Using the Laboratory Information System to Achieve Strategic Advantage Over the Competitors of Hospital-Based Clinical Laboratories

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The primary goal of hospital-based pathologists is to provide high quality and low cost testing services to the clients of the hospital laboratories, defined narrowly here as clinicians, administrators, and patients. Because these clients have the opportunity to choose testing options other than accepting those offered by the hospital laboratories, pathologists are forced to offer better value than their competitors. It is not our intention to discuss directly the quality or cost of laboratory tests; rather, we argue that the power and functionality of the laboratory information system (LIS) can be used to increase test quality and decrease test cost.

This article demonstrates how the LIS can increase the efficiency of laboratory operations and clinicians, assist clinicians in using laboratory services more effectively, and serve patients better. The LIS provides a variety of strategic choices by matching, exceeding, or substituting the capabilities of hospital laboratory competitors. The LIS also can provide strategic advantages by creating switching costs for clinicians, administrators, and patients who are considering other testing options. The presence of these switching costs increases the likelihood that pathologists will retain a large share of the laboratory testing market.

This article is divided into five parts. First, the strategy and different ways in which value can be added to tests are defined. Next are listed the competitors of the hospital laboratories and the competencies and advantages enjoyed by hospital laboratories in relation to these competitors. Then, the various users of laboratory tests are described, along with the testing options available to them. Next, the ways are given by which a

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hospital laboratory can build on its competencies and advantages, using the LIS to create a superior information product that integrates into the users' own systems and routines. Finally, the organizational changes are discussed that are required within the clinical laboratories and hospital to take advantage of the strategies detailed beforehand.

DEFINING STRATEGY AND VALUE

A strategy is a plan, overt or evolving over time, that creates something of value that a competitor cannot match. If a competitor fails to respond to such an initiative, competitive advantage (that is, a preferred position in the eyes of current or potential clients) over that competitor is gained in the process.\textsuperscript{11} We define value, in relationship to the information product of the hospital laboratories, as (1) a less expensive but equivalent test; (2) a new test; (3) an improved test; (4) a differentiated test; or (5) a new laboratory service, often LIS-mediated, that supports the improved use of test results.

Although the definitions of less expensive and new tests are obvious, the three other value categories require explanation. An improved test has a more accurate or precise result or an enhanced information content. A differentiated test can be a repackaged test, such as a new test profile reconfigured from previously available tests or a single test option extracted from a previous test profile. Examples of new laboratory services include electronic access to an on-line, long-term data base, or automatic remote stat printing of test results to a patient care location such as a critical care unit.

THE COMPETITORS OF HOSPITAL LABORATORIES

The competitors of hospital pathologists fall into five categories: (1) commercial reference laboratories; (2) hospital special function laboratories performing esoteric tests in competition with the central laboratories; (3) pathology groups in neighboring hospitals; (4) hospital mainframe computer personnel; and (5) users of what is referred to in this article as patient proximity testing systems (PPTS). These five competitors are illustrated in Figure 1.

Although commercial reference laboratories, special function laboratories, and pathology groups in neighboring hospitals are readily acknowledged by pathologists as competitors, the hospital mainframe and PPTS categories of competitors require further explanation. In some contexts, hospital mainframe personnel can be viewed as natural allies by pathologists, such as when they help to implement a hospitalwide local area network from which pathology will derive major benefits because clinicians can access the pathology data base directly.\textsuperscript{6} An ally in one context, however, can be a competitor in another.

To be more specific about the relationship between pathology and mainframe personnel, the two groups often are thrown into competition for
control over the same value-adding information resources in a hospital. Mainframe personnel, and the hospital administrators to whom they report, gain strategic advantage whenever information technology controlled by them replaces systems controlled by pathology. Examples of such replacements include implementing order-entry result reporting through the
mainframe computer. The net consequence of such a change is that pathology becomes increasingly dependent on hospital mainframe personