11B
Introducing Physician Order Entry at a Major Academic Medical Center: Impact on Medical Education

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Introduction

The introduction of an information technology (IT) system that mandates order entry by physicians had significant and often unexpected effects on medical education at the University of Virginia Medical Center. The system was deactivated briefly after the introduction of laboratory ordering, and frustration with the pharmacy ordering pathways provoked a major confrontation between the residents and medical center management. With time and experience, however, the housestaff have adjusted to the system and developed facility in using it. Much of the dissatisfaction was derived from the perception that "doctors spend too much time on the computer." In fact, less than 10% of the physicians spent more than an hour each day. However, a small group of residents on call for the busier services were sometimes at the computer for more than four hours each day. Changes in responsibilities, patterns, and priorities of work introduced by the system also contributed significantly to the general dissatisfaction. These issues had not been thoroughly considered in the planning stage, but it was only after accommodation was made to these changes that integration of the technology into routine practice could proceed. The chapter emphasizes the importance of extensive involvement and leadership of attending physicians in the planning and implementation of such a system. It presents a set of recommendations to those considering similar IT initiatives and wishing to reduce the disruptions that may accompany their introduction (Academic Medicine 68 (1993) 25–30).

Considerable attention has been focussed on the application of information technology (IT) to medical education [1–3]. Far less attention, however, has been paid to the influence of IT packages introduced into the patient care environment for administrative purposes, even though these can have broad and sometimes unsuspected influences on teaching activities. Since large IT packages represent major institutional investments and are often custom-configured during the procurement process, it is important that

medical educators understand the potential tension that can arise between the requirements of an IT system and a school's educational mission, and participate fully in decisions regarding selection and implementation of these systems.

This chapter describes the introduction into a major teaching hospital of a system mandating order entry by physicians, outlines the difficulties that occurred, discusses the consequences for residents and medical students, and offers a set of organizational recommendations for the successful implementation of such a system in an educational setting.

Background

The University of Virginia (UVA) Medical Center serves as the primary training facility for the 560 medical students and over 500 residents of the UVA Medical School. In 1982, the hospital's executive board (primarily the chairs of the various clinical departments) approved a recommendation to proceed with a medical information system (MIS) featuring mandatory physician order entry. A cost savings of $26.3 million over five years was projected from time-and-motion studies of the activities of nurses and allied care providers. Unfortunately, a corresponding calculation of *additional* physician time was not included in that analysis, but this discrepancy was not appreciated until the selection process was reviewed several years later.

A physicians' advisory board was established to oversee the implementation process in 1984. This group, which included representatives of the housestaff, met regularly under two different chairs and involved a constantly changing membership for several years in the processes of reviewing and approving screen designs, ordering pathways, and operating protocols.

Early in 1988, the first hospital-wide implementation that involved physicians—enabling them to use the computer to give orders for dietary and radiology procedures—was initiated with little difficulty. Later that year, the system was expanded so that orders could be given and results retrieved for laboratory functions also. The initial responses of the housestaff were negative, and these functions were deactivated almost immediately by the center's administration. Computing services personnel worked closely with the housestaff to accommodate their concerns, and the system was reactivated after a three-week downtime.

In July 1989, pharmacy-order communication was implemented, with much stronger opposition from the housestaff. Residents appealed to their chairs and/or program directors, and medical students petitioned the dean for relief from the restrictions imposed on them by the system. In contradistinction to the deactivation of 1988, however, the system remained operational while these problems were discussed. Dissatisfaction peaked in June 1990, when a work action was initiated by a group of the most frus-

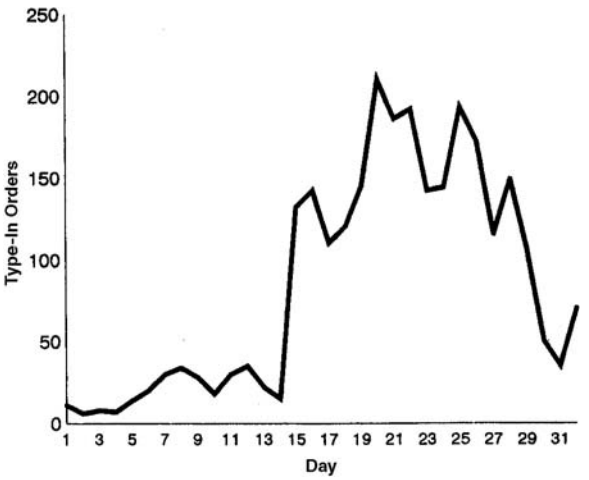

Figure 11B.1. Volume of typed-in pharmacy orders (during a residents' 1990 work action at the University of Virginia Medical Center) to avoid placing orders electronically. Type-in orders are far more labor-intensive for the pharmacy staff to fill than are the electronically generated requests.

trated residents. The electronically processed pharmacy-order pathways were bypassed and an optional type-in mode was chosen. (Type-in orders required considerably more processing time in the pharmacy and placed extraordinary demands on the pharmacists, who were throughout very active and enthusiastic supporters of the MIS.) During the peak of the type-in demonstration, 250 orders were generated in the type-in mode, compared with a baseline of no more than 10 to 20 (see Figure IIB.1).

