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Resistance to Technology: Some Examples from the Health Care Delivery System

Understanding why people don't like something is like understanding why the dog *didn't* bark in the night. One is often looking for objections unspoken, fears unexpressed and concerns concealed. It is the purpose of this paper to attempt to explore some of the factors that are at work when radical changes are introduced into a new setting.* I will try to separate problems that arise from changes we introduce from those that derive from external factors. Finally, I will consider some of the ways by which we cannot only overcome the resistance that we meet in users, but take advantage of it by extracting from it important information on improving the system.

As examples, I will consider the introduction of technology into two different medical domains to user groups who have a reputation for some substantial degree of resistance to change: in the first case, clinical pathologists and laboratory technologists; in the second, physicians, nurses and others in a ward setting. I will discuss the differences encountered between the introduction of laboratory information systems and the introduction onto the ward of hospital information systems. These will illustrate some of the problems involved in promoting public use of information technology.

We have worked for many years with physicians trying to design hospital information systems that would be used not only for simple billing and bookkeeping, but used by physicians and other health professionals as a tool for patient care. This has led us to encourage hands-on

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participation of the health professional in the actual operation of the information system. We have tried to make our primary users—doctors, nurses, pharmacists—comfortable with automation. We have had limited success. An analysis of the limits reached and the problems encountered will be useful. Before beginning this analysis, however, I will set forth one simple but powerful postulate: it is more useful to find out why a tool does not work than simply to try to force its use.

In many cases, new developments—which seem so attractive to their developers—have flaws which are evident to nearly everyone else.[1] When these flaws are finally identified by the developer, it is a source of immense surprise that the problem was concealed for so long. In many cases, it was really a case of not wanting to think about the problems. It is not an easy task to evaluate your own work. It is often painful for the innovator to step back and ask, "What am I doing wrong?" This is not a question with which one is usually comfortable. However, it is generally pointless to try to persuade users to employ a new tool without understanding why they don't want to use it. It is only by perceptive analysis of those features of a system that disturb users that we can gain some insights into how to modify the system so it may be more useful.

I am asserting that assessment is a critical and integral part of the process of introducing new technology into public use. We frequently associate technology assessment with economic analysis, changes in cost that will accompany the substitution of one way of doing a task with another. If considered only in these terms, those involved with a development that is expected to bring new qualities to society—in particular, greater public access to knowledge—tend to take a dim view of such constrained economic assessment. However, a strict economic analysis is only a limited component of what comprehensive technology assessment should be. It should lead to a system-oriented viewpoint which will evaluate new developments not only from the vantage point of the developer, nor even that of the primary user alone, but also from those of others in society. As developers, we should not reject assessment, but rather try to use it to improve our products. Although some of the factors causing innovations to fail may be beyond the control of the developer, many others are amenable to changes and improvements, once the problem is identified.

Medical Information Systems—Their Promises and Their Problems

In the early 1960s, in the early days of information technology, there was very substantial enthusiasm for the use of computers and information systems in hospitals and in other components of the health care system. In order to put the picture in some perspective, it is useful to look at the scene

as it was at that time, and also to note the changes then occurring within the health care system itself.

In the sixties the problems associated with health services were only beginning to emerge as a pressing national issue. Several factors predominated: there had been an enormous expansion in the capacity to provide effective and life-benefiting therapy with the advent of antibiotics, blood transfusions and new vaccinations. This was accompanied by rapid social changes emerging after World War II. There was a growing perception that medical services were not just a privilege open to the affluent few, but rather a national resource to be widely available to all social classes. The immediate result of this was a tremendous increase in demand for health care services. Just as we face today a biomedical information explosion, the sixties were a time of explosion in the actual delivery of medical and other health care services. Hospitals and other health delivery institutions were extremely ill-prepared for those drastic changes in the usual pattern of service delivery.[2]

The rise in basic medical research had not been accompanied by a study of ways to make such research benefits available to the people in the form of effective care. As a result, hospitals, starting from marginal efficiency, quickly found themselves in serious difficulties keeping up with the demand for expanded services.

The consequences were profound. Costs began to skyrocket as hospitals hired more and more personnel. Always a labor-intensive industry, health care was especially susceptible to damages through rapid expansion of its relatively inefficient, but very numerous, service personnel.

At this time, a variety of expensive diagnostic and analytic instruments were introduced. These added both to the costs and to the gross amount of information generated and the complexity of patient care. Foremost among these was the automatic laboratory analyzer. This single device has had as profound an influence on medical care, practice and costs as any other single development in the last two decades. Prior to the automatic clinical laboratory analyzer, laboratory tests were extraordinarily expensive. More than that, they were unreliable: the analytic instruments had such substantial variations that physicians were actually trained to ignore results of laboratory tests when they did not fit in with diagnostic impressions based on bedside observations. The high speed, accuracy and relatively low cost of tests performed with automatic analyzers changed that. The role of laboratory tests in clinical practice moved from a mistrusted ancillary to the very heart of the diagnostic process. Medical education changed rapidly to accommodate this new technology. The use and interpretation of laboratory tests became an important part of medical school and residency training. Physicians began to order tests not

only to confirm suspicions, but to rule out previously unconsidered or unlikely possibilities. Mass screening became possible, and was instituted widely throughout the country.

