

EMR Implementation: Lessons Learned from ERP

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Abstract. The adoption of electronic medical records is a strategy for improving health care in the United States, and there are national efforts to provide funding for the initial purchase of EMR systems. The use of IT in making clinical health care more efficient and effective is well known. But recent articles in the healthcare domain indicate that 20 to 30 % of electronic medical record (EMR) systems fail within a year of implementation [11]. This study examines the implementation of EMR systems and compares these practices, issues, lessons learned, and critical success factors with what we have learned from implementing ERP systems. The findings identify the similarities between ERP and EMR systems projects and offer insights into applying the lessons learned in the past to the current challenges in EMR implementation.

Keywords: Electronic medical record implementation · Project management

1 Motivation and Importance of the Research

“Those who do not learn from history are doomed to repeat it,” is a well-known quote by George Santayana. The current wave of electronic medical records system projects is similar in many respects to the enterprise systems implementation projects of the past 10–15 years. Electronic medical records systems are enterprise systems in that they are implemented to enable data integration, efficiency, and cross-functional process integration [3, 14]. The integration of data and processes requires that the enterprise system be aligned with the best practices that the system is designed to support.

When enterprise systems are introduced into an organization, there is often a “misfit” between the best practices supported by the software and the existing processes of the organization. In order for enterprise systems to be successful, the organization can re-engineer its processes to “fit” the best practices supported by the ERP or EMR software. In general, re-engineering or “tight coupling” is needed to achieve the benefits of integration and control that is associated with ERP/EMR implementation [12, 36, 37].

However, the “gaps” between the best practices of the ERP/EMR software and existing organizational practices can be quite great [35]. To address these gaps, one alternative is to customize the software to support existing organizational processes. Another alternative is for end-users to do “work-around’s” or improvisations which

lead to “drift.” That is, providers continue to conduct their practices outside the system [6, 35, 43].

A number of researchers have examined settings where enterprise systems have been implemented with “work-arounds.” This is known as “loose coupling.” “Loose coupling” involves the timing and performance of activities different from the expectations of the system [31, 35, 43]. In a university setting, administrative staff enabled faculty to work-around procurement processes supported by a new enterprise system [31, 43]. In a healthcare organization, nurses handled patient scheduling processes outside the system, only to reconcile them later [35]. Researchers in a pharmaceutical company captured data on paper during working hours rather than entering it into the enterprise system. The problem with “loose coupling” is that the benefits of process and data integration that should result from ERP/EMR implementation are compromised.

2 Research Objectives

1. To conduct an in-depth case study of EMR implementations to develop a grounded theory of why, when, and how IT innovation occurs and the impact of change.
2. To compare the best practices and critical success factors for EMR implementation with the best practices and critical success factors for ERP implementation.
3. To identify the similarities in best practices and critical success factors between EMR and ERP implementation.
4. To identify unique challenges in implementing EMR systems.

3 Related Literature: ERP Implementation Studies

ERP systems are adopted by organizations to provide an integrated, packaged solution to their information needs. In most cases, ERP packages replace aging legacy systems which no longer meet business needs or have become too difficult and expensive to maintain. Despite ERPs promise, these software solutions have proven “expensive and difficult to implement, often imposing their own logic on a company’s strategy and existing culture” [23, 32] cite ERP failure rates to be as high as 50 %. Brown and Vessey [10] observe, “Although failures to deliver projects on time and within budgets were an old IT story, enterprise systems held even higher risks – they could be a ‘bet-our-company’ type of failure.”

A number of research studies have addressed the best practices and critical success factors for successful ERP projects. As in all large-scale IT projects, top management support, presence of a champion, good communication with stakeholders, and effective project management, are critical success factors in ERP projects. Factors which are unique to ERP implementation include re-engineering business processes, understanding corporate cultural change, and using business analysts on the project team [39]. Management support of the project team, a project team with the appropriate balance of technical/business skills, and commitment to change by all the stakeholders are all of paramount importance [29].

CSF 1. Business Justification for ERP. It is important to make the business case and to establish measurable benefits at the outset of an ERP project, so that these results can be assessed [33].

CSF 2. Vanilla ERP Implementation. Re-engineering business processes to support the best practices supported by the ERP software is linked with on-time, on-budget ERP implementation [19]. Vanilla ERP implementation and business process re-engineering affords the organization the greatest possible return on investment through streamlined operations [9]. Minimal customization is a key factor in successful ERP projects [29].

CSF 3. ERP Project Team has Business Experts. Business experts should be assigned to the project on a full-time basis [9, 10, 21]. The project team should include members representing the business functions to be affected by the ERP implementation [21].

CSF 4. ERP Project Leadership. Project leadership is a very important issue, and project leaders need to have a proven track record [10]. One of the lessons learned in case studies of ERP projects is that a strong project leader needs to keep the project on track, even when changes require following contingency plans [34]. A disciplined approach to project management which includes project scope, time, and cost management is important [42]. A project manager must prevent scope creep and must monitor project activities through tracking milestones, dates, and costs [26].

CSF 5. Effective Training. User training is critical to ERP success, because people's jobs will change. User training should focus on business processes, not just technical training on how to use the software [45]. Umble et al. [42] cite education/training as the most widely recognized critical success factor. Researchers have found a relationship between user satisfaction with training and user satisfaction with the ERP system. Training should enable managers to use query and reporting tools to generate needed reports [33].

CSF 6. Use of External Consultants. Effective management of external consultants is important for the success of an ERP project, because they can offer valuable expertise in analyzing cross-functional business processes and in configuring application specific modules [10]. Organizations should use consultants, but take advantage of opportunities to develop internal knowledge [45].

CSF 7. CEO Involvement. The involvement of senior executives is a common characteristic of ERP projects that finish on-time and on-budget [19, 25, 29]. Top management needs to promote ERP as a top priority [10, 22]. Bradford and Florin [8] found in a survey of SAP users that top management support is related to perceived organizational performance and user satisfaction.

CSF 8. Project Champion. A project champion is essential to project success [25, 29, 45]. Bowen et al. [7] found both statistical and qualitative support to the proposition that higher levels of involvement of project champions are associated with IT project implementation success. Beyond this, project team members need to have the authority to make decisions on behalf of their functional area [10].

CSF 9. Reducing Resistance to Change. In implementing ERP, companies often fail to address resistance to change, especially resistance to changes in job design. Since ERP implementation entails changes in business processes, change management is essential [10, 22, 25]. A review of 43 articles published in 20 IT and IT-related journals over the last 25 years found that user resistance is treated as a key implementation issue. An organizational culture which fosters open communications is important to avoid resistance to change [34].

CSF 10. Steering Committee Meets on a Regular Basis. A steering committee with executive leadership is one of the strategies used in successful ERP projects, as measured by on-time and on-budget implementation [10].

4 Related Literature: EMR Implementation Studies

As background, the gap between actual EMR adoption and target goals is still great. In a survey of 1,000 hospitals in 2002, 80.7 % of the hospitals surveyed were not using EMR/Computerized Physician Order Entry (CPOE) systems. The gap existed because of environmental factors (information safety, cost), organizational factors (significant investment in time and cost, resistance to change), personal factors (perspective that new technologies detract from patient care), and technical factors (systems integration challenges between hospital records and office-based records). Physicians are more likely to adopt EMR systems in a hospital based setting because of organizational support [1].

A number of studies have addressed the issue of how the use of EMR affects the quality, timeliness and effectiveness of patient care. A meta-analysis and synthesis of 63 papers relevant to EMR implementation reported that EMR systems increased the time it took to enter initial patient information, but that the use of standardized forms enabled nurses to be more efficient. One trade-off is that the increased time it takes to enter documentation takes time away from patient care, but information in the record is more complete. The outcome is increased quality of patient care [30].

Getting physicians on-board to using EMR systems is a challenge, so it is important to understand factors associated with adoption. The research on adoption of EMR systems includes studies of office-based use of EMR and hospital-based use of EMR. When physicians were interviewed as part of the National Ambulatory Care Survey (NAMCS, 2006), conducted by the Center for Disease Control, 29.2 percent of the office-based physicians surveyed claimed to use EMR systems. The survey used a representative sample of 3350 office-based physicians. While this represented a 22 percent increase in EMR use over 2005, the full functionality of EMR systems were not being used. Among physicians with full EMR systems, 63.7 % said that their systems had reminders for guideline-based interventions, or screening tests, but only one-half of those physicians send prescriptions electronically. Even though EMR systems are becoming more widespread in physicians' practices, continued efforts are needed to increase adoption [16].

In terms of office-based use of EMR, several studies have used interviews, observations, and archival data to study office-based use of EMR systems. While the goal of EMR implementation was to streamline front-desk operations such as patient check-in and appointment scheduling, one study indicated that the EMR system increased the time it took to conduct these procedures—largely because system functions forced employees to collect specific information before moving forward [46]. This study raises the issue of re-engineering processes to align with the best practices of the EMR software system.

EMR use by physicians in a hospital setting has also been studied. One of the most high-profile cases in EMR implementation occurred at Cedars-Sinai Medical Center—where physicians forced the system implementation to be cancelled. Physicians did not see CPOE as beneficial to patient care and therefore didn't view it as positive change for the patient [5]. Physicians were ambivalent about whether tools would help them do their job and even thought that the system might negatively affect their job performance. Since they viewed CPOE as being “forced upon them,” most of them viewed its implementation negatively.

Successful adoption of CPOE requires adoption by the hospital system and by physicians themselves. Physicians dislike the extra time it takes to use a CPOE, but they value their ability to enter orders (e.g. tests, medication) from any location and the ability to use pre-set orders for common conditions [13]. Successful CPOE implementation requires top management leadership, extensive training, involvement of key stakeholders, and commitment to resources.

Some attention has been paid to the impact of social influence factors on EMR use. By promoting an EMR system, senior physicians can influence junior physicians to use a system. Champions can also influence physician adoption of EMR systems [41]. Other factors influencing physician use of EMR systems are learning costs and economic costs. The researchers considered factors influencing indirect system use (having an assistant enter data for them) vs. direct system use (personally using the system). Higher learning costs increased the likelihood that physicians would choose indirect system use, whereas higher economic cost increased the likelihood that physicians would choose direct system use [41]. In either case, it is important for physicians to be convinced of the value of using the EMR system.

In another study of influence tactics, Ilie found that using hard tactics (direct pressure, demands, reminders) created resistance to change while simply using soft tactics (encouragement) created compliance but not commitment. Since the goal is to gain commitment, strategies such as needs assessment, implementation support, and end-user involvement are more effective in facilitating adoption [17].

Clearly, change management is critical to successful EMR implementation. In the high-pressure, high-stress healthcare environment, managing change is difficult because changing work methods and processes is threatening. One of the most effective ways of overcoming resistance to change is to enable those affected by the change to take ownership over the change. Finding out what the needs are, and providing healthcare workers with tools and processes to do their job(s) more effectively is important to information systems success [18].

5 Research Design and Methodology

The research uses the grounded theory approach [15] to understand the success factors in EMR implementation. In the grounded theory approach, qualitative data is gathered and used to guide the theory-building process. The data collection phase involves interviews and observations in the context of EMR implementation. The first round of interviews was designed to identify EMR implementation practices and to develop core categories for organizing the data. The results of the first round of interviews were reported in a working paper [38]. The second round of interviews applied the concepts gathered from the first round of interviews to depict best practices and success factors for EMR implementation from the vantage point of the clinicians themselves.

6 The Case Studies

The study used a case study design. The case studies are based on EMR implementation at a major hospital system between 2007 and 2010. The project justification for EMR implementation included: improved workflow, systems integration, and operational cost reduction. The implementation of common processes and an integrated common database assured quality patient care by reducing the number of repeat procedures, reducing errors, and providing better information for clinical decision-making. The systems benefits included access to a common medical record, use of on-line tools to place orders for medications and tests, and availability of decision support tools, including best practice alerts and medication reconciliation alerts.

7 The Sample

The respondents were clinicians at a major hospital system in the St. Louis area. Seventy-five clinicians were invited to participate in the survey via an email message explaining the objectives of the survey. Of these 75, 15 clinicians accepted the invitation to participate in an interview. Of these 15 possible respondents, 10 participated in the actual interview process. The other five could not be reached on a timely basis because of other commitments.

8 Interviews

The data were collected using structured interviews. The preliminary interviews used the project retrospective instrument (Nelson, 2005) as a basis for obtaining data on project characteristics, project management organization, project timeline, impact of the system, and project success factors. Additional questions relevant to the impacts of EMR systems and EMR system use were added to the structured interview form. The data were collected using phone interviews. Respondents completed the structured interview form as well.

The focus of the interviews included:

1. Motivations for the project, including project justification and management expectations.
2. Project team leadership and composition, including the role of clinicians, IT professionals, external consultants, project managers, and super-users.
3. Project characteristics, including project timeline and costs.
4. The impact of the system on health care quality, patient safety, communication among clinicians, interactions with patients, efficiency, and documentation.
5. EMR system use, including the impact of the system on work processes, how workflow issues were resolved, and the extent of customization.
6. Problems arising in system implementation and factors important to project success.
7. Critical success factors for project success, including project manager expertise, the role of super-users, the effectiveness of training, the involvement of top management support, the role of the project champion, the effectiveness of change management, and steering committee leadership.
8. Issues of acceptance, from the perspective of the end-users (providers, medical staff).

See Appendix A for the structured interview form.

9 Case Studies of EMR Implementation

The interviewees participating in the project were healthcare professionals with roles in the design and implementation of EMR and CPOE systems. With clinical backgrounds, they transitioned into roles as “super-users,” with responsibility for process re-design, testing, training, and support. Their job title, role in EMR project implementation, and the systems being implemented are summarized in Table 1. Most of the projects were EMR systems implementation projects supported by commercial off-the-shelf software, including Metavision, Sunrise Clinical Manager, Horizon, McKesson, and Cerner. The hospital system used a “best-of-breed” approach, whereby different systems are acquired and implemented based upon the extent to which they met requirements.

10 Project Need

Project justification included upgrading from legacy systems, better documentation, standardization, error-reduction, integration with billing systems, and improved safety. These findings are summarized in Table 2.

