IMPLEMENTATION OF AN ELECTRONIC MEDICAL RECORDS SYSTEM: HOW CAN HEALTH CARE MANAGERS ENSURE ITS SUCCESS?

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ABSTRACT

This paper examines the implementation of an electronic medical records system at the second largest hospital in the United States. Based on an in-depth examination of this implementation, several practical insights are offered for those who have responsibility for managing the implementation of computer-based systems. First, it is important to analyze the contextual situation surrounding the implementation and to identify the issues to be addressed and the challenges to be overcome. Second, the way in which the implementation process unfolds is heavily influenced by the experience, skills, and interest of the people involved. Third, implementation managers must access the appropriateness of the standard, widely accepted implementation tactics for the situation at hand. Fourth, problems are likely to arise even under the best of circumstances. Implementation managers must learn to be proactive in identifying and solving problems. These findings shed some insights on why organizations who attempt to apply normative implementation prescriptions sometimes fail. This study shows that there is no one way to manage the implementation of a computer-based information system; rather implementation managers must acquire the skill for assessing the implementation context and for using this knowledge to guide the selection and application of effective implementation tactics.

1. INTRODUCTION

In the past, the health care industry has been sheltered from many environmental forces, but this situation is rapidly ending. Most agree that quality of care at a competitive price represents the current challenge within the realm of hospital competition. A hospital's reputation for doing this has become a significant marketing advantage in efforts to attract both patients and health care providers. Given the myriad complicated elements in today's health care environment, the geographic dispersion of points of care, the interaction of many specialists and the need to balance the complex set of care steps for every patient, hospitals can no longer be competitive without substantial application of information technology (IT).

As a result, computerization of medical records has increased in recent years and it appears that this trend is likely to continue, particularly as technology improves and becomes more affordable and as the demand for health care

information increases [2]. As a clear indication of this, the 1995 Deloitte and Touche international health industry survey reveals that 43 percent of health care organizations rate full/mandatory access to medical record systems as important [8].

The current and rapid movement of electronic medical records systems into health care organizations has raised managerial concern regarding the capability of today's institutions to satisfactorily manage their introduction. Information technology implementation research can be called upon to guide this introduction.

There is extensive literature on IT implementation dating back to the 1970s (e.g., [28]; [24]) with a growing number of studies conducted in the late 1980s and early 1990s (e.g., [17]; [6]; [20]). This stream of research is primarily constituted of studies, often referred to as "factor studies," which have tried to identify and/or measure factors believed to be relevant to system success. For instance, researchers have advised practitioners that managerial support, high quality system design, commitment to advancing with the field, and extensive project planning are all key elements of successful systems. Yet despite these normative principles and prescriptions, many organizations find their attempts to make use of information systems fraught with difficulty.

The ultimate intent of this study is to broaden and edify our understanding of health information systems implementation. Precisely, our attempt is to provide a deeper understanding of "how" health information systems, and more precisely medical records systems are being implemented and "how" and "why" previously identified implementation factors and outcomes are associated. This study provides health care managers as well as health informatics professionals with insights into the *dynamics* of the implementation of these systems.

2. METHODOLOGY

2.1 Design

Given that the implementation of health information systems is a process which takes place over time, is a complex endeavor involving multiple actors, and is influenced by events that happen unexpectedly, case studies are well-suited to identifying key contextual conditions, implementation tactics, and key actors in the implementation and to linking them in a causal chain. Using a case study methodology, we examined the hospital-wide implementation of an electronic medical records (EMR) system at a large, not-for-profit, teaching hospital.

Qualitative data were primarily collected through face-to-face semi-structured interviews. An interview guide was developed and used during each interview. The interview guide contained questions related to the reasons for introducing the new system and pre-implementation expectations; the context which surrounded and shaped the implementation process over time; the nature and diversity of tactics adopted to ensure a successful implementation; and the extent of system success.

Interviewees were individuals who participated in the development of the EMR system and a small group of user representatives, namely, physicians and medical records personnel. A total of 39 interviews were conducted over a period of twelve weeks, 26 with project team members and 13 with users. All interviews, except one, were conducted on a one-to-one basis. The one group interview was conducted with the three education coordinators (trainers) involved in the EMR project. Finally, it is worth noting that all of the key actors involved in the project were still working in the medical center, and participated in the interviews.

After the data collected in the interviews had been analyzed, a 37-item questionnaire was developed. Each item in this questionnaire corresponded to a finding from the study. Ten individuals who were actively involved in the implementation project were asked to indicate their level of agreement with each finding. These answers corroborated the findings drawn from the interviews and indicated that there was congruity and consistency concerning the implementation process and the extent of implementation success.

In addition, all documents relevant to the present study, including organizational charts, annual reports, special reports and administrative documents, newsletters, and training material were collected and analyzed. Finally, observation took place during one training session and three meetings involving team members and an external party.

2.2 Site

Jackson Memorial Hospital (JMH) is an accredited, not-for-profit, teaching hospital. The facility is the second largest hospital in the United States and is under the jurisdiction of the Public Health Trust of Dade County, Florida. The medical center is affiliated to the University of Miami School of Medicine. Of the 980 full-time faculty members of the medical school, more than 600 are physicians engaged in clinical practice who are permitted to join the medical staff and can admit patients to JMH. The medical center has over 1,560 licensed beds housed in a multibuilding complex.

The medical center was recently honored as one of the top medical centers in the nation according to the publication, *The Best in the Nation* [27]. This national reputation for excellence was also reconfirmed when JMH was named among the nation's top hospitals in *The Best*

Hospitals in America [9]. JMH provides a comprehensive array of diagnostic and treatment services to both residents of Dade County and patients from throughout the southeastern United States, the Caribbean Basin and Latin America. The medical center is a nationally recognized referral center for newborns with serious medical problems, high risk obstetrical/gynecologic cases, severe burns, acute orthopedic and spinal cord injuries, organ transplantation, comprehensive cancer care, the most acute emergency and trauma cases, and patients requiring treatment for chronic pain, and intensive medical, surgical and neurosurgical care. It is interesting to note that about one-third of JMH's beds are dedicated to these specialized programs.

3. THE EMR PROJECT

The idea of using computer technology to support medical records functions at JMH was first proposed in the early 1980s by the Director of Medical Records (DMR) department. As shown in figure 1, the EMR project consisted of three distinct implementation phases.

3.1 The Three Phases of the EMR Project

Phase I

As a first step, a medical records abstracting system and a derived electronic face sheet document were designed and implemented to support the internal operations of the department. The electronic abstracting system summarizes information contained in a patient chart. More precisely, up to twelve diagnoses and twelve procedures are collected and edited for specific requirements. Data entry is performed by a group of analysts/coders after they have completed an in-depth review of a patient's paper chart. Data entry usually occurs the day after a patient is discharged. It is important to note that the electronic abstract does not constitute a legal document and has been mainly used for billing purposes. The medical record abstract was produced electronically in 1985.

The electronic face sheet is composed of a subset of data elements included in the medical records abstracting system. Contrary to the electronic abstract, though, the face sheet constitutes a legal document. Besides diagnoses and procedures, the face sheet contains demographic information with reference dates of prior admissions that are relevant to a patient, and information related to surgeries, if any. The face sheet constitutes a synopsis of what occurred to a patient during the hospital stay. Prior to 1992, face sheets were printed out each night at the Medical Records department, which attending staff had to visit personally to sign.

Phase II

The initial push toward the electronic signature of the face sheet started in 1986. As discussed in greater detail later, initial efforts consisted of making inquiries to the regulatory and reimbursement agencies such as the Joint Commission of Accreditation of Hospitals and Healthcare Organizations (JCAHO), the Health Care Financing Administration (HCFA), Medicaid and Medicare regarding their standards relative to the authentication of the electronic signature. Policies and procedures that met the agencies' requirements were developed and implemented in the late 1980s.

System development efforts regarding the electronic signature of the face sheet started in the Fall of 1991. Starting on February 18, 1992, attending physicians were required to affix their electronic signature to any face sheet for which they were responsible, in order to finalize the requirements for completion of the medical record. Phase II then represented a major step towards JMH's objective of having medical data accessible via computers throughout the center.

Phase III

The third and most recent phase of the EMR project was completed almost a year after phase II when, as of January 2, 1993, all attending physicians were required to sign electronically two other legal documents included in a patient chart, namely, the operative report and the discharge summary. These two documents have a shared characteristic; they both must be dictated by a physician. Under current policy it is the responsibility of either the attending or the resident physician to dictate operative reports and discharge summaries. However, only the attending physician may attest to and hence sign any document to be included in the medical chart. As a statistical note, between 75 and 100 surgeries occur every day at JMH while approximately 150 people are discharged on a daily basis.

Dictation takes place via phone lines connected to a sophisticated dictation system. Once the dictation is done and the physician hangs up the phone, the dictation is digitized through the phone line and stored on the hard disk of a PC connected to the dictation equipment.

All dictated documents stored on the hard disk of the PC (of the dictation system) are accessed by an off-site transcription company, ABC, via a modem and a phone line. Once ABC has transcribed the reports, they are transferred back to JMH's mainframe computer. Once

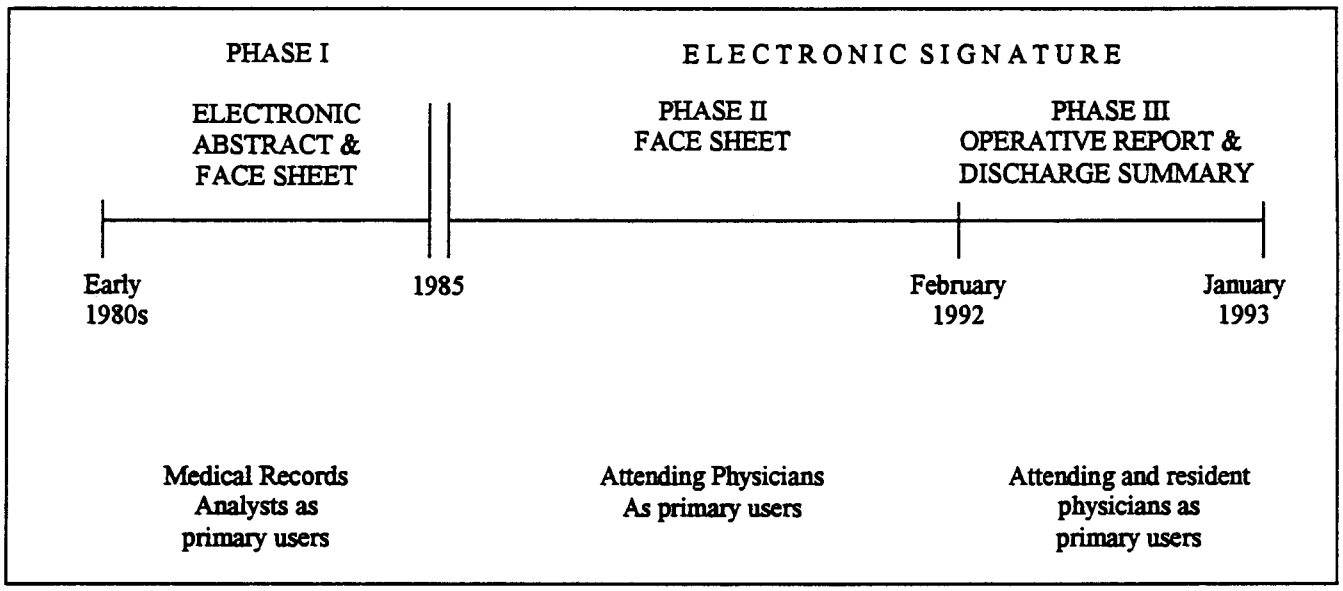

Figure 1. The Three Phases of the EMR Project

reports are received, internal programs format the reports in a way recognizable to the physician when they appear on the computer screen.