Thus was technology of a high degree of sophistication introduced with considerable speed and with wide penetration. What was its impact? What was the extent and quality of the resistance to the introduction of automatic, high-speed laboratory analyzers? The resistance was, surprisingly enough, very scant in both duration and intensity. Pathologists could scarcely increase the capacity of their laboratories fast enough to run tests at a speed sufficient to satisfy the demand of the clinicians who ordered these tests. A widespread reliance on results, in terms of both diagnosis and future treatments, grew rapidly. Automatic analyzers of higher capacity and greater speed were developed. What resistance there was took the form of counsels of caution by medical educators. Such advice was heeded in the abstract, but largely ignored in practice. Senior internists continued for a time to warn against the "indiscriminate ordering of laboratory tests." However, the ever-increasing volume of tests actually ordered is evidence of the ineffectiveness of this attempt at maintaining parsimony and strict rationality in the ordering of laboratory tests.

It is worthwhile to examine some of the apparent reasons for the high degree of acceptance of laboratory automation. Possibly the most obvious single factor is the economic impact that automated testing has imposed. It has produced a high volume of increased activity—with accompanying revenue—for the clinical pathologist. It has not taken revenue away from another section of the medical profession. It initially added to the costs of care paid for by the patient or the patient's third-party payer.

It is often the case in medicine that technical developments in one area do not reduce the volume of activity in another; it is more likely that the new innovation will simply be a new service not previously supplied, ideally and presumably improving the quality of care.

Economic factors are probably among the most important relating to the acceptability of new developments. Where an innovation is in the economic self-interest of a group, it is likely to meet widespread acceptance within that group. Where that group controls its use, it is likely to gain widespread currency throughout society, unless opposing pressures are extremely strong. Several consequences follow from this economic determinism:

1. Resistance can be better understood in the light of an understanding of whose economic interests will be served and whose will be hurt.
2. Often the impact of a technological development is only considered and controlled by the group which will be benefited; others who may be adversely affected are frequently unaware of the impact of new developments on them until widespread changes are already in place.

When evaluating the public's access to automated stores of knowledge, we need to consider in detail who stands to benefit—but equally we should consider who stands to lose. We must weigh the benefits against the losses, and devise systems that will accommodate the desired social change with the least economic dislocations.

To return to the evolution of laboratory automation, what was the effect on the technologists? In general, laboratory automation was willingly accepted by most of the technicians in the field. The increased volume of operations brought far more prominence and visibility to their field. Their work became easier. The test results, which are their principal product, became trusted. Accordingly, their work achieved higher prestige, with higher job satisfaction. Laboratory technicians became elevated in both professional status and compensation.

What about loss of jobs due to automation? In this instance, this did not occur. Laboratory technology opened up a whole new industry. The job market for laboratory workers increased enormously. Here, then, is an example where technology was introduced, quickly accepted, and has had a tremendous impact on the substance of the health care system.

A principal conclusion is that where technology provides benefits without any immediate or apparent disadvantages, the fact that it is new is not an impediment to its acceptance, even in a conservative profession. A secondary lesson is this: the unhesitating acceptance of a new technological development may lead to its uncritical overutilization. As discussed earlier, there is a considerable concern in medical circles that laboratory tests are now substantially overused. There has been a sharp increase in malpractice claims. The rise of scientific medicine has led to a higher expectation of accuracy in diagnosis, and what is now termed "defensive medicine" is the common mode of medical operation. Since laboratory tests were introduced into common medical practice without any critical examination of the value or cost-effectiveness of any particular test or battery of tests (in essence, a shotgun approach was adopted), there is now no good measuring stick by which to gauge the value of the ever-growing use of the laboratory. Overuse of the clinical lab is a significant factor in the cycle of rising medical costs.

The Introduction of Technology to the Ward—A Model of Cyclic Resistance

Earlier it was mentioned that the rise in demand for health services had placed sudden and severe strains on the ability of hospitals to provide needed in-patient services. This was partially due to a shortage of physicians, and in the sixties this was dealt with by direct means—namely, increasing both the number of medical students per school and the number

of medical schools in the United States. The effect of this change was not to be felt for a number of years. Consequently, hospitals were called upon to take more rapid action to handle the immediate burden. Research programs designed to improve the delivery of health care were started. Information flow in hospitals and inefficiencies in medical record systems were recognized early as serious problems. Not only did lost or missing medical records interfere with the treatment of an individual patient, but a missing medical record would trigger a spreading train of confusion and wasted effort. A temporary record would have to be set up, and messengers would be dispatched to various sites where the record might have been mislocated. Tests would have to be repeated if the earlier results were lost.

It is hard to document the amount of the economic loss attributable to lost medical records in the wards and clinics of large hospitals. However, in the early sixties, it was estimated that in one large Eastern university-operated hospital, one out of four requests for a medical record was answered with a "cannot locate" response. In addition, hospitals had no ready administrative control over their pharmacy costs and other ancillary patient care services. Manual methods of ordering drugs and services were not adequately linked with the billing systems. Substantial numbers of charges were lost, or so delayed in posting to patient accounts that bill collection and cash flow were seriously impaired.

