Electronic Medical Record Implementation
Barriers Encountered During Implementation

Alan S. Tonnesen, MD, Director Medical Informatics, Hermann Hospital
Anne LeMaistre, MD, Project Executive, Hermann Hospital
David Tucker, Chief Information Officer, Hermann Hospital

Abstract: The authors were intimately involved in choosing and implementing a clinical information system for an integrated medical care delivery system. We will describe our experiences in implementing the first stages of an electronic medical record. We will consider the problems encountered, solutions that were found and continuing areas of sub-optimal performance.

Introduction: A consortium of a major urban teaching hospital, a medical school faculty plan and a primary care physician group embarked on a major project to implement an electronic medical record. We will outline and discuss the real-world issues impacting this implementation and, where possible, our solutions and failures.

1. **Shifting administrative priorities**
   - 1.1. The building and deconstructing of a primary care network. The primary care physician network never achieved financial viability and was not able to contribute to the financial support of the project. The distant locations and the fluid number of offices created large amounts of re-work. Ultimately the network was dismantled.
   - 1.2. The need to change professional billing systems before the new millennium for the medical school faculty. The new billing system created tension related to different philosophies related to scheduling and to the relative importance of collecting good billing information or good clinical information.
   - 1.3. Hospital merger. The hospital had been engaged with several entities interested in merging or purchase. These negotiations became serious about one year after the start of the EMR project. This created an outflow of critical personnel in several areas, particularly the network and PC support group. The ultimate merger brought together widely disparate groups with differing history and agendas.
2. **Software immaturity**
   - 2.1. The level of software development was not as advanced as expected despite extensive pre-negotiation evaluation. This resulted in delayed delivery of software, impairing credibility of the product in the clinician and administrative personnel.
   - 2.2. The level of software documentation was inadequate to allow us to operate independently from the vendor. The absence of clear, current, correct and comprehensive documentation increased our dependence on the vendor and the dependence of the on-site vendor personnel on the engineering division. This was a function of our role as early adopter - development partner.
3. **Software - hardware mismatch (response time)**
   - 3.1. The software was unable to achieve stated performance goals on the stated hardware requirements. Despite the vendor's commitment to response times in the contract, it has proved difficult to achieve these goals and difficult to clearly identify the bottlenecks in performance. The causes are multifactorial and involve the server, the network and the client software.
   - 3.2. Complex queries result in long response time as do queries that involve non-indexed fields. The addition of appropriate indexes is critical. Limits on queries that returned large numbers of results helped.
4. **Resource deployment**
   - 4.1. The need to fully support current systems while implementing a new system created stresses despite expanding the staff for implementation. Although we budgeted for increased staff during implementation, the job market was very competitive, delaying our hiring of skilled personnel. The people supporting the production systems were somewhat threatened by the new system that had significantly different

1091—8280/99/$5.00

skill set requirements. In addition, the design and building of the new system absolutely required the input and expertise of those running the production system.

4.2. Obtaining clinical input for the building was critical, but difficult. Clinicians are busy and despite interest in the development of a system, most were interested only when implementation in their realm of practice was immediately pending. Active user groups of physicians, nurses and other users from the outpatient and inpatient areas were extremely helpful.

4.3. Having been a main-frame-based system, we had to build a PC support group and functions from scratch. Time for deployment, stabilization, and support experience and improvement need to be built into the project plan.

5. Training issues

5.1. Identifying training plans for multiple different groups. Users of the system varied widely in their job descriptions and computer expertise. Within a job classification, there were wide variations in computer skills, ranging from complete novice to advanced users. We attempted to provide training modules that included basic computer knowledge and skills separate from training on use of the application.

5.2. Finding time in a business for training. Although acknowledging the critical role for training in implementing new processes and the use of new technology, it was still very difficult for the managers to find time for personnel to receive training during working hours (to avoid paying overtime) without seriously impacting current operations.

5.3. Marketing training. It proved difficult to accurately identify the current skill levels of the users. Some users overestimated their skills, while others grossly underestimated them. We tried to devise objective tools for identifying skill levels, so that users could be trained in groups that were as homogeneous as possible.