The EMR system is very easy to learn and use. After entering their usernames and passwords, physicians can have access to a patient's medical record by typing in the patient's full name or medical record number (if known). Next, the system displays a screen allowing the user to probe the type of document (discharge summary, face sheet, or operative report) to be displayed for review purposes. The physician can then sign a document by simply probing the "SIGN" icon at the bottom of the screen.

Physicians can review and sign electronic documents from any of the 1,600 terminals located throughout the medical center. The EMR system can also be accessed from numerous remote locations such as a physician's home or office via a modem and a phone line. Importantly, the EMR system can be accessed from any of the ten primary care centers located throughout the community, where JMH has installed and made available for its physicians a number of terminals connected to the mainframe.

When all required documents are properly signed, the medical record is automatically assigned a status of "complete." All documents signed on-line by a physician during a given day are printed that night. Medical records staff then file these reports in the patents' charts. Under current policy, all electronic documents stay on-line for a period of five years and can be consulted at any time by any resident or attending physician.

3.2 The Implementation Story

This section recounts the story associated with the implementation project. The story reveals the nature of the interaction between the context surrounding the implementation project and the adopted strategies or tactics. It also provides the reader with a good understanding of the dynamics of the implementation process, that is, the "how" and "why" of what happened. We begin by discussing the main challenges encountered during the project and the way in which the challenges were met. These challenges are listed in Table 1.

1.	Get sufficient human resources allocated to the design of the EMR system
2.	Satisfy regulatory and reimbursement agencies' requirements (JCAHO, HFCA, Medicaid, Medicare)
3.	Design a conceptually and technically sound information system
4.	Obtain approval of Executive Committee of Clinical Staff and support of Chiefs of clinical services
5.	Have all physicians comply and sign medical records electronically
6.	Cope with an external party and solve data communication problems
7.	Restructure operations within the Medical Records Department

Table 1. Challenge Encountered During the Implementation of the EMR System

Challenge 1: ***Get sufficient human resources allocated to the design of the EMR system***

The implementation of the EMR system was seriously jeopardized even before it started because of the limited availability of human resources. As mentioned earlier, the idea of using computer technologies to support the activities of the medical records department was brought up in the early 1980s by the DMR. As an initial step, she sent a memo to the MIS Director at JMH describing the potential of medical records computer applications and requesting resources to develop and implement these applications. The DMR was initially told that systems analysts and programmers were not available and that even though the importance of automating medical records functions was recognized, it did not coincide with immediate institutional priorities, which were mainly related to financial applications. Looking for alternatives, the DMR considered the acquisition of software packages, conducting a survey of the products available on the market. When one remembers that the national movement toward the computer-based patient record (CPR) only started in the early 1990s, it is no surprise that the DMR was unable to find a software package that would satisfy all of her requirements at the time. Indeed, applications available at the time were optical systems used mainly for archival purposes.

Desperate but still determined to automate medical records functions, the DMR thought there was no other solution than for her department to assume the costs of software development. She then proposed that the Director of the MIS division assign one systems analyst to medical records projects in exchange for the transfer of one full-time equivalent position to his division. Recognizing the importance of the departmental needs, the MIS Director accepted the proposition and one senior systems analyst was dedicated to medical records projects.

Among her first assignments, the systems analyst was asked to design the medical records abstracting system and the derived electronic face sheet (phase I of the EMR project). Between the end of phase I in 1985 and the design of the electronic signature of the face sheet in 1991, she was actively involved in both the enhancement of existing applications and the development of new departmental applications such as a medical records tracking system. Once legal approvals were obtained from most regulatory agencies, the systems analyst was asked to design the electronic signature of the face sheet (phase II).

As evidenced below, championing actions taken by the DMR were instrumental in getting human resources allocated to the project.

> *"Resources were available only because I made them available [...] I was not going to stop the project from going forward because of that <referring to the lack of resources>. So, it was finally agreed that if I gave them <MIS division> one FTE, one of my positions, they could assign someone to work on medical records functions." (Director of Medical Records Department)*

DMR's actions were a clear indication of her strong commitment to and belief in the project. As a result of her strategic maneuvers, some situational stability in terms of organizational resources was ensured. Importantly, having a systems analyst dedicated to medical records projects right from the beginning created the advantage of having someone who gradually developed expertise in the medical records area.

It is worth noting that once the challenging task of having human resources allocated to the EMR project was surmounted, organizational resources were not a major issue. Indeed, the medical center had a substantial technological infrastructure in place with over 1,600 terminals and almost 500 printers located throughout the main campus. Having this infrastructure in place eliminated the costs associated with hardware acquisition, site modification and cabling needs.

Challenge 2: ***Satisfy regulatory agencies' requirements as to the authentication of medical records and the electronic signature***

Prior to authorizing physicians to sign face sheets electronically, regulatory agencies' requirements for the authentication of medical records needed to be considered in relation to the nature of the electronic signature, and those requirements satisfied. As discussed below, the efforts put forth to obtain the approvals necessary to satisfy the demands of all agencies, both nationally and in the state of Florida, were arduous.

As a preliminary step, the DMR made inquiries to the JCAHO regarding its standards relative to the electronic signature. The major concern expressed by the Physician Advisor for the Department of Standards of the Joint Commission was related to the authentication or verification of what is being entered or dictated. Other concerns were related to the security of the computer system and the authorship mechanism, the use of initials for authentication, the mechanisms for the correction of entries,

the confidentiality and misuse of information, and the access to the information.

The DMR asked the participation of JMH's Medical Records Committee in the development of a series of new policies and procedures which would satisfy all of the Joint Commission's requirements. The committee was composed of a variety of people including physicians, registered nurses, as well as MIS, risk management, quality assurance, and medical records personnel. In short, the mandate of the committee was to act as a governing body, making sure that all legal and security issues were adequately considered.

