11A
Introducing Physician Order Entry at a Major Academic Medical Center: Impact on Organizational Culture and Behavior

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Introduction

In 1988 the University of Virginia Medical Center began implementation of a medical information system based on mandatory physician order entry. The implementation process was much more difficult than expected. The program experienced considerable delays, and cost much more than was originally estimated. Although there were some legitimate questions concerning the user-friendliness of the new technology, these were less significant than the cultural and behavioral problems encountered. The new system challenged basic institutional assumptions; it disturbed traditional patterns of conduct and forced people to modify established practice routines. Real progress toward the integration of the system into the center's operational culture occurred only after a senior management team representing important sectors of the hospital staff and administration began meeting regularly to address the institution-wide issues that had been raised. The chapter describes the problems that occurred and the organizational behaviors on which they were based, analyzes the lessons learned, documents the progress that has been achieved, and outlines the challenges that remain. The center's experience provides insight into the issue of technology-driven organizational transformation in academic medical centers. Recommendations for successful introduction of similar agents of institutional change are presented (Academic Medicine 68 (1993) 20–25).

Increasingly, information technology (IT) is being used to manage the logistical organization that supports healthcare delivery operations. Linking physicians to the IT infrastructure is a major challenge [1]. Physician-order-entry systems establish that linkage by requiring doctors to place orders (for all clinical services including lab tests, x-rays, medications, and nursing interventions) directly into the computer without the assistance of nurses, clerks, or other support personnel. This technology provides an appealing option for many academic medical centers. Under severe cost pressures,

they anticipate that having residents online will allow patient care to be delivered more efficiently and will provide one of the operational and strategic innovations that centers need to survive in the present competitive healthcare environment.

There is precedent for this belief. In the retail industry, capturing customer and product information at the "point of sale" has created competitive advantages for numerous firms in different marketplaces [4]. By inference, clinically important information can be generated by the physicians closest to the "point of care" [5]. But, in contradistinction to the retail sector, which can assign relatively inexperienced employees to data-entry positions, the healthcare sector places the most highly trained professional personnel with the greatest opportunity cost in the data-entry role. (Opportunity cost is the value of the activities that must be forgone when one option is chosen over another.) Accordingly, the acceptability of an IT system to physicians is important in any clinical setting but crucial in large teaching hospitals, where balancing education and efficiency is a constant challenge.

This chapter describes what happened when an IT system that mandated order entry by the physician was introduced into the operational environment at one major academic center, outlining some of the behavioral and cultural transformations that occurred, discussing them in the context of technology innovation in the contemporary teaching hospital environment, and drawing several conclusions regarding the management of change in that setting.

Background

The University of Virginia (UVA) Medical Center is a fully accredited 700-bed tertiary referral hospital and is the primary training facility for over 1000 residents and medical students. In 1981, a management consultant firm recommended major IT expansion, including a financial and accounting system and a medical information system (MIS). In recommending the MIS, the consultants projected cost savings of $26.3 million over five years with a payback period of less than two years.

The accounting programs were installed first, with little apparent difficulty and great success. (As an indication of the effectiveness of this effort, accounts receivable were reduced from more than 100 days at the onset to less than 60 days after implementation.)

The MIS installation began in 1985. The basic administrative functions (such as admission, discharge, and transfer) were introduced over the next two years, with no discernable impact on clinical practice. Between 1988 and 1991, clinical functions were added sequentially. The first phase placed dietary and radiology orders on line. Laboratory ordering and results retrieval were provided next. Pharmacy pathways came later, and major

ancillaries and nursing procedure orders were introduced in the final phase. In late 1992, over 550 terminals were being deployed in three inpatient locations and in numerous outpatient clinics. More than 3600 nurses, 1200 residents, 800 medical students, and 200 attending physicians had been trained to use the system. Virtually all physician orders were captured, all lab results were obtained, and most radiologists' impressions were retrievable through the MIS.

Although these numbers indicate a significant commitment on the part of the medical center, implementation was much more difficult than expected. The program was three years behind schedule and cost nearly three times the original estimates. The project provoked a major confrontation between the medical staff and the hospital administration. Real progress toward integration of the MIS into the center's operational culture occurred only after the Computer and Information Sciences Executive Committee (CISEC) was created and began to meet weekly so that its members could address the problems. This senior management team included the chairs of three major clinical departments (medicine, surgery, and pediatrics), the executive director of the medical center, the director of nursing, the chief information officer, and the senior associate vice president of the UVA Health Sciences Center.

Analysis

At least four factors contributed to the widespread organizational stress that accompanied the implementation program: the alteration of established workflow patterns and practices; the strict, literal interpretation of rules by the computer (or conversely, an inability of the IT system to identify intent); the ambiguity of governance policies; and the lack of a clear understanding within the physician community of the long-term strategic value of the MIS initiative. The concerns relating specifically to housestaff and medical students' education are discussed separately in a companion article [6].

Questions regarding the quality and user-friendliness of the center's new technology were raised throughout this process. Some of these concerns were quite appropriate and remain valid today. In retrospect, however, the technology issues almost always were used as surrogates for other agenda items related to the challenging of basic institutional assumptions and beliefs. From the organizational perspective, the details of the technology were probably overshadowed by the cultural and behavioral issues, which will continue to be significant even when improved technology is available. Thus, the UVA experience provides insight into the issue of technology-driven organizational change in academic medical centers and is generalizable to other teaching facilities that may be considering similar initiatives.

Work Dynamics

The MIS altered traditional workflow patterns and changed the way the center's professional groups related to each other. Prior to the MIS, an order was written in the chart on the patent's unit. The charge nurse "signed off" on the request, communicated it to the bedside nurse, and assumed responsibility for the unit clerk's delivery of a "hard copy" to the pharmacy. If the order was clear, the pharmacy staff completed the order. If any part of it was unclear, direct contact with the ordering physician was necessary, usually by paging the physician and obtaining clarification by phone. This process changed once the MIS was established. Now, orders are placed by physicians from anywhere in the hospital. No direct communication with other caregivers is required; the bedside nurse is notified of the order from a computer-generated acknowledgement printout generated at each nursing station. Legibility is no longer an issue, and dosage schedules, generally selected from the screen options are less of a problem.

Early in the implementation process a multidisciplinary review committee of practicing clinicians was established to discuss the effect of the MIS on hospital practices. Although in principle this committee was to develop procedures for the MIS, in practice, it was frequently used to enforce policies that had been previously approved but had not been fully implemented. The residents, who were most affected by these policies, often reacted defensively and directed their anger at the MIS and not at the service that initiated the change. They opposed using the MIS for enforcing or policing any behaviors that had not been part of their practice patterns prior to the implementation of the MIS. The CISEC eventually assumed the responsibility for settling these conflicts very late in the implementation process, but only after they had become a source of significant frustration to the residents and other clinical staff.

The attitudes toward the MIS varied across professional groups in proportion to the levels of positive impact on their daily work activities. A survey instrument was designed to quantify those differences. Almost 1500 clinicians completed the survey in 1991, and the results were highly consistent within each group (see Figure 11A.1). The members of each of the three major professional groups (resident physicians, nurses, and pharmacists) tended to assume that their perceptions of the impact of the MIS were similar to the perceptions of the other groups' members. The physicians believed that many clerical functions had been transferred to them from the nurses. Unit secretaries and other nursing personnel were out of the ordering loop. The assistance they had previously provided was no longer available. As a result, housestaff uniformly had a negative view of the MIS and thought that its impact on others was negative as well. Pharmacists, relieved from the tyranny of illegible, incomplete handwritten orders, saw only positive consequences for themselves and for the others. Nurses and respiratory therapists, who gained some independence from the physicians

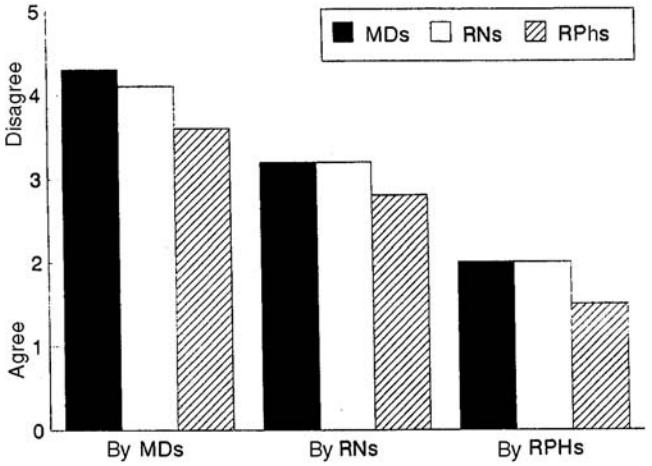

Figure 11A.1. Three professional groups' perceptions in 1991 of how a medical information system (MIS) enhanced their jobs. Nurses, residents, and pharmacists at the University of Virginia Medical Center were asked to rate how much they thought the MIS had enhanced their jobs and the jobs of the other two groups, using a scale of 1 (strongly agree that it had enhanced the job) to 5 (strongly disagree). Differences in responses across groups are significant ($p < .01$ for all cases).

in the ordering process but also assumed additional computer charting requirements, were much more ambivalent about the system. These mixed results are consistent with those reported in previous studies [7–9]. Details of the survey are available elsewhere [10].

Literal Enforcement

Much of what professionals do is based on mutually understood, often unexpressed intent. Protocols and guidelines exist, but rules are not necessarily ends in themselves. Computers are far more rigid. There is no "spirit of the law" subroutine in the MIS systems. Rules are rules; no deviation from a literal interpretation of them is allowed.

As an example, this structural rigidity led to problems with "unsigned verbal orders." Verbal orders had always occurred in certain situations, such as in emergencies or phone communications. Before the MIS, a flag was raised on the patient's chart, indicating that a verbal order had to be cosigned. There were probably instances when these reminders were overlooked, but no one specifically looked for them, and certainly no one had any sense of their volume.

The MIS changed that. Every order placed as a verbal order in the name of a physician by another authorized caregiver (such as a nurse or therapist) was recorded and counted. There was an impression that more verbal

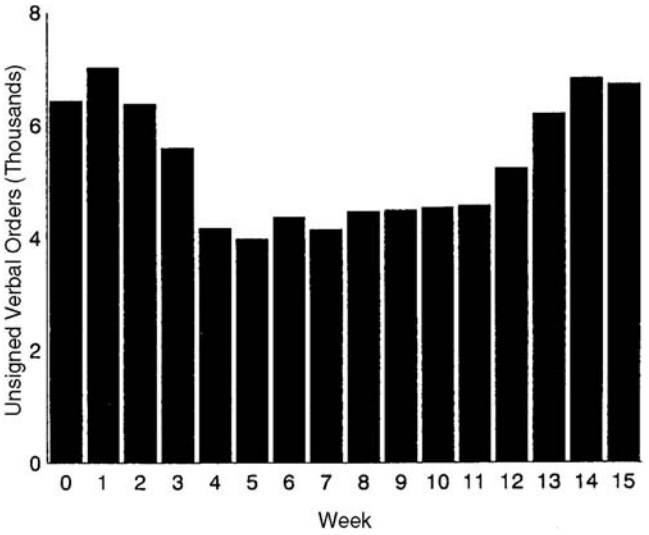

Figure 11A.2. Impact of mandatory review at the University of Virginia Medical Center on the number of unsigned verbal orders during a 15-week period in 1988. Weeks 4–10 represent the trial period. The number of unsigned verbal orders in the trial period was significantly different ($p < .01$) from the number before (in weeks 1 and 2) or after (in weeks 13–15).

orders were being generated, especially in emergency situations, because of the time and effort required to place an order on the MIS. Although it was impossible to confirm whether more were generated, it was certainly easy to see that more were being counted. Figure 11A.2 shows the numbers of unsigned verbal orders recorded by the system before and after a system change (introduced in week 3 as shown in the figure) that required that all unsigned orders be removed before new orders could be entered. The reduction in unsigned orders fell significantly, but did not fall to zero. (The residual orders probably reflect those patient records awaiting dictation and order sign-off after discharge.) Although everyone understood the accountability and potential financial difficulties created by having that number of unsigned orders in the chart, the mandatory signature process proved to be sufficiently unpopular with the residents that a non–computer-based solution to the problem was finally instituted in the twelfth week by the medical staff, and the mandatory requirement was eliminated.

An additional letter-versus-spirit example revolved around "acting interns," that is, fourth-year medical students who often functioned as junior house officers on specific rotations. While supervision was closer than for regular interns, and cosigning of orders was required, acting interns had more latitude in decision making and patient interaction than did third-year students. The MIS made no such distinctions. The fourth-year students do

not have an MD degree; therefore they have no ability to enter orders independently or have them cosigned after the fact. This literal interpretation of the rules made the rotations far less attractive to students. A number of creative attempts were made to circumvent this apparent rigidity, but none was successful.

Governance

Alderfer describes an "underbounded system" as an organization where the lines of authority are not well drawn and where the decision-making process is ill-defined [11]. Hanlon applied this concept to teaching hospitals [12]. He suggests that in these large complex organizations there are few firm guidelines regarding the boundaries of administrative and medical control; there is considerable uncertainty about who establishes patient care policies at the institutional level. In such an environment individuals at all levels are unsure about limits or priorities in their roles. This hinders their capacity for systematic planning and contributes to a pattern of short-term focus and crisis management. Also, because patient care activities tend to be highly decentralized, personnel tend to focus on local (unit and department) problems. As a result, it can be difficult to harness the human resources necessary to coordinate and manage a broad institutional initiative. While the management control systems at the UVA center probably do not differ appreciably from those in many other teaching hospitals, they did have many of the characteristics of the underbounded system. This led at least initially to considerable uncertainty in responsibility and authority in dealing with the MIS challenge.

Organizational ambiguity is particularly troublesome when conflicts must be resolved, that is, compromises based on consensus are not easily achieved. In implementing the MIS, the UVA center demonstrated many of the characteristics of an underbounded system; it was virtually impossible to deal with many of the major MIS controversies until the questions of ambiguity in governance practices were addressed.

Broad operational systems such as the MIS tend to cut across functional lines. Integration of cross-functional processes is not easy under the best of circumstances; it is particularly difficult in the traditional department-based functional organization of an academic medical center that has poorly defined governance traditions. In other industries, project management teams are often created to oversee complex cross-functional initiatives, and project managers are generally given the authority to make the necessary decisions. But the delegation of authority to project management is not common in the underbounded academic environment.

At the UVA, the MIS project team was unable to accomplish the project management function. Drawn from within the computing services group, they provided the needed services, but had absolutely no decision-making authority. They clearly owned the problem, but it was far less clear who

owned the solution. Eventually the CISEC team assumed ownership of the entire process, but only after the situation had reached crisis level.

One of the continual dilemmas in an underbounded system is determining who speaks for whom. At the UVA, this was especially true for housestaff involvement in MIS decisions. Although residents are nominally employees of the hospital, each relates almost exclusively to the clinical department in which he or she is being trained. The linkages between residents in different departments were very tenuous. In fact, during this process of adjustment to the MIS it became clear that even though there was a central hospital mailbox assigned to each resident, these boxes were checked very infrequently; there was no effective way to communicate directly to the entire community of residents except through their clinical departments. One of the clear and positive tangential results of the MIS has been the establishment of a chief residents' coordinating council, which now meets and exchanges information across residents' teams. This council has provided some elements of continuity and a longer-term horizon to the residents, who originally, and quite appropriately, were oriented to their clinical departments and focused on the short-term aspects of their work.

Short- versus Long-Term Horizons

It is far easiert to deal with short-term difficulties if the long-term benefits are well understood. While the "enabling" benefits of an online physician system (such as decision support, the electronic medical record, automatic capture of quality improvement, and financial performance data) were appreciated by the leadership of the medical center, these benefits were neither perceived nor valued by the attending physician community as a whole. Residents, realistically and appropriately, were concerned with issues of day-to-day survival. Presumably, attending physicians have a greater interest in the long-term future of the institution, but during the implementation they were unprepared or unable to provide incentives or rationalizations for the process or to defend the ultimately beneficial effects of the MIS.

Discussion

In the business world, it is widely appreciated that the introduction of a major new technology can be a destabilizing event [13], but this fact has gone largely unnoticed in medicine, where new technologies are introduced almost daily. Most medical technologies, however, are introduced as part of a natural evolutionary process. They are managed and controlled by a limited number of people who understand them and provide oversight for their use. But the MIS was different in that it required fundamental changes in the ways many individuals worked and, at times, in the ways they perceived themselves.

From an organizational perspective, the projects that tend to be most destabilizing tend to be those that are most "invasive," that is, those that challenge assumptions and routine behaviors. Thus, the invasiveness of a technology relates to how much change in the institution's culture will be demanded by its introduction. The vigor of the response to this invasion can be viewed as a homeostatic reflex to the disturbance introduced by a major cultural challenge. The MIS forced the center's physicians to modify their behaviors in ways they disliked. It was viewed as an administrative initiative, imposed from the "outside" with no real sponsorship in the medical community. All the energies that they normally would direct toward a hostile outside threat were directed at the MIS.

By any criterion, the cost of implementing the MIS, in terms of organizational invasion and resources, was far greater than anticipated. At the same time, the savings have never approached those projected by the original consultants. Pharmacy service has become more efficient, documented ordering errors have been drastically reduced, and the ability to identify reduced, and the ability to identify and capture costs has been enhanced. However, actual personnel reductions, in many ways the raison d'etre for the system at the onset, are not readily identified. Nursing personnel have increased by 30% during this period for a number of reasons, including expansion of services and significant increases in severity of illness, none of which are related to the use of the MIS. Perhaps the personnel growth would have been greater had the MIS not been installed, but the fact remains that five years into the program it is impossible to document even one position that was eliminated as a direct result of the MIS.

Conclusions

The implementation phase of the MIS at the UVA center has concluded with a new equilibrium in place. The organizational accommodations and changes were far greater than expected. In the process of change, we came to understand several things that are relevant to others considering similar initiatives.

First, we learned that information technologies of the scope and invasiveness of an MIS are not culturally neutral. The system was viewed by many as a threat to the values of the organization, and their responses to this cultural assault were predictable. Responses of this magnitude should be anticipated, and they must be managed. The implications of the changes should be explained to those most directly affected, and key personnel should be introduced to the anticipated long-term benefits. Initiatives of this magnitude cannot be managed on a part-time basis using personnel who volunteer time from an already busy schedule. The institution must be prepared to invest resources—both human and financial—that are appropriate to the magnitude of the task, and must be prepared to support those individuals it chooses for this management role. Of course, others have

learned similar lessons in many different settings, but we were desensitized to the potential challenge by our success with financial software and our positive experiences with the introduction of clinical technology into the practice environment.

Second, we learned that information technology alone cannot fix problems that it did not create, but that such technology can accentuate existing problems by diverting attention from the root causes and fundamental issues involved. The communication difficulties and governance questions that were identified demanded the attention of the leadership of the institution before the technology could function appropriately. Had these challenges been foreseen and dealt with earlier, the implementation process might have been much less traumatic.

Third, we learned that cross-functional innovation in an institution structured along functional lines requires active and constant support from the top management team. Solomon-like decisions do not come easily at any level, but they appear to be more successful when delivered from individuals in positions well above the fray.

Fourth, we clearly did not generate the operational savings we anticipated. Instead, we adopted an imperfect technology base that has forced us to look at our clinical practices in a different way, and we do things differently because of it. With the experience we have gained, we are better able to understand the technology and ultimately to enhance the care we provide with it.

Finally, we may have gained a strategic and competitive advantage for the future by being forced to deal with issues of institutional change. Although the driving force for this particular crisis was internally generated, numerous other forces demanding change are present for all academic medical centers in the external environment, and our experience may have contributed to our ability to deal more effectively with these others in the future.

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