11 Project Characteristics: Project Teams and Project Schedule

The project teams consisted of information technology (IT) professionals, clinicians, consultants, project managers, and specialized health information technology coordinators. Table 3 summarizes these roles across the projects, along with the project schedules,

Table 1. Case studies of EMR implementation

Job title of interviewee	Role in project	System
Health information coordinator	Information management	Metavision/Surgical information system/compass
Lab technical coordinator	Testing, validation	Horizon lab
Nurse practice specialist	Workload assessment	Sunrise clinical manager-CPOE
	Advocate (for nursing professionals)	
	Consultant—best practices	
Clinical director—informatics	Clinical (physician) “lead”	MetaVision
Process consultant	Process consultant—IT	Horizon clinicals
Testing coordinator	Test planning and testing	Clinical manager (Eclipsis)
Coordinator	Project manager	McKesson med admin
		Cerner eclipsis
Senior analyst—RN	Team lead	Surgical information system (SIS)
Operating room IS team		Metavision
Senior analyst—IT	Configuration, process re-design	Cerner
	Education	McKesson
	Troubleshooting, help desk	
	System maintenance	
	Data mining	
Periop IS resource nurse	Teaching, support	Surgical information system (SIS)

including start dates, expected completion dates, and actual completion dates. As you can see, most of the projects were on-schedule.

12 System Impacts

The assessment of system impacts is central to the effectiveness of EMR systems. These impacts included improving the quality of patient care, patient safety, improving the communications among clinicians, improving interaction with patients, improving overall efficiency, and improving documentation. These effects were assessed on a scale of 1 to 5, with 5 = met to a great extent, 3 = met to a moderate extent, and 1 = not met. The comments relevant to these impacts are equally relevant to the quantified measures. Tables 4, 5, and 6 provide the data on these system impacts.

Table 2. Project need

System	System type	Reason for implementation
Metavision/SIS	CPOE	Operating room documentation
	Nursing documentation	Decreased medical errors
		Improved patient safety
		Upgrade outdated system
Horizon lab	Lab system	Upgrade system
Sunrise clinical manager	Medical barcoding	Upgrade outdated system
	CPOE	Provide single place for documentation
		Provide audit for safety and compliance
		Standardize orders
		Provide timely access to orders from multiple locations
		Decrease transcription errors
		Improve patient safety
		Track medications for billing
MetaVision	EMR anesthesia	Improved billing throughput
		Improved quality of documentation
		Improved patient safety
		Robust research database
Horizon clinicals	EMR	Standardize EMR across hospitals
Clinical manager (eclipsis)	EMR	Common system
	CPOE	
McKesson medical admin	EMR	Improved processes
Cerner eclipsis	CPOE	Enhanced technology
		Competitive advantage
Surgical information system (SIS)	EMR	Upgrade old system
Metavision	CPOE	Ability to track patient orders (lab, radiology)
McKesson	EMR	Improve patient safety
Cerner	CPOE	Reduce errors
		Improve reporting
		Improve interdepartmental communications
		Upgrade outdated system
		Prepare for government stimulus package
Surgical information system (SIS)	EMR	Upgrade outdated system

Table 3. Project characteristics

Project	Project roles ^a				Project schedule		
	Clin	IT	Con	PM	Start	Exp	Actual
Metavision/SIS	x	x	x	x	Multiple phases	Multiple phases	Multiple phases
Horizon lab	x	x	x	x	2002	2004	2004
Sunrise clinical manager	x	x	x	x	Late 2007		2009
MetaVision	x	x	x	X	Jan 2008	July 2009	Oct 2009
Horizon clinicals	x	x		x	Nov 2009	Dec 2010	Oct 2010
Clinical manager (eclipsis)	x	x	x	x	Sept 2008	Dec 2009	Dec 2009
McKesson medical	x	x	x	x	Not reported		
Surgical information system (SIS)	x	x	x	x	Various dates		
McKesson	x	x	x	x	Ongoing	Ongoing	Ongoing
Cerner							
Surgical information system (SIS)	x	x	x	x	Jan 2009	Apr 2009	Apr 2009

^a Clin: Clinician. IT: Information Technology. Con: Consultant. PM: Project Manager.

13 System Impacts: Quality and Safety

In terms of system impacts on quality (Table 4), the respondents noted that transcription errors were reduced and that accountability was increased. Error-reduction and system-generated warnings led to greater safety.

14 System Impacts: Communication and Patient Interactions

In terms of the impact of the systems on communications among clinicians (Table 5), the theme of better documentation was re-iterated. Shared documentation meant that the medical record was accessible to everyone on the multi-disciplinary team, which enhanced coordination and communication. The increased focus on documentation did impact patient interactions, and some respondents noted that the technology-focus actually reduced time for interaction with patients (see Table 5).

15 System Impact: Efficiency and Documentation

EMR systems also have an impact on efficiency and documentation. One clinician noted, “efficiency will grow along with the learning curve in using the system,” but that initially it took more time to enter the documentation into the medical record (See Table 6).

