP implementation success. Beyond completing the implementation on time and within budget, the success of such projects vary as the reasons for undertaking the project vary [46]. With ERP systems, reasons such as year 2000 compliance, inventory reduction, reduced cycle times and greater process efficiency are common. With EMR systems, reduced patient cycle time, less "chart chasing," and availability of electronic prescribing are recognized as common reasons for adoption [31]. Some physicians believe they will be able to see more patients in a day, due to time and workflow

efficiencies offered by EMR systems. Others expect to spend more quality time with the same number of patients. The review of the relevant EMR and ERP literature yields the following model and propositions which are applicable to broad and varied definitions of success:

P1: Successful EMR implementation projects will begin with building a clear business case for the project.

Strategic and economic justification for the project is crucial not only for the success of the project, but also to the healthcare organization's ability to assess the success of the project [9, 17]. Neumann *et al.,* [32] discuss the importance of building a business case for healthcare information technology investments.

This activity is usually marked by the creation of broad but measurable project objectives and identification of barriers to implementation [43].

P2: Successful EMR implementation projects will be marked by strong support from the practice physician(s).

As mentioned earlier, in the case of EMR implementations, physician support can be seen as organizational or top management support. There is already some evidence that physician owned practices are less likely to adopt EMRs than practices owned by a healthcare organization [7], so physician buy-in is crucial [19, 37]. Prade [39] and Newmann [33] both suggest that physician support is critical.

P3: Successful EMR implementation projects will be marked by an internal project "champion".

The ERP literature makes a compelling case for the necessity of a project champion [17, 19, 37]. In the case of EMR implementations, this person will not necessarily be the practice physician(s). While, as we have suggested, physician support is necessary, many physicians will not be able to play the role of project champion, due to the time constraints of their practice.

P4: Successful EMR implementation projects will be marked by a careful and deliberate planning phase.

While careful planning has been considered a CSF for ERP implementations [26, 37], smaller organizations such as many medical practices may neglect this important phase. Planning involves translating the business case into clear goals and objectives for the implementation process. This activity is also where project resources are acquired [17, 43].

P5: Successful EMR implementation projects will be marked by the presence of someone with strong project management skill and experience.

Project management, and to a lesser extent change management, are crucial requirements for a complex and risky project such as implementing a system that has the potential to affect every aspect of an organization's activities and processes [19, 26, 37].

Healthcare organizations, especially smaller practices, may lack personnel with project management experience and will need to look to independent consultants or vendor consultants to fill that need [1, 15, 51].

P6: Successful EMR implementation projects will be marked by a willingness to change workflow and processes on the part of the practice.

Most complex and tightly integrated software systems such as EMR/ERP systems are only configurable to a point, and usually require the adopting organization to conform their business processes to the software [21, 37, 51]. Business process reengineering (BPR) has become an accepted part of the price of implementing an enterprise information system [43] and the implementation of EMR systems is likely no different. Ovretveit *et al.,* [35] suggests healthcare organizational change capability is crucial for EMR implementation success.

The theoretical model is displayed in figure 1.

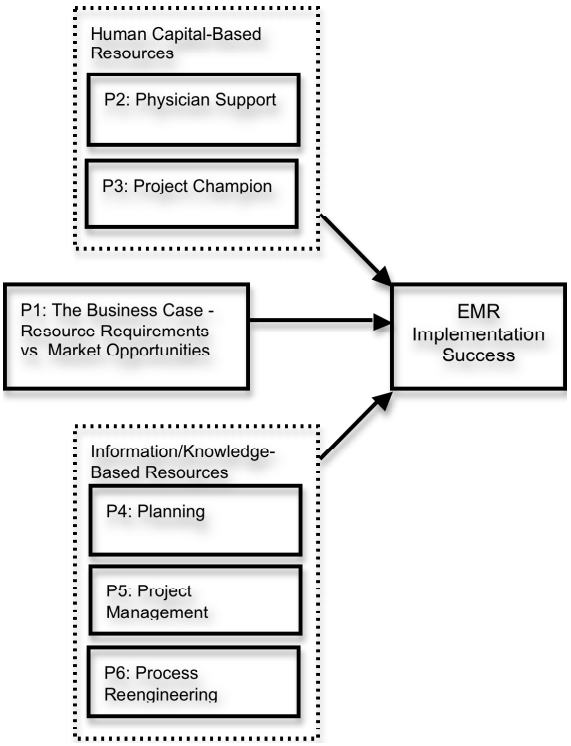

Figure 1: Theoretical model: Critical success factors for EMR implementation

6. Data collection and analysis

Data collection for this study consisted of structured telephone interviews with 8 key informants from various areas of the EMR stakeholder community. The makeup of the sample was as follows: 2 physicians, 1 regional sales manager for EMR systems, 2 independent EMR consultants, 1 CEO of a medical group practice, 1 EMR project coordinator, and 1 R.N / office manager. All subjects have experience with EMR systems implementation. The eight interviews were conducted by one of the authors using structured interview questions. A transcript of the responses was made. The two authors independently reviewed the transcripts of the interviews and coded the responses to each question using scales constructed for each question based on keywords and phrases. We asked for a reaction based on the Likert-type scale shown in Table 1; strongly agree, agree, neutral, disagree, strongly disagree, with additional coding options for unclear response and no response. We also asked them to elaborate on their responses to the structured questions and in most cases asked follow-up questions as pertinent. The interview subjects were also asked general questions regarding their experiences with integrated EMR systems implementations. The subjects were also allowed the opportunity to offer any other thoughts they had regarding this research or their experiences. Interviews were conducted by telephone and took between 30 and 45 minutes.