In June 1987, the question regarding the acceptance of a computerized signature was posed by the DMR to the HCFA's Atlanta Regional office. All requirements from the HCFA, which were mainly related to the access and confidentiality of the information, had already been satisfied through the policies and procedures developed by the Medical Records committee. Next, the DMR made inquiry to the federal government's payment agency, Medicare, as to standards for the authentication of records. The guidelines prescribed by Medicare forced the development of another set of policies and procedures related to computerized signature access and security guidelines for issuance or modification of security codes. The approval process also included an on-site observation of the database management system used to support the medical center's electronic signature. On January 24, 1992, written approval was received from Medicare, Part A, and a notification of approval was received from Medicare, Part B, on March 17, 1992.

The next and last step was to check the policies regarding computerized signatures for Medicaid, the major contributor to JMH's financial stability. In order to obtain Medicaid approval for the use of computerized signatures, the DMR first referred to Title XIX of the Social Security Act which stipulates that in order for a change in policy or procedure to be accepted, it has to meet the requirements stated by the federal agency. Therefore, the request for approval along with all appropriate documentation and the letter of approval from Medicare were submitted to Medicaid. A letter was received on June 24, 1992, stating that the electronic signature had been approved but was limited only to inpatient services effective as of January 24, 1992.

Having secured all the requirements from JCAHO, HCFA, Medicare, and inpatient services for Medicaid, physicians were required to affix their computerized signature to the face sheet and attestation statement in order to finalize the medical record. It is worth noting that a subsequent request to Medicaid was made by the DMR to reconsider the original approval and include the use of computerized signatures for outpatient services. At this time, final approval for outpatient services has not yet been received from Medicaid.

In summary, pioneering and ardent championing efforts on the part of the DMR have allowed the medical center to overcome the initial hurdles associated with obtaining formal approvals from all federal and state agencies. Based on evidence presented so far, the DMR could be described, using Beath's [4] terms, as "a manager who actively and vigorously promoted her personal vision for using software technology and who pushed the project over or around implementation hurdles." As evidenced below, these pioneering efforts were facilitated by the irrefutable support provided by the V.P. Medical Affairs.

> *"My boss <V.P. Medical Affairs> has allowed me to have the climate whereas I was empowered and I could handle the project the way I thought was best. That was really important to me because I didn't have any barriers." (Director of Medical Records)*

Obtaining the consent from governmental agencies had a very stimulating and positive effect on the overall project for two main reasons. First, it provided even more credibility to the DMR's vision and hence incited her to pursue and intensify her efforts. Second, having gone through this process brought more evidence that JMH was among the first public medical centers in the entire country to attempt such a venture. As a consequence, a great sense of accomplishment was felt among the involved actors.

Challenge 3: ***Deliver a computer-based information system that is (1) on time, (2) within budget, and (3) meets users specifications.***

A challenge common to most implementation projects is to deliver a system that is (1) on time, (2) within budget, and (3) meets users' specifications. As described below, several implementation tactics were adopted in order to achieve these objectives.

First, the selection of a user representative as project leader has always been an important element of the MIS division's systems development strategy and was applied to the EMR project. The local use of the term "user group" for the implementation team in itself represents a clear indication of the importance of users in the design process. As expressed below by the MIS Education Coordinator, user acceptability of the EMR was greatly facilitated since the project originated within the medical records area.

"A big thing was the users playing an active role and taking ownership of the system. <DMR> and her people did that very well. It wasn't like we were trying to convince them that they needed the system. She <DMR> envisioned what she needed and how it would happen and I think that was one of the most important things." (MIS Education Coordinator)

Participation of physicians (end users), on the other hand, was kept to a minimum. Once a prototype of the electronic face sheet was developed in phase II, a small group of selected attending physicians was asked to provide their input as to the use of the system. As evidenced below, the decision to restrict the participation of physicians was mainly influenced by memories of past experiences with physicians on implementation teams.

"These guys <physicians> are tough to pin down. They are always late for meetings and they don't show up all the time... so it is really tough working with them." (MIS Director)

The limited participation of physicians violated one of the accepted beliefs concerning the guidelines for successful outcomes. However, having a system which meets users' (physicians) needs was ensured by the presence of key team members advocating physicians' interests.

"I saw my role as a catalyst and as a mediator to make sure the interests of the clinical services were moved forward." (V.P. Medical Affairs)

"Being a nurse myself I always want the interests and needs of the clinicians to be satisfied." (MIS Education Coordinator)

As another implementation strategy, the project team was purposely composed of a very unified group of people who had a history of working together. Indeed, several computer applications had been developed to support the operations of the medical records department prior to embarking on phase II. As a result, a collaborative effort was established over time and became an important strength of the project. Everyone on the team was involved from the beginning and was part of the meetings so that each actor knew what was happening and what was expected from him or her. Decision making was also a team process and was based on consensus. Importantly, as the project leader, the DMR played a major role in making sure that the team was meeting regularly and that the project was moving forward.

"<DMR> did what any project leader should normally do which is to keep the project moving along, making sure that the team met on a regular basis..." (MIS Education Coordinator)

Finally, it is worth noting that the management of the software development process was largely influenced by key actors' beliefs and attitudes regarding systems development and management practices. As indicated below, both the MIS Education Coordinator and the DMR have strong opinions regarding system development practices, and these opinions had a direct and major influence on the overall management process.

"I don't necessarily have this great Gantt that spits out of a computer... I have seen people do that and no one ever looks at it... so everything changes and they plug in new dates and spit out another one. So, to me, I would rather spend two hours working with the users on the functions than to spit out pieces of paper." (MIS Education Coordinator)

"My view is that I wanted the project done. We met, we talked, we agreed, and we did it. It was just a project to get done without superanalyzing it." (Director of Medical Records)

Indeed, normative project management principles were not adopted as formally as prescribed in numerous development methodologies and textbooks. For instance, the idea of doing feasibility studies or cost-benefit analyses was not an integral part of the software development strategy either. In the same line of thought, no specific planning tools such as Gantt diagrams were adopted in order to determine the sequence of tasks to be performed and to estimate the time, money, and technical resources the team will need to execute them. Organizational maturity strongly influenced the way the project was managed and controlled as well. As indicated below, systems professionals involved in the project had been working for the MIS division for several years and hence had developed a lot of autonomy. They knew what was expected of them and how to get things done.

"I have been here for so long that... I don't need a lot of directions." (MIS Education Coordinator)

"As long as you are giving the users what they need you can feel free to use your own creative techniques to do that." (Senior Systems Analyst)

Challenge 4: ***Obtain the support of the Chiefs of clinical services and the formal approval of the Executive Committee of the clinical staff***

As in most IT implementation situations, top-management support was a key contextual condition in the EMR project; especially in phase II where the electronic signature was first brought up. The V.P. Medical Affairs was immediately sold on the idea and had been a strong advocate and proponent of the electronic signature from the very beginning.

"He <V.P. Medical Affairs> is very dedicated to the hospital and he very much wants to make it better. He's one of the primary physicians that sees the way of doing that <referring to medical recording> was with the help of automation. He wants Jackson to be the best place for patients to come and be cared for... so, he's always been a big proponent for automation." (MIS Education Coordinator)

The V.P. Medical Affairs, who is a physician, soon became a key opinion leader. He helped the DMR spearhead the idea of the electronic signature to Chiefs of services and attending physicians. Personal contact is one of the most validated strategies in bringing about knowledge transfer and organizational change and was in fact a key aspect of the V.P.'s strategy. His role as an opinion leader was even more effective because he had a lot of credibility and was highly respected by other doctors. The V.P.'s personal participation and involvement in the project was also a strong and clear indication that the electronic signature was important to senior management.

The DMR did her share of education and communication as well. Right from the beginning she was well aware that a lot of collaboration and commitment would be required, not only from the V.P. Medical Affairs but also from all the Chiefs of clinical services in order to proceed successfully. Over the years, she shared her vision of the electronic medical record with the Chiefs of services and attending staff. She highlighted the problems with paper-based records and discussed how an electronic record would solve these problems. She also distributed books on the CPR to whomever was interested in learning more about the concept. Finally, another key element of her educational efforts took place when she offered a video presentation sponsored by the Institute of Medicine (IOM). The video addressed issues such as critical success factors for the implementation of CPRs, potential benefits associated with CPRs, barriers to the effective introduction of CPRs, communications standards among sites, and presentation of a few state-of-the-art technologies, including voice-activated and pen-based technologies.

As indicated below, an important facilitating condition in obtaining the approval of the Executive Committee was the well-established relationship between the DMR and Chiefs of clinical services. Indeed, the DMR had proved over the years that she was working for and with the physicians and hence had gradually built a relationship based on trust and mutual respect.

"<DMR> has a very good relationship with the Chiefs of services and she obtained a lot of support because she earned it." (Chief of a Clinical Service)

"I have known and worked with Chiefs of services for a long time... so that was a big help." (Director of Medical Records)

A second key supporting condition in obtaining top-management support was the debut of the national movement toward the CPR in the late 1980s. Indeed, national efforts started in 1989 when the IOM formed a committee to explore ways in which patient records could be improved to enhance the quality and cost efficiency of patient care. When the IOM made the recommendation that health care professionals and organizations should adopt the CPR as a standard, it solidified the existing stance and efforts deployed since the early 1980s.

Challenge 5: ***Have all physicians comply and sign medical records electronically***

Physicians have long been accused of unwillingness to use computer systems and many studies show a great deal of computer anxiety among physicians ([29]; [1]; [25]). A clear indication that attending physicians at JMH had negative attitudes toward computers prior to the implementation of the electronic signature is that most of them had simply decided to avoid the computer till that point. A lot of anxiety was expressed among attending staff when the electronic face sheet was first

implemented. Computer skills among attending physicians were very limited and keyboard fright had to be overcome.

> *"They <attendings> were not used to the computer and they were not computer literate. They never checked for a lab result or anything so we couldn't expect them to just jump on." (Medical Records Supervisor)*

It is being argued in the medical informatics literature that the key to getting physicians to use any computer system is gradualism ([19]; [16]). This argument was revealed to be true in the case of the EMR project. Considering the span of the project in terms of number of physicians being affected and the potential for resistance, the DMR decided to introduce attending physicians to the electronic signature in a slow and gradual fashion. The initial introduction of the electronic face sheet in 1992 was the very first step and showed immediate benefits to doctors in terms of accessibility to the information. With the introduction of the electronic face sheet, physicians were able to access the legal document at any time without having to chase the chart throughout the medical campus. As a direct consequence, physicians' productivity was enhanced by reducing the time needed to find missing documents and/or wait for patient charts already in use.

In order to further facilitate the transition, an extensive, hospital-wide training program was put in place a few months prior to the introduction of the electronic face sheet. Considering the very large number of attending physicians, it was decided that training would be facilitated and would be more accommodating for the medical staff if it took place within clinical areas during grand rounds. During these in-service sessions, attending staff was informed of the policy and procedure of computer generated records, their confidentiality, and the significance of the computer generated signature on the face sheet. MIS education trainers in collaboration with the medical records supervisor would then explain how to access, review, sign or refuse to sign records electronically, and how to make changes if necessary. Training sessions could also be arranged on a personal basis with the medical records supervisor. In all, the overall training program was designed based on the special needs and demands imposed by physicians.

Finally, what appeared to be the most critical and effective tactic was to mandate the use of the electronic signature. The DMR already knew that no matter how smoothly the system was going to be, how good the training would be, or how easy the system would be to use, there would be some and maybe even strong resistance on the part of physicians.