Table 4. System impact (quality and safety)

System	Quality		Safety	
Metavision/SIS		5		5
Horizon lab	Great improvement	5	Reduction in errors	5
Sunrise clinical manager	Reduced transcription errors	4	Better access to medical information	3
	Better documentation		Fewer transcription errors	
	Multi-disciplinary care		Orders distributed to correct department	
MetaVision	Improved communication	5	Probably, but no data to support	
	Better decision support			
	Improved legibility			
Horizon clinicals	Benefits not achieved yet	3	Expectation	5
Clinical manager (eclipsis)		4		4
McKesson medical admin		3	Better warnings (e.g. dosage)	3
Cerner eclipsis				
Surgical information system (SIS)	Will monitor	3	Will monitor	3
Metavision				
McKesson	Better accountability	5	Reduced medication errors through bar code scanning	5
Cerner				
Surgical information system (SIS)		4		4
Average		4.10		4.11

Scale: 5 = met to great extent; 3 = met to moderate extent; 1 = not met

The availability of more accurate, more legible, and more complete documentation would facilitate better information retrieval and reporting (Table 6). Yet, at the initial stages, entering all of this information was cumbersome. One clinician noted that the patient data consisted largely of “checkboxes,” rather than clinical opinion—a shortcoming that would need to be addressed by better design of the system itself.

16 System Impacts

The assessment of system impacts reflect the trade-off’s between systems objectives and the implementation learning curve. Respondents rated the impact of the system on quality, safety, and documentation relatively higher than the impact of the system on

Table 5. System impact (communications among clinicians, patient interactions)

System	Communication among clinicians		Patient interactions	
Metavision/SIS		5		5
Horizon lab	Real-time posting of lab results	5	Patients feel better	5
Sunrise clinical manager	Multiple access to medical records	4	Better access to information, but takes time away from bedside	3
MetaVision	More legible documentation	5	Using a computer and talking to patient difficult	3
Horizon clinicals	To be expected	5	To be expected	5
Clinical manager (eclipsis)		5		
McKesson medical cerner eclipsis	Encourages communications; fixes broken processes	4	Changes focus to the technology, not the patient and family	2
Surgical information system (SIS)	Will monitor	3	Will monitor	3
Metavision				
McKesson Cerner				
	Provides better documentation; difficulty retrieving information	3	Easily printed patient instructions	5
Surgical information system (SIS)		3		4
Average		3.90		3.89

Scale: 5 = met to great extent; 3 = met to moderate extent; 1 = not met

communications, patient interaction, and overall efficiency. The learning curve and time associated with inputting documentation evidently has a perceived impact upon communications and patient interaction. Several respondents reported that computer-time took away from time with patients and family. This may be a learning curve phenomenon and could be diminished as system use becomes more familiar and widespread (Table 7).

17 Impact of EMR on Work Processes

One of the most important issues addressed in this study is the impact of the EMR system on work processes, the resulting changes in workflow, and the resolution of these issues—by adapting to new processes, by creating workaround’s, or by customizing the

Table 6. System impact (efficiency, documentation)

System	Efficiency		Documentation	
Metavision/SIS		5		5
Horizon lab	Reduction in errors	5	Provides audit trail	5
Sunrise clinical manager	Efficient documentation (but time-consuming)	3	Better organized information (but cumbersome workflow)	4
MetaVision	Supports existing anesthesia clinical workflow	5	More legible, complete documentation	5
	Improved backoffice billing			
	Improved research data			
Horizon clinicals	Expected	5	Expected	5
Clinical manager (eclipsis)		3	Ability to read documentation	4
McKesson medical cerner eclipsis	Better efficiency (wish to go back to old methods)	3	More legible documentation	4
			Improved completeness	
Surgical information system (SIS)	Faster	4	Needs to be clearer	4
Metavision				
McKesson	Efficiency will grow	3	Better documentation,	3
Cerner	Paradigm shift		But checkboxes, not narrative with thoughts/opinions	
Surgical information system (SIS)		3		4
Average		3.90		4.40

Scale: 5 = met to great extent; 3 = met to moderate extent; 1 = not met

software to “fit” existing processes. These issues are core to the implementation of off-the-shelf enterprise systems, including EMR systems.

This study confirmed what earlier research on the impact of enterprise systems implementation on work processes says. The benefits of EMR implementation are the ability to improve processes, re-engineer processes to “fit” the best practices supported by the software, and derive a better audit trail. However, the issues of “fit” did occur. In one case, the anesthesiology physicians on the design team tailored the new system to “fit” their existing, preferred processes. The use of dual systems—a byproduct of the “best-of-breed” approach, required users to re-key information from a physician documentation system to a clinical management system. Both of these issues illustrate the