5.4. The need for ongoing training after initial deployment and training. Although we recognized the need for ongoing training after the initial sessions, we under-estimated the need to conduct on-site support and more advanced training for long periods of time.

6. Incomplete data repository

6.1. The paper chart still represents the one place where everything can be found. One of the attractions of an electronic medical record is that it holds the promise of one-stop-shopping for all clinical data. However, during implementation, this is not true. The system will be evolving from paper towards electronic media for several more years. In the outpatient arena, the sources of data are more varied and outside the control of the Information Systems team. Thus, not all results are found in the EMR, leading back to the lowest common denominator, paper. The total conversion is an evolutionary process. We have surpassed the completeness previously available electronically. Similarly, the users have come to expect the most recent information will be in the EMR and not in the paper chart.

7. Physician order entry

7.1. The order entry system was not physician-centric. The order entry system is far too detailed for physician tolerance. It was built for individuals who did not have the medical knowledge to write independent orders on the one hand. Conversely, it required answers to questions that physicians depend upon others to provide.

8. Client-Server related problems

8.1. Client PC software deployment issues. As client application software arrived, it needed to be deployed initially to fewer than one hundred PC's, but this rapidly grew. We were unable to push the software to client PC's necessitating manual installation of each revision and patch, with the inevitable result that machines were missed, generating errors and user frustration.

8.2. Client PC user-related instability. We clearly recognized the need to stabilize the client PC so that the PC presented a uniform desktop to the user. Windows 95 did not allow sufficient lock out capabilities for our sophisticated users. Although Windows 95 was more cost effective to deploy (hardware costs/license) the cost of support was

higher making over all cost much greater. NT had a greater intial support cost but it stability and ability o lock down the desktop made its overall cost better.

8.3. PC support was critical in ambulatory care. If a PC goes down in an exam room, then the room is out of commission. We resolved this issue by local hot swapping of PCs.

9. **Help Desk and support issues**
   9.1. The users did not perceive that the help desk was helpful. This was not specific to the new project, but the new load magnified the ongoing problems.
   9.2. Weaknesses in training magnified the load on the help desk and could overwhelm it quickly. At this point users quit calling. A distributed Poweruser support system to help identify and resolve problems seems more useful.
   9.3. Clinical users do not complain or use the help desk. They find another way to access data or record it. Only if the phone call is answered immediately AND results in rapid resolution of the problem, do they call again. The result is a false sense of success. The number small number of calls to the help desk seemed to reflect the users belief that they could not be helped rather than reflect the success of the software.
   9.4. Visits to the clinical areas with direct observation of users is critical to detecting problems.

10. **Feedback from Information Systems to managers**
    10.1. The importance of providing new information to administrators and managers. A strong selling point for the system, was the ability to look at information that was previously extremely difficult to obtain. The major new strength was the ability to examine clinical data, in contrast to the current ability to examine financial-related data. The initial efforts were all directed at providing the clinicians with the patient-centric data required for their efforts. This left the administrators feeling that the system was not providing value to the business.

11. **Security**
    11.1. Users and administrators were universally concerned about data loss. A solid plan to prevent such loss was an integral part of the system. In fact, the data loss electronically has been nil, while the inability to find paper-based data continues to be a major problem. A cluster of mirrored servers with failover was built in addition to the typical system of magnetic media back up.
    11.2. Privacy concerns are paramount yet there is no reliable way to predict who might have legitimate need to access information. After the security model had been designed and built, hospital adminstration had external consultants evaluate overall electronic systems security. The consultants entered the process late and it took substantial time to explain the processes. They also did not have a realistic view of the need for flexibility in a complex medical care environment. Had they been included much earlier, some delay would have been avoided. The resolution was to include substantial emphasis on the confidential nature of medical records and to demonstrate that the act of opening a patient's electronic chart was permanently recorded immediately. We wrote queries to monitor access of VIP charts and plan additional monitoring as use patterns stabilize.

Acknowledgements. Terry Satterwhite, MD, Medical Director, Hermann Hospital, who recognized the need for deep and meaningful involvement of information systems in an integrated medical care system. The Board of Directors and administration of the hospital for their support and patience. The information systems staff who did all the work.