Later that month, in a confrontational open meeting called to discuss the type-in action, many physicians reiterated their displeasure with the system and demanded it be shut down. Senior members of the medical administration stressed the system's strategic importance and reaffirmed their decision to keep it operational. At the time, it was unclear whether additional work actions would be attempted. As it turned out, this public demonstration of frustration and anger, with the countering statement of resolve by management, was the apogee of the resistance to the system. After this meeting, type-ins were discontinued and residents resumed normal ordering procedures. A few days later, the new class of housestaff arrived and were oriented to the system with few difficulties.

In July, a fax-based alternative to physician entry of medication orders was introduced as a pilot on three patient care units [4–6]. Copies of handwritten routine orders were transmitted directly to the pharmacy, where they were entered into the MIS by pharmacy personnel. The fax option initially captured 22% of the orders processed on the pilot floor, but after three months of operation the proportion was down to 2–3%.

Perhaps the most effective innovation during this time was the introduction of departmental and personal order sets (POSs), which allow groups of frequently associated orders to be bundled together for speed and efficiency. Department order sets are developed and utilized by the appropriate service and are maintained by computing services. Personal order sets allow each physician to generate customized groupings of his or her own personal orders on an ad hoc basis.

The academic year 1990–91 passed with no major incidents and by July 1991 the attitude toward the MIS had changed appreciably. New residents were oriented with the help of experienced senior residents and immediately accepted the MIS as part of the practice environment. They quickly developed POSs and acquired facility in using the system to do so. By June 1992, 273 residents had generated 2684 POSs, and a resident-led oversight committee reviewed the POS files and reduced the total to 545 with no problem from their peers [7].

Analysis

From the beginning, almost without exception, the residents complained that they spent too much time "on the computer." In fact, usage data generated during the most difficult period indicated that fewer than 10% of the physicians spent more than 60 minutes during a 24-hour day. It was clear, however, that a small number of residents spent much longer intervals at the terminals. It was equally clear that "excessive" time is much more a function of rotation and/or rotation design than anything else. On those rotations where the junior residents were responsible for entering the majority of orders, terminal times were very high. Figures IIB.2 and IIB.3 show characteristics of usage patterns and breakdowns of efforts. The major impact of the system was clearly on first-year residents. The repeating patterns of long periods of time spent at computer terminals corresponded almost perfectly with the interns' call schedules on specific rotations and services.

The usage pattern of two general surgery interns (Figure IIB.4) is a dramatic but not isolated demonstration of that high-usage phenomenon. Unfortunately, this pattern continues to the present for most of the residents. Figure IIB.4 gives the terminal time data for the new residents' turnover period in June 1991. The number of residents spending over two hours on the MIS increased significantly after June 23, the first day of service for new housestaff.

Medical students were also affected. They received MIS training and passwords, but their pharmacy and laboratory orders were "suspended," to be activated only by the intervention of a licensed physician. While this was not in principle different from pre-MIS procedure, in practice it had several significant ramifications that, in the eyes of the students, reduced the teaching they received on the floors.

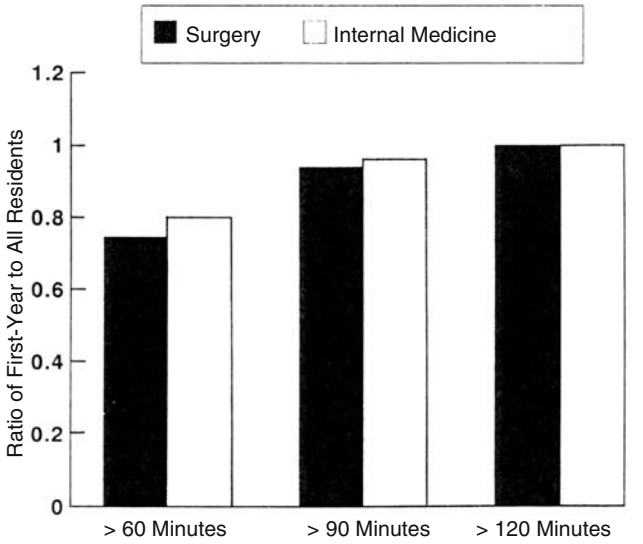

Figure 11B.2. Characteristic amount of use of a medical information service by residents in two specialties at the University of Virginia Medical Center, expressed as ratios of first-year residents' use to all residents' use for three lengths of time. The first-year students use the system much more than do the other residents.