The sample was a convenience sample; the respondents were all people who were involved in implementation of EMR systems. We felt that this was appropriate in that this research is in the exploratory stage, and the study was conducted for the purpose of generating a workable theory of EMR implementation that can be formally tested using quantitative methods on a larger sample. Qualitative research is often used to develop theory that can later be tested quantitatively [12] and the interview process is a common and accepted way of collecting qualitative data [30]. We acknowledge that there are limitations to the analysis and findings. We detail these in subsequent sections of this paper.

6.1 Results

The interview results yielded strong support for all six propositions. While some informants emphasized the importance of some of the factors over others, there were no dissenting opinions on any of the factors. Positive opinions for propositions 2 and 3 were especially strong (See Table 1 below).

There were a number of additional insights yielded by the interviews that are noteworthy. Several of the interview subjects cited the necessity of choosing an EMR system which was CCHIT (Certification Commission for Healthcare Information Technology) [8] certified and favorably reviewed by KLAS, an independent evaluator of healthcare technology [25]. The independent EMR consultant interviewed is a former ERP consultant and strongly affirmed the notion than an EMR system is a type of ERP system. This subject also recommends that practices going through the research and evaluation process of EMR systems should define business processes rather than requirements when communicating with EMR vendors. Training and support were identified by a few respondents as also very important for implementation success. Both physicians interviewed expressed concern that EMR systems have the potential of reducing a patient record to a sterile set of facts, thereby losing some of the “narrative” behind diagnosis and treatment of patients that is often able to be communicated with paper records. One physician characterized this as

enhancing the "science" of medicine and losing the "art".

	P1: Business Case	P2: Physician Support	P3: Project Champion	P4: Planning	P5: Proj. Mgmt.	P6: BPR
Physicians (n=2)	1.5	1.5	1.5	1.0	1.5	1.0
Consultants / Sales Mgr. (n=3)	1.33	1.67	2.0	1.33	1.0	1.33
Admins (n=3)	1.33	1.67	2.0	1.67	1.0	1.67
Overall mean (n=8)	1.38	1.63	1.88	1.38	1.13	1.38

-2 = strongly disagree factor is a CSF
-1 = disagree factor is a CSF
0 = neutral
1 = agree factor is a CSF
2 = strongly agree factor is a CSF

Table 1: Results by Respondent Group

While all 6 propositions were supported, greater variance in the results was expected. In part, the nature and small size of the sample may explain the uniformity of the results. The respondents in this convenience sample were all people who were involved in implementation of EMR systems and several had been involved in multiple EMR implementations.

6.2 Additional variables

The interviews also yielded some additional variables which we suggest should either be measured or controlled for when empirically testing the proposed model. These variables may have moderating or mediating effects on the proposed relationships.

They are:

- Size of the practice
- Specialty of the practice
- Age of practice
- Age of the physicians and staff
- Technical proficiency of the physicians and staff.
- Location (rural/urban/suburban)
- Resource availability (technical, human, and financial)

Larger practices are more likely to have resources available which may give them an advantage over small practices [14, 15]. One interview subject suggested that a practice such as pediatrics, which is more likely to deal with common illnesses and diagnoses, will have an easier time adapting to an EMR system than a neurosurgery practice. Newer practices will have fewer paper charts to convert and may not be as entrenched in their business processes. Most of the interview subjects regarded age and technical proficiency as a factor in implementation success but were not in agreement as to whether they were positive or negative factors. We also suspect there will be antecedent relationships between some of the CSFs. For example, we suggest that a strong business case will influence physician support. Also, physician support and a project champion could likely influence willingness to reengineer business processes.

7. Next steps

Obviously this research has limitations. At this point the research is still in the early stages and is largely conceptual. Although our interviews yielded support for the propositions, the sample size was small. Based on our structured interview results, we believe that the next steps to further this research are to operationalize these constructs and empirically test them in medical practices. We believe a combination of qualitative and quantitative research methods will allow investigators to best understand the success factors for EMR implementation. Survey instruments, interview scripts, and case study protocols must be created. The integration of these systems with other healthcare stakeholders, such as hospitals, patients, insurance companies, and pharmacies will also provide a rich and diverse area for future research.

8. Conclusions

Based upon the evidence in the practitioner literature, the next two decades will mark a large surge in the number of medical practices implementing EMR systems. This research treats EMR systems as medically oriented ERP systems and draws upon that literature to develop a number of propositions regarding the critical success factors for EMR implementation. Qualitative interviews were conducted to investigate support for

these propositions. This is a relatively new field, and theories will need to be tested and adjusted as more of these systems come online. Also there is likely to be theoretical divergence when examining EMR implementations in different settings, such as very large practices, or if research is conducted in areas where socialized healthcare is the model. Overall, healthcare information systems, of which EMRs are a part, should provide researchers with new and diverse phenomena to be investigated. We believe that this paper makes three contributions to EMR research. First, we hope to improve understanding of EMR implementation by integrating findings from the ERP literature into EMR research. Second, we hope that by providing some theoretical background and propositions we can help EMR research move forward. Third, we hope that collecting qualitative data provides some general support in the identification of success factors and a basis for developing more detailed empirical data collection.

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