In the face of all this, it is no surprise that the hospital was a prime target for the introduction of computer-based information systems. It is hard to imagine now the enthusiasm that preceded and accompanied the earliest stages of hospital "computerization." Hospital administrators were sufficiently concerned about, and crippled by, their information management problems that they saw in the computer a magic answer to their problems. This enthusiasm was very short-lived. It soon became apparent that the development of hospital information systems presented problems in several domains, none of which had been adequately anticipated:

1. The hardware needed for a real-time, on-line system was not yet sufficiently reliable.
2. The software that would permit the rapid development of new programs, and their easy modification in response to user criticisms, was not available. Assembler languages were still the standard for production programming, and high-level languages which easily accommodated text manipulation were not in common use.
3. Hospital functions were not understood in detail sufficient to permit precise specification of a hospital information system.
4. The management of large information system projects had not yet been adequately explored. The importance of user consultation in advance of

design specification may have been known, but was not commonly practiced. All too often, systems were set forth by the programmer-analyst, cast in concrete by the coder, then sent forth for the first time for the inspection of the user.

With these deficiencies, it is no surprise that early hospital information systems almost universally ran into serious opposition from their various user constituencies. Nurses were called upon in many cases to be the direct users of the systems. Ill-trained in administration, but with increasing management tasks thrust upon them, head nurses now had either to enter data directly or to supervise the clerks who did. With the system deficiences outlined above, this additional task was time-consuming and frustrating. Since no discernible benefits accrued to the nursing service from the information system, there was no accompanying motivation to use the system.

The physicians and other professionals involved similarly viewed early systems as impediments—as part of the problem, rather than as steps to the solution. Of course, there were exceptions; some medical professionals became enthusiastic about the potential benefits of the system—the opportunity to have clinical information available for research, the chance to have an adequate data base for planning rational treatment, the potential for more effective uses of hospital personnel resources. These intended benefits were the raison d'être for hospital information systems, unrealized as they were.

The result of these unmatched expectations was predictable. Medical information systems lost their charm to physicians and hospital administrators alike. Interest in developing them dropped sharply, both on the part of medical researchers and commercial software companies, as it became apparent that success in such efforts was unlikely. Progress in the field slowed considerably, with the exception of continued efforts in computer-based hospital billing. Medical information was viewed by the developers of such systems as primarily data that reflected fiscal events, rather than from the point of view of their medical content.

Thus, another wave of growth followed, this one emphasizing the accounting, business and collection (ABCs) aspects of hospital operations. This, in general, is the present state today. Several large vendors sell business-oriented hospital information systems. These are largely successful in helping hospitals capture charges. In the process, they also facilitate more complete and timely processing of orders to laboratories and pharmacies. Thus, they do benefit medical care indirectly. But they are largely insufficient in terms of their potential medical content, and they have not reached the goal of aiding more rational medical treatment as was originally set forth.

Within the past year, however, the availability of inexpensive microprocessers, and the ability of hospital clinics to devise special-purpose information systems tailored to their individual medical needs, has instituted still another wave of developments. Small, medically oriented information modules are becoming increasingly prevalent in hospital and clinic environments. These are meeting with much less user resistance than did the earlier systems. A major reason for their acceptance is that they work. Although this sounds like a truism, it is probably the most powerful factor compelling acceptance of an innovation. If it produces the promised results—even at a higher cost—it will usually be accepted. Also, the new systems are often either locally designed or skillfully tailored to local needs. This direct personal involvement is a powerful force stimulating acceptance. (But it should be realized that the personal involvement of the user in the creation of a system can lead to noncritical acceptance of a system that really is not demonstrably effective.) Finally, the reduced cost and intrinsic higher reliability of new computers has been a significant factor in promoting the success of recent developments.

Thus, after a poor start, with resulting emphasis on predominantly fiscal functions, changes in technology have again brought forth a new wave of developments.[3] Now, medical information systems are being recreated with increasing success and with new emphasis on clinical decision support. Resistance can be overcome by the personal involvement of the users and by improvement in the intrinsic quality of the tools of technology.

Summary

The attitude of society to technology is still difficult to predict. This is disappointing to innovators, if not surprising to analysts. Society—or even smaller segments of it, such as the health services community—has no single common goal and no agreement on the weighting of utility values. Thus, the first step in introducing any new technological development is to decide in advance what the expected goals are and to set forth the expected benefits and anticipated losses. No technological innovation is an unequivocal blessing. There may not be universal agreement with stated goals, but at least their explicit existence provides a bench mark against which to judge the success or failure of an innovation.

Although an analysis of economic benefits for the involved groups will be a powerful predictor of the attitude of those groups to a technical innovation, other, less tangible factors are involved as well. The perception by an individual of the status of his job is an important determinant in the success of a system. The participation of users in the design of a system

will help ensure their cooperation in its implementation. However, such involvement may lead to uncritical acceptance, and may bias cost-effectiveness analysis. In spite of this, user involvement is the single most powerful technique that can be used to ensure system success.

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