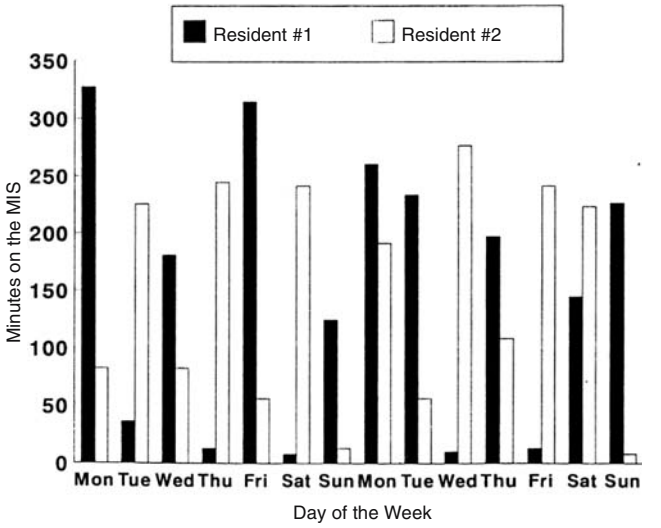

Figure 11B.3. Influence of call schedule on the use of the medical information system by residents at the University of Virginia Medical Center in 1990. The figure indicates how two general surgery residents used the system on an every-other-night call rotation over a two-week period.

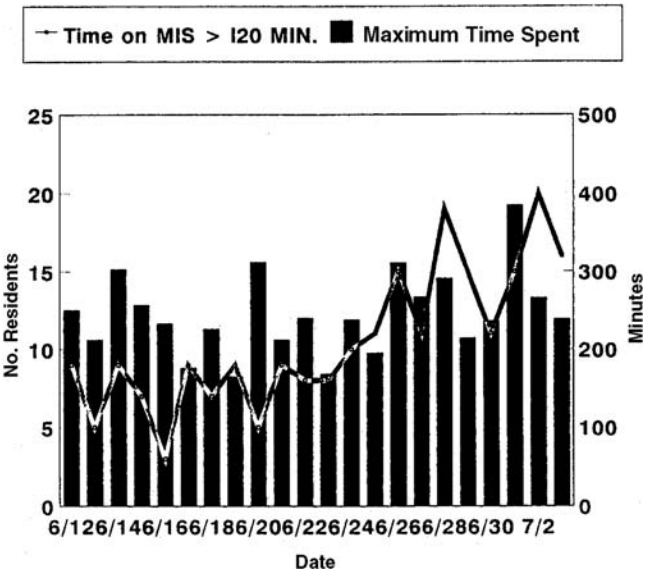

Figure 11B.4. Graph showing how use of the University of Virginia Medical Center's medical information system increases as new residents enter service. The bars represent maximum time the residents use the system each day. The graph line indicates the number of residents who are using the system for more than two hours.

A common complaint was that the suspend mode of the MIS system took them out of the ordering loop. Before the MIS system was used, medical students prepared the treatment plans and wrote the orders, which were then cosigned by the resident following a discussion of the plan. With the MIS, it was far less efficient for the resident to go over the suspended orders proposed by the student (which were at various levels in different pathways throughout the system) than it had been to go over handwritten orders on a single sheet. A simple modification could become a time-consuming operation. Thus, the ability of the medical student to help (i.e., save time for) the resident was compromised. In the end, the resident had less time available. As a result, some of the opportunities for teaching, provided on a quid-pro-quo basis for the time saved by the student, were lost.

Another important relationship that was disrupted by the MIS was that between the attending physician and the residents and/or students on the physician's service, Clinical training is in large part based on role-modeling and example-giving, journeyman to apprentice. The MIS turned that upside down. With a few exceptions, attending physicians generally do not place orders themselves and, therefore, do not routinely become adept at doing so. As a result, they could offer no guidance to their trainees. Thus, the residents were faced with a substantive practice problem in which they had more experience than their mentors. The frustration of faculty unable to offer appropriate guidance to trainees was directed at the MIS and to the

administrators who had implemented it. This led to a further isolation of the MIS operation. The MIS became even more the administrators' system—"their" problem—and "they" had to fix it.

Technically, the MIS operation functions well; 99.99% of all physician-initiated transactions are processed in much less than one second. The system is off-line for approximately 20 minutes per day between 3:00 AM and 4:00 AM to allow for data to be downloaded to storage. Unscheduled downtime for 1990 and 1991 was less than 12 hours per year, which is really quite impressive for a system of that size.

But physicians entering large amounts of data in the form of orders expect more than data-processing excellence. They want the system to be simple and effortless. In the jargon, they want user-friendliness, that is, easy and flexible conformability to individual practice patterns and styles. Over 95% of our medical students had familiarity with personal computers and expected similar ease of use from the mainframe-based MIS system. One of the perceptions that hindered the early acceptance of the MIS was that there were much friendlier systems "out there" and that "they" had purchased the "wrong one." Only after several attending physicians became knowledgeable about the industry—long after the problems with pharmacy-order entry erupted—and reported that, at least at that time, there was no commercially available system that offered substantially greater flexibility and friendliness did this issue subside.

In reality, the modeling of physician behaviors is not straightforward. Osheroff and colleagues have reported on inquiries of internal medicine residents on rounds [8], but there are major differences in information needs and uses across specialties and levels of training. The first and perhaps second generation of MISs have been developed primarily for administrative functionality without significant involvement of physicians. Perhaps one of the most significant benefits of the MIS to UVA is that we now have several hundred physicians prepared to enter into a dialogue about how physician-friendly IT should be configured.

Discussion

The issue of time is real for the residents, especially for those few individuals on the high-volume services. By almost any criteria, the times recorded in Figures IIB.2, IIB.3, and IIB.4 are excessive. And they are probably an underestimation of the time an on-call resident spends, since they are based on a 24-hour calendar day and not the morning-to-morning schedule of the typical call rotation.

Absolute comparisons, however, are difficult. Unfortunately, there are no good data to indicate how much time a busy resident on a traditional non-computerized service spends writing orders in a chart or phoning the lab for a blood gas result. There is certainly no cataloging of the time lost

searching for misplaced records or having to take the elevator from the operating room to the intensive care unit to write admission orders. As pressures build to reduce the time demands on housestaff, an understanding of the time costs of various components of their workload would be very useful information. It would also make possible comparisons of before-and-after changes as "invasive" technologies are introduced.

Although, in principle, there were potential practice options that could have relieved the major impact on the few vulnerable interns (e.g., redistribute assignments, modify coverage, and similar measures), these alternatives were never realistically considered. Organizations tend to resist change and to confine the change to as limited an area as possible. The universal consensus was to attempt to find IT answers to IT questions. Departmental and personal order sets were successful because they were seen as computer-based solutions to computer-generated problems. Restructuring residents' work assignments would have meant adopting a non-IT response to an IT challenge. That went too far in extending the potential option-set into areas that were outside the acceptable range, that is, that were not directly related to the computer system.

In our setting, the MIS required physicians to behave differently. The MIS 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 at a hostile outside threat were directed at rected at the MIS.

The MIS-imposed changes were perceived by the physicians as a loss. They responded in ways consistent with Elisabeth Kübler-Ross's stages of grieving and accommodation to misfortune [9]. Their initial reaction prior to and during the initial phase of implementation was one of almost complete denial: "This isn't going to happen to us." Although the process of order entry had been described to the physician community, neither the attending physicians nor the resident staff acknowledged the changes that the MIS required. Their anger was unmistakable—a clear and protracted phase: "How could you do this to us?" The anger ultimately led to bargaining, as "both sides" began to understand the other's predicament and to maneuver for position and control. As the irreversibility of the implementation became clearer (i.e., after the June 1990 confrontation), the residents became disenchanted and depressed. Some of that lingers, but overall this appears to have been a necessary prodrome to the ultimate accommodation and acceptance that have occurred recently. Although today's MIS is technically very similar to that first implemented three years earlier, it has been integrated into the practice environment of the hospital and is no longer a source of great controversy for the medical community. The change, accompanied by a sense of loss to those most involved, has been accommodated and a new equilibrium has been established.

Clearly, one of the major dissatisfiers with the time spent was that it represented effort in "non–physician-related" activities, especially regarding

the order-entry functions. (Technically, these systems are known as order-entry and results-retrieval systems.) But physicians understand the need for data in making clinical decisions. As a result, the retrieval process was less of an issue. Most of the debate centered on the ordering component, but there are no physician role models for "point-of-care" order entry. Residents were forced to absorb duties previously performed by clerical staff, and they resented it. The order of priorities, the pecking order, had been changed. Physicians and physicians-in-training no longer had the positions of primacy in the healthcare information process. With time, the harshness of these initial interpretations appears to have softened. The general outlines of the restructuring are now accepted and have become the basis for the current operating procedures on the various units.

Conclusions and Recommendations

In retrospect, the lack of broad and committed attending physician involvement and direction prior to implementation was the biggest single source of problems for the housestaff. Although both residents and attending physicians were involved in the advisory committee, this group functioned like any other hospital advisory committee, supporting a general overview and providing a forum for discussion of procedural issues. But no one in the group really understood the magnitude of the behavioral changes that would be required or the time that would be demanded of the few unfortunate residents on the high-volume services. It was unreasonable to expect the housestaff to anticipate the problems for themselves or to have the institutional acumen to coordinate the necessary compromises and solutions. Residents are relative short-termers in the hospital setting; their input and insight are valuable, but should be used to supplement, not supplant, involvement for long-term faculty. Thus, our first recommendation is to develop a group of clinically respected internal advocates within the attending physician population who know the system and are aware of the associated requirements.

It is not obvious how that level of involvement could have been generated at UVA. The clinical chairs who formally approved the package were told that it would require physicians to interact closely with the computer at the time of the procurement decision, but they had no idea of the scope of this interaction. Most of them had spent time with the consultants prior to the procurement phase and had discussed the future opportunities that computers offered to medicine in general and their specialties in particular. They had received no return visit describing the practical limitations of the available options under consideration. The second recommendation, therefore, is to undersell the proposed system, keep under control everyone's expectations of it, and solicit support for the short-term implementation effort and long-term success of the endeavor.

Had our chairs understood the effort involved, they might have committed the faculty time necessary to develop the skills required and, had the faculty time been so committed, we might have looked more closely at the practice behaviors we were about to instigate. Ideally, this might have prevented some of the excesses seen in the time required for implementation. Even if these practice behaviors had not been modified in advance, we would have at the least understood the precomputer situation better. As a result, we would have been able to more effectively distinguish the problems residing in preexisting conditions from those stemming from the new system. Accordingly, we recommend studying the practice environment carefully, modifying and streamlining problematic operations before automation wherever possible. These early strategies provide important baseline information for evaluation later and also protect the IT team from the "slay-the-messenger syndrome," which is bound to occur in these circumstances. As a corollary, the implementation team should be prepared to stay the course once an operational decision has been carefully considered and made. Although the first impressions of an implementation may be negative, learning-curve advantages may overcome the initial problems and allow the benefits to become relatively more visible.

Finally, in the early stages we did not anticipate problems; we were often surprised by them and had no ready response or alternative prepared. Under these circumstances it is prudent to consider "What if . . . ?", to analyze the potential difficulties, to consider all possible options, and to understand the implications of each decision that may be required. This anticipatory anxiety is both appropriate and perhaps prophylactic in dealing with many of the significant organizational conflicts that are certain to accompany an undertaking as complicated and as invasive as the introduction of an MIS into the patient care environment of an academic medical center.

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References

[1] R.B. Haynes, M. Ramsden, K.A. McKibbon, C.J. Walker, and N.C. Ryan, A review of medical education and medical informatics, *Acad. Med.* 64 (1989) 207–212.

[2] J.W. Murphy, N.W. James, P.A. Williams, and R.S. Hillman, A residency-based information system, *Ann. Intern. Med.* 112 (1990) 961–963.

[3] P.A. Jennett et al., Preparing doctors for tomorrow: Information management as a theme in undergraduate medical education, *Med. Educ.* 25 (1991) 135–139.

[4] J.C. McAllister, Pharmacy fax, *Am. J. Hosp. Pharm.* 46 (1989) 255–256.

[5] B.J. Ellinoy, Fax fiction, *Am. J. Hosp. Pharm.* 46 (1989) 1549–1550.
[6] D.W. Joubert, The case for fax machines, *Am. J. Hosp. Pharm.* 46 (1989) 2461–2462.
[7] M. Nadkarni, W.T. Stevenson, J.O. Perkins, and T.A. Massaro, "Enhancement of personal order set use by residents in a university hospital environment," presented at *MISPA*, *8th International Conference*, San Francisco, C (October 1992).
[8] J.A. Osheroff et al., Physicians' information needs: Analysis of questions posed during clinical teaching, *Ann. Intern. Med.* 114 (1991) 567–581.
[9] E. Kübler-Ross, *On Death and Dying* (Macmillan, New York, 1979).