> *"When we did the face sheet it was cold turkey. I mean it was like 'You will do it, no ifs, no buts, in order for you to complete the medical record you have to sign your documents electronically.' That was a challenging decision to take but it was a necessary one... and it worked." (Director of Medical Records)*

The DMR knew that attending physicians would come up with different reasons and excuses for not using the system. For instance, she expected them to say that they were too busy to spend time at a computer terminal or that they would prefer to review the rest of the medical chart before signing discharge summaries or attestation statements. The decision to mandate the use of the system was therefore facilitated by the support of all Chiefs of clinical who ensured compliance. For instance, in the case of the operative report and discharge summary, Chiefs of clinical services were ultimately responsible for decisions related to medical recording responsibilities after automation. All Chiefs of services decided that although a report may be dictated by the resident or the attending physician, the final attestation and signature had to be done by the attending physician.

Once in use, any system must meet the performance expectations of its users in terms of system useability, quickness, and reliability. Team members were aware that the electronic signature had to be simple and quick. In this regard, the system did not represent anything new to the physicians, since what appeared on the screen was exactly what they used to see on paper. Conceptually, then, the system was very easy to learn and understand. The physician can access, consult and sign his or her reports very quickly, since all a physician has to do is probe options from menu choices through the use of a light pen.

It is also important to note that the acceptance of the electronic signature was facilitated not only because the system was easy to use but also because it did not interfere with traditional practice routines and was not intended to affect physicians' work roles, status and autonomy.

In sum, the decision to mandate the use of the system appeared to be an extremely effective tactic for ensuring physicians' compliance. Such a decision could have caused much annoyance and discontent among doctors but in actuality it did not, and the EMR system was generally well received. The gradual implementation strategy along with the communication efforts, the

flexibility of the training program and the continuous support provided to physicians have all contributed to easing the organizational transition. Overall, the transition went quite smoothly and the success of the system can be seen through compliance and satisfaction.

Challenge 6: ***Cope with the presence of an external party and solve data communication problems***

The complexity of the EMR project was amplified in phase III when an external party became involved in the overall process. As mentioned earlier, an off-site company, ABC, was responsible for the transcription of operative reports and discharge summaries.

In regard to the design of the system itself, ABC was mainly responsible for developing computer programs related to the transfer of reports back and forth. Other computer programs such as those related to the billing process (based on a count of characters per report) had to be written as well by the off-site company. Having no computer programming staff at the time of embarking on the project, ABC hired a contract programmer to develop its part of the system.

The presence of this external party affected the overall progress of the project. Indeed, the implementation process suffered from the lack of control over the work done at the off-site company. As an indication of this, the programs developed in-house were ready long before those developed by the contract programmer were. Further, once the programs were ready, the off-site company had some technical problems establishing communication with JMH's mainframe computer. As a result, team members felt the project was being delayed because of circumstances beyond their control.

> *"Another key part was the role of that off-site transcription company because they had a role that we didn't have as much control over. We had some but not as much." (MIS Education Coordinator)*

> *"It makes it a lot easier when you don't have to work with outside parties because there are inevitable problems... especially when you're doing a project involving data communication between sites, you ought to know what is going on at both ends." (Senior Systems Analyst)*

Both the delays and the technical problems themselves created some anxiety on the part of the project team, especially the project leader. Once communication problems were solved, the DMR wanted the system to be implemented immediately and was willing to accept that there might be some problems up front. She was strongly motivated to do so because the delivery date she had promised to the physicians had already arrived. As a result, it was decided to "go live" with the very first report coming across the communication lines, without extensive testing in a controlled environment. As indicated below, ABC did not consider testing as an important step in the overall process either.

> *We were really anxious to get the system implemented and the people at the transcription service... would say 'well, if we can send you a piece of data that means we're done and ready to go' where I would have preferred to have sent several reports over in a controlled testing environment and make sure that things were happening. The very first report they finally sent us was supposed to be live data and that should never have happened but it did [...] I should have been more forceful in saying that we shouldn't go until we do at least some testing." (Senior Systems Analyst)*

The decision to go live without prior testing created negative consequences for the project. When JMH started receiving reports across the communication lines, major problems were immediately noticed by the systems analyst. Errors in reports varied from misaligned characters, presence of incorrect numbers, and most importantly, repeated data elements. Problems were rampant when reports first started coming in and no one at JMH had expected such an outcome.

> *"When we first started 95% of the reports had at least one edit error... it has gotten better but some reports still contain errors that we need to fix. [...] We didn't really anticipate how bad the quality of the data that came across would be." (Senior Systems Analyst)*

Immediate solutions to these communication problems had to be found, since reports could not be made available to physicians with such errors. Further, the presence of repeated characters had a direct effect on the billing process. As a temporary solution, then, the DMR asked some of her staff to "clean" the reports upon arrival prior to making them available in the EMR database for

signature. Besides being a costly alternative, having people cleaning medical reports has had its negative effects on the satisfaction of the people involved in the process.

Even though several meetings and phone discussions have taken place to solve the data communication problems, many reports still come back to JMH with transmission problems. The ineffective finger-pointing approach adopted showed a serious lack of commitment on both sides to finding solutions to the problems. Further, it appears that a lack of computer expertise on the part of the off-site transcription company might have interfered with the search for a solution.

> *"It's kind of a finger-pointing type of process right now. They say that they are shipping it correctly and we're messing it up; and of course I say that we're not and that they're shipping it to us like that." (Director of Medical Records)*

> *"It would have certainly helped, I believe, if there had been more programming expertise from the transcription service side of it." (Senior Systems Analyst)*

Challenge 7: ***Restructure operations within the Medical Records department***

As prescribed in the IT implementation literature, changes in job designs, organizational structure and communication patterns, to name a few, must be anticipated and managed as part of the implementation process, if one's intent is to minimize undesirable consequences. The EMR system affected primarily the work of medical records personnel who represent the secondary users of the system. As a result, operations within the area had to be restructured.

Planning and management of departmental consequences was an integral part of the implementation strategy. Once again, the DMR played a key role in preparing her group for changes in the operation of the department. Prior to installing each module of the EMR system, she organized a series of departmental meetings where she would explain the motives for implementing the new system, what was going to happen or was expected to happen; that is, how the unit would be affected. As a result the EMR system was pulled into the medical records department rather than being pushed into it.