Table 7. System impacts

Response	Quality	Safety	Comm	Patient	Efficiency	Document	Resistance
1	5	5	5	5	5	5	
2	5	5	5	5	5	5	4
3	4	3	4	3	3	4	6
4	5		5	3	5	5	6
5	3	5	5	5	5	5	6
6	4	4	2		3	5	6
7	3	3	4	2	3	4	10
8	3	3	3	3	4	4	8
9	5	5	3	5	3	3	7
10	4	4	3	4	3	4	4
Average	4.10	4.11	3.90	3.89	3.90	4.40	6.33

Table 8. Impact of EMR on work processes

System	Work processes—Plus’s	Work processes—Minus’s
Metavision/SIS	Improved work processes	Creates interaction issues with pharmacy and the hospital
	Consistency	
	Meets regulatory requirements	
	Easier to customize physician orders	
	Improved testing results	
	Faster to change electronic forms than paper	
Horizon lab	New processes safer for the patient	New processes difficult for the nurses
		Time-consuming to access patient data
		Complaints from the beginning
Sunrise clinical manager	Orders go directly to appropriate department	Lengthens patient discharge time
	Improved order tracking	Resulted in dual systems for documentation (nurses must re-key documentation from physician system to clinical management system)
MetaVision	Increased use of data repository	Physicians didn’t like system processes for charting
	Improved access to information to physicians for pre-op	
	Improved workflow	
	Tailored “build” to match preferred processes	

(Continued)

Table 8. *(Continued)*

System	Work processes—Plus’s	Work processes—Minus’s
Horizon clinicals	Impact on clinical workflow	
	Impact on medication administration	
Clinical manager (eclipsis)	Physicians do order-entry	Creates issues:
		Physicians enter incorrect information
		“System is a tool”—it doesn’t practice medicine
		Difficult to get physicians’ buy-in
		Too much reliance on the system rather than talking to each other
McKesson medical admin	Impacts all processes	Users create workarounds
Cerner eclipsis	Users “re-pave” the cow paths	Workarounds not always negative
Surgical information system (SIS)	Configured system to mimic current processes	Change upsets routines
Metavision		Difficult to customize because it affects regulatory compliance
		Concerns about information security
McKesson	Real-time charting a big change for clinicians	Lack of readiness—end-users with little computer experience
Cerner	Looking to see how EMR impacts health care	Resistance to change
		Software not meeting expectations
		End-users are skeptical
Surgical information system (SIS)	Big change in documenting healthcare plans	Customizing system processes and reports a problem

challenge of trying to make the new system accommodate the processes of the legacy environment—with negative productivity impacts. There are constant trade-off’s between re-engineering work processes to “fit” the software vs. trying to customize the software to “fit” existing practices. See Table 8 for details.

Workflow issues (the difference between the workflow supported by the systems and the workflow preferred by the clinicians and physicians) were addressed in numerous ways. Strategies included adapting to the new processes, configuring the software to “fit” current practices, and deploying workarounds (Table 9). To gain support for new processes, the respondents recommended training, support, the involvement of super-users, and leadership. One clinician pointed out that continuously trying to customize the software to “fit” current practices would create upgrade issues because customizations could not be migrated to the next versions. Better participation in the design process was key to resolving these issues and gaining the buy-in of the

Table 9. How workflow issues were addressed

System	How Workflow Issues were Addressed
Metavision/SIS	Staff and physician buy-in, participation on teams
	Time-off work to participate on teams
	Effective training
Horizon lab	Some workarounds
	Adapted to new processes for the most part
Sunrise clinical manager	Discharge process evaluated for “fixes”
	Trying to link to systems to prevent re-keying
MetaVision	Application very customizable
	Very few user workarounds
	Some processes cannot be modified
	Less computer-savvy users write
Horizon clinicals	Not known yet
Clinical manager (eclipsis)	Peer leadership resolves issues
	Super-users assist older physicians
McKesson medical admin	Education, individualized training
Cerner eclipsis	Strong leadership
	Best not to customize
Surgical information system (Metavision)	Education
McKesson	Education
Cerner	
Surgical information system (SIS)	Involve key players in planning, testing, teaching, implementation

end-users, particularly the physicians. End-user involvement in requirements definition in advance of systems acquisition would also help bridge the gap between user preferences and the processes supported by the system.

18 Systems Implementation: Problems and Success Factors

Many of the challenges of EMR systems implementation were highlighted when respondents were asked to describe major problems. Some of these problems were the tendency for users to do workarounds, the time it took to learn the new system, excessive workload from having to learn the new system while doing normal duties, poor end-user support, and physician resistance (Table 10). The success factors recommended by the respondents addressed these issues and included: obtaining top management buy-in, obtaining end-user involvement, supporting new workflow and standardized processes, and using clinicians as champions. Education, training, testing, and communications were all key to successful implementation. In the section dealing with Critical Success Factors in system implementation, we will go into each of these factors in greater detail.

Table 10. Systems implementation: problems and success factors

System	Problems implementing	How to make an EMR project a success
Metavision/SIS	Contractors making changes at the users request—not going through process (through committees)	Stick to the plan
	Turnover of project design staff	Written policies and procedures
	Difficulty recruiting staff	
	Super-users enabling un-intended uses of system	
	Hardware issues, printing issues	
	Reporting issues	
	Changes in super-users	
Horizon lab	Excessive workload (trained 150 users in 6 weeks)	End-user involvement
	Learning curve (learning other systems)	End-user help in overcoming resistance
	Excessive support calls	
Sunrise clinical manager	All-at-once implementation	Achieve goals without negative impact to patient safety
	Providing 24-hour support a challenge	Achieve goals without increasing nursing workload
	Physicians did not attend training	
	Champions had to provide users' training	
	Learning process increased workload	
	Increased time to enter orders	
	System more complex	
	System time-consuming to learn	
	System use takes time away from bedside—may negatively affect patient care	
MetaVision	Some great ideas not implemented	Need clinician champions
	Post “go-live” support poor	“Go-live” needs to go smoothly
	Hospital help desk had no application expertise	Workflow needs to be well-understood
	Hospital helpdesk had to page vendor	Need to stay true to new workflow
		Use vendor-supported help desk
Horizon clinicals		Understand that process workflow will change

(Continued)

Table 10. (Continued)

System	Problems implementing	How to make an EMR project a success
		Standardize processes
		Provide training early
		Provide refresher training
		Skilled project management
Clinical manager (eclipsis)	Problems with user adoption of system	Communications
McKesson medical admin	Technology issues—connectivity, lack of hardware	Top management backing
		Planning with input from all disciplines
Cerner eclipsis	User resistance—system avoidance	Education and training
	Cost more than planned	Communications of changes
		Sufficient hardware and on-site support
Surgical information system (SIS)	Staff resistance	Buy-in of staff
Metavision		End-user involvement
		Keep administration aware of issues
		Maintain momentum
McKesson	Staff have little computer experience	Education
Cerner		
Surgical information system (SIS)	Vendors promising too much	Take time to practice
	Distrust of system	Scenarios are helpful
	Distrust of IT and vendor	Need to practice before using system in patient care

19 Critical Success Factors in Systems Implementation

The final section of this study deals with the critical success factors in systems implementation. First, we will look at the critical role of the super-users. The super-users were clinicians who were responsible for application design, training, implementation support, and testing. Many of the super-users participated in these interviews and were on the “front lines” of systems implementation.

Two other critical success factors were effective training and top management commitment. Training was at best “adequate,” and at worst “weak,” according to the respondents. Many “learned on the fly,” and relied on vendor training. One respondent noted that “cheat sheets” were far more beneficial than a 500-page reference manual. In most cases, vendor training was the primary source of training and was adequate.

Top management commitment was essential. Top management provided vision, leadership, budget, and support. They were responsible for major approvals—scope, time, and budget—as well as scope changes. At times, they were responsible for expediting the project by anticipating issues and providing problem resolution.

Each project was governed by a steering committee which was composed of clinical leaders, including physicians, management, and nursing professionals. The responsibilities of the steering committee were making design decisions, supporting standardized processes, and making systems implementation decisions. Steering committee members were responsible for managing upgrades, including mandating testing before an upgrade went into production.

Finally, the role of the champion was critical to the success of the projects studied. The champions were physicians, clinicians, nursing professionals, and super-users representing the end-user constituencies. In most projects, there were multiple champions, including physicians, nursing professionals, and super-users representing various functional units. Table 11 summarizes the critical success factors mentioned by the respondents in each of the EMR implementation projects:

Table 11. Critical success factors in EMR systems implementation

Project	Super-users	Training	Top Mgmt	Steering Comm	Champion
Metavision/SIS	x	x	x	x	x
Horizon lab	x	x	x	x	x
Sunrise vlinical	x	x	x	x	x
MetaVision	x	x	x	x	x
Horizon clinical	x	x	x	x	x
Clinical (Eclipsis)	x	x	x	x	x
McKesson Med	x	x	x	x	x
Metavision/SIS	x	x	x	x	x
Cerner, McKesson	x	x	x	x	x
Surgical I/S	x	x	x	x	x

20 Resistance to Change

Resistance to change was a factor. On a scale of 1 to 10, with 10 being the highest level of resistance, the overall average resistance reported by the respondents was **6.3**. Strategies for managing resistance to change were: communications, top management commitment, end-user involvement, education, and implementation support. As noted by one super-user, many of the older physicians were resistant to the new system and training/hand-holding/support were key to success (Table 12).

Table 12. Managing resistance to change

Project	Level resist	Strategies to manage resistance
Metavision/SIS	n/a	Address technical problems
Horizon lab	4	Keep staff in the loop
Sunrise llinical	6	Early communications (goals, system justification)
MetaVision	6	Top management commitment, end-user buy-in
Horizon clinical	6	Communications, training, practice, collaboration
Clinical (eclipsis)	6	Super-users working one-on-one with end-users
McKesson Med	10	Administration backing, education
Metavision/SIS	8	Discussions with staff
Cerner, McKesson	7	Give end-users ownership, provide support
Surgical I/S	4	Little resistance (replacing a system)
Overall	6.3	

21 Systems Implementation: Open-Ended Comments

Open-ended comments by the respondents confirmed many of the issues mentioned earlier. First, many of the respondents believed that the new systems being implemented provided benefits, including data integration across areas, more timely reporting, improved efficiency, reduced medical transcription errors, order tracking, and improve patient safety. Overall, they welcomed the benefits of the new systems.

Yet, the learning curve and the time it took to enter data, particularly on the part of the physicians themselves, detracted from patient interaction. Double-entry of data into multiple systems also created time-consuming bottlenecks, largely because the hospital system pursued a “best-of-breed” approach, compared with a fully integrated “common” system.

The open ended-comments also confirmed several of the critical success factors which were mentioned previously. These included “pushing” for more end-user participation and following standard processes, as opposed to making workarounds and changes.

22 ERP and ERP: Similarities

The issue raised by the title of this paper is: EMR implementation: What lessons have been learned from ERP implementation? From these case studies in EMR implementation, several preliminary observations can be made. First, the critical success factors for EMR implementation are remarkably similar to the critical success factors in ERP implementation. These CSF’s include the participation of super-users (e.g. functional area healthcare professionals) on project teams, the importance of training, the importance of top management support, the role of the steering committee, and the role of the champion.

Second, the issue of re-engineering vs. customization was continuously addressed. While clinicians and other healthcare professionals wanted to implement workarounds and customizations, project team members were vividly aware of the importance of

re-engineering existing processes and workflow to conform with the best practices supported by the enterprise-wide software.

23 Summary and Conclusions

A telling comment by one of the clinicians was that EMR systems implementation was a continuous process requiring continuous process improvement, ongoing application upgrades, ongoing fixes, and continuous testing. Continuous systems implementation was largely being justified in terms of improving patient care through better information, better reporting, better documentation, error-reduction, and an audit trail.

However, systems implementation was dependent upon the emerging, important role of the clinicians themselves who participated in this survey. These clinicians are the super-users who are responsible on an ongoing basis for providing training, support, and design. Their knowledge of clinical processes, and their ability to understand and support the new systems and their processes, is critical to realizing systems outcomes—in terms of safety, quality, and patient care.

Without a doubt, the greatest take-away from this research was their commitment to leadership and their invaluable role in project success. If there is any lesson to be learned from these data, it is that the people (the super-users, top management, team members, steering committee members) are critical to systems success. All of these people are healthcare professionals who are transitioning to individuals responsible for the design, implementation, testing, deployment, and maintenance of information systems. Their role is unique because it combines a clinical background with responsibility for information systems design and implementation.

Appendix A: Project Interview Form

Organization Name _____

Contact Person: Phone: _____ Email: _____

Job Title: _____ Department: _____

Part 1: EHR Project Information

1. What information system have you been involved in implementing?

○ Name of system _____

○ System type (EHR, Lab system, etc.)

○ What was the reason for acquiring the system?

2. Who is involved in the project? (check all that apply)

- ☐ Clinicians
- ☐ IT professionals
- ☐ External consultants
- ☐ Project managers
- ☐ Other

What is your role in the project? _____

Part 2: Project Timeline

- ☐ Start date _____
- ☐ Expected completion date _____
- ☐ Actual completion date (if complete) _____

Part 3: Impact of the System

1. On a scale of 1 to 5, with 5 being the highest, please assess the extent to which each of these systems objectives were met:

5 = met to a great extent

3 = met to a moderate extent

1 = not met

NA = not applicable

_____ Quality: improving the quality of patient care.

Comment: _____

5 = met to a great extent

3 = met to a moderate extent

1 = not met

NA = not applicable

_____ Patient Safety: reducing medication errors.

Comment: _____

_____ Communication: improving communications among clinicians.

Comment: _____

_____ Patient Interactions: improving interactions with patients.

Comment: _____

_____ Efficiency: improving efficiency.

Comment: _____

_____ Documentation: improving documentation.

Comment: _____

Other benefits:

Part 4: EHR System Use

1. What was the impact of the system on work processes? What aspects of workflow changed?

2. How were these issues resolved? (users adapted to new processes, users created workaround's, software was customized).

3. What were some of the problems arising in implementing the system?

4. In your opinion, what needs to happen to make the project a success?

Part 5: Evaluation of EHR Project Success Factors

1. How was the project managed? Was it managed by healthcare professionals or was it an IT project?

2. What role did the "super-users" play a role in system implementation?

3. How do you feel about the training? Did you receive enough training?

4. What is top management's involvement?

5. Is there a champion?

6. On a scale of 1 to 10, with 10 being the highest, what was the level of resistance to change? _____
What methods were used to reduce resistance to change?

-
7. Is there a project steering committee? _____

Other notes:

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