> *"There was a lot of teamwork back then because I wanted to make sure everybody understood what was going to happen. People were involved early so they knew how the workflow with the operative notes and the discharge summaries was going to be." (Director of Medical Records)*

Overall, the EMR system has had a tremendous impact on the effectiveness and efficiency of the medical records department. The system has significantly decreased the work backlog related to the coding and analysis of medical charts which is a labor-intensive process. Several functions have been eliminated with the introduction of the computer-based system. For example, prior to automation medical records staff would deliver hundreds of patient charts daily to the physicians' offices in order to be signed. Specifically, they delivered an average of 450 charts throughout the medical center each day prior to automation. After automation, this number dropped below 200. Most importantly, medical records staff formerly cleared the medical records manually after they had been signed by physicians. The clearing process is now performed automatically by the computer system. Despite the fact that the system has eliminated a lot of functions such as clearing records and assigning deficiencies, no FTE was eliminated; rather, employees were assigned new tasks. As a final remark, a facilitating factor in the process of planning and managing departmental consequences was the DMR's own experience within the department. Indeed, she had been a medical records employee for several years when the project started in the early 1980s. She first occupied a clerk position in the medical records department. After a few years, she was promoted to supervisor of the incomplete area, a position that she occupied for five years. As a supervisor, she really started to know and to be known by physicians and administrators at JMH. She was finally asked to become the director of the department and had been in that position for more than six years when the EMR project started.

4. DISCUSSION

A certain number of new perspectives and practical insights can be derived from the implementation experience recounted in this paper. These insights are presented next along with their implications for health care managers and medical informatics professionals.

Practical insight #1: **Successful implementation requires identifying and addressing implementation challenges**

Empirical evidence suggests that successful implementation of health information systems such as EMR systems are likely to be those where key actors socially construct envisioned end goals and anticipate challenges ahead. This evidence adds support to previous research that has found that most unsuccessful IT implementation projects are the result of poor management, not technical problems ([30]; [22]; [10]). While much of the implementation research has equated good management with knowing what to do ([5]; [26]; [19]), we suggest that good management must also focus on what to look for and think about.

The case at hand clearly depicts the broad nature of the implementation process through the variety of encountered challenges. The implementation of such systems should therefore be conceived as a complex and dynamic process where key actors are likely to face, more likely simultaneously than sequentially, challenges such as ensuring situational stability (organizational resources); obtaining external approvals and top-management support; designing high quality systems and ensuring adequate maintenance; limiting resistance to change; managing relationships among team members; coping with the presence of external actors; and managing individual and organizational consequences. In the EMR project, it is worth noting that all of the encountered challenges, but one, were anticipated by key actors and hence courses of action were thoughtfully planned. For instance, getting human resources allocated to the project, satisfying regulatory and reimbursement agencies' requirements and having all physicians comply and sign medical records electronically were clearly established end goals which drove the rational process of evaluating, selecting and adopting tactics to cope with the encountered challenges. As explained earlier, only the data communication problems with the off-site transcription company, more precisely the extent of these problems was not anticipated.

The primary message to health care managers and systems professionals is that success requires a *proactive* stance where implementation challenges are anticipated as early as possible. In other words, findings from this study suggest that a good implementation plan should start with the *issues* and *challenges* to be overcome rather than the actions to be taken and decisions to be made. In a similar vein, it appears that success is more likely when key actors develop and present to all parties involved a clear vision of the project.

Evidence from the present case study reveals that contextual factors exist at different levels, namely, the organizational context in which the project takes place; the project context itself; the work-unit context where the implementation actually takes place; and the characteristics of the technology itself. An in-depth analysis of the implementation context at the start of the project should not only help anticipate and identify the challenges ahead but also determine the degree of risk and uncertainty associated with it. An early assessment of the context becomes even more important when it is realized that each implementation situation is unique, with its own strengths and weaknesses.

Finally, the experience with the EMR system at JMH strongly suggests that key actors' decisions and actions are not all independent of each other and hence their order matters in achieving implementation success. For instance, obtaining human resources allocated to the project was a preliminary and intermediary end goal whose fulfilment procured a temporary state of "rest" in moving toward the envisioned end goal of designing high quality information systems. In phase II, obtaining local and governmental approvals regarding the electronic signature also represented an intermediary end goal whose achievement procured some temporary state of "rest." The implementation effort should be conceived as an *incremental process* where intermediary goals should be fulfilled prior to achieving envisioned end goals. Issues to be dealt with initially often relate to getting sufficient human and financial resources allocated to the project, obtaining external approvals and local executive support, and forming the implementation team. In short, a good implementation plan should therefore not only consider what to look for and think about but also the *priorities among issues and challenges* to be dealt with.

Practical insight #2: **The selection and effectiveness of implementation tactics depends on the background, skills, and beliefs of key people involved in the implementation project**

Evidence from the EMR project shows that the selection of a particular implementation tactic is a *rational process* influenced by the degree to which key actors can recognize the mediating role of each tactic, can conceive of an alternative beyond the selected course of action, and are motivated to action. For instance, the nature of the training program (in-service process) was influenced by the actors' perceptions of what would be most accommodating for the physicians (considering their specific needs and demands) and most effective for the MIS educators (considering the very large number of physicians to be trained). As another example, project management principles were rather informally applied mainly because of key actors' beliefs regarding the overall effectiveness of such practices in system development efforts. Finally, the solution proposed by the DMR in order to get information systems

professionals assigned to the project was a strong indication of her commitment to the project and appeared to her as the only means through which she could get the project under way.

Interestingly, it was found that the effectiveness of a given implementation tactic is likely to be enhanced when *complemented* or supported by key actors' characteristics such as their experience, skills, and credibility. For instance, clinical expertise of key actors largely facilitated the design of the EMR system. As another example, it is clear that the decision to mandate the use of the electronic signature was a necessary condition for ensuring compliance from all physicians. However, as evidenced earlier, it is the project champion's belief that this decision might not have been as effective without the support from each Chief of clinical service.

Evidence also shows that key actors' characteristics might even *compensate* for the non adoption of long prescribed implementation tactics. As reported earlier, the end goal of designing a conceptually and technically sound system was fulfilled despite the limited participation of physicians in the design process. The presence of actors advocating physicians' interests on the team (contextual condition) compensated for the limited participation of physicians and hence ensured the fulfilment of the envisioned end goal. Similarly, the common tasks of keeping the team members on track, keeping people informed of the development, and having the job done on time were not problematic despite a rather informal project management strategy. The non-adoption of formal project management mechanisms was balanced or compensated by the presence of experienced team members who had developed autonomy, independence, and expertise in their work. The lack of formal project management mechanisms only produced negative consequences (errors in transmitted documents) when team members did not have sufficient expertise in data communication.

While previous research has acknowledged the importance of having individuals with specific characteristics involved in an implementation effort ([11]; [26]; [14]; [15]), this study has shown how these characteristics affect both the selection and effectiveness of various implementation tactics employed. This implies that no one set of normative implementation tactics can or should be applied to all projects. Rather, project leaders should ensure that implementation tactics are adopted that complement the experiences, skills, and beliefs brought by each player in the implementation effort.

Practical insight #3: **The context in which an implementation project takes place shapes and guides the implementation process**

The EMR project clearly reveals that the way in which an implementation project unfolds is influenced by the context in which it takes place. Indeed, as evidenced earlier, participation of physicians in the project was kept to the minimum because of past experiences related to the use of that particular strategy at JMH. Prior experiences associated with having physicians on project teams revealed that kind of involvement not to be the most effective strategy, and hence has come to influence key actors' beliefs relative to its potential effects on project success. The creation of "user groups" and the selection of a user representative as project leader are implementation tactics that were established in the early years of systems development at JMH and which gradually became standardized practices (mainly due to their apparent effectiveness). In turn, these established practices directly influence key members' beliefs regarding how systems development projects should be conducted and managed.

In this light, a context-sensitive view of implementation should be adopted. Projects do not take place in a vacuum; the social and organizational context which surrounds an implementation project directly influences the implementation process and outcomes. Consistent with Sviokla's (1992) finding, organizational memories have a major influence on how the implementation process takes shape. Project leaders should be aware that tactics adopted in the past are likely to be applied without an assessment of whether they are appropriate to the situation at hand. Previous organizational experiences will effect perceptions and beliefs concerning the implementation. By adopting a context-sensitive view of implementation, one rejects prescriptions such as "train users," "design high quality systems," or "mandate use of the system" as being too simplistic. Prescriptions must make sense for the context in which they are being applied.

Practical insight #4: **Every implementation project has a life of its own that cannot be perfectly controlled or predicted**

Finally, evidence from the EMR project indicates that the implementation of health information systems is likely to be characterized by a certain indeterminacy. This indeterminacy means that unexpected challenges, such as the data communication problems encountered at JMH, are likely to be encountered. If no effective actions are taken to circumvent such challenges, unanticipated and likely

undesirable consequences might result from the implementation process (e.g., unsolved data communication problems, disruption of medical records operations, team members' dissatisfaction).

Most implementation research has attempted to identify and/or measure factors believed to be relevant to system success (e.g., [13]; [12]; [23]; [18]; [21]; [7]; [6]; [3]). From this research has come a set of contextual conditions (e.g., top management support, adequate resources, experienced personnel, motivated users) and of implementation tactics (e.g., involve users in the implementation process, provide adequate training) which, taken altogether, constitute the "ideal" IT implementation situation. This study highlights the improbability of an organization being able to create such an ideal situation. Rather, project leaders must be prepared to deal with the challenges and problems that results when recommended contextual conditions are missing and recommended implementation tactics are ignored or rejected.

5. CONCLUDING REMARKS

In this research, a case study methodology was adopted to examine the implementation process, use, and consequences of an electronic medical records system at Jackson Memorial Hospital. The ultimate objective of the study was to broaden and strengthen our understanding of health information systems by emphasizing research efforts on the dynamic nature of the implementation process. More specifically, efforts were directed toward opening the "black box" and providing the story that explains how and why contextual conditions and implementation tactics interact and work together to affect project outcomes.

Findings add several new perspectives and practical insights to the existing body of knowledge in the field of medical informatics. First, results reveal that success requires a proactive stance where key actors anticipate the challenges ahead. Consequently, it is recommended that a good implementation plan focus as much on what to look for and think about as on what to do. In other words, before thinking about how to implement a system, it appears important to spend some time analyzing the contextual situation which dictates the issues to be addressed and challenges to be overcome. A second key finding shows that the nature and overall quality of the implementation strategy can be largely predicted by the people involved in the project; given their own background, skills, interest, and level of motivation. It was found that the effectiveness of implementation tactics is likely to be enhanced when complemented or supported by key actors' characteristics and that these traits might even compensate for the non adoption of long prescribed implementation tactics. Third, it appears that health care managers and IT professionals should adopt a project-contingent view of system implementation given the idiosyncratic nature of the process. In this light, key actors should be aware that solutions or strategies do not apply to all projects and that tactics adopted in earlier projects might not adequately suit the situation at hand. Finally, evidence from the EMR project clearly indicates that problems are likely to arise even under the best of circumstances. Implementation managers must learn to be proactive in identifying and solving problems.

Overall, these findings shed some insights on why organizations who attempt to apply normative implementation prescriptions sometimes fail. This study shows that there is no one way to manage the implementation of a computer-based information system; rather, implementation managers must acquire the skill for assessing the implementation context and for using this knowledge to guide the selection and application of effective implementation tactics.

Clearly, additional case studies must be conducted to increase the validity of the findings of this study. Future research efforts should be pursued and directed toward opening the "black box" and providing the story that explains how predictors interact and how and why predictors and outcomes are associated. The theoretical findings would benefit not only from being tested in other organizational contexts and using other information technologies but also to be tested against recent project failures where projects were abandoned at some point or where systems were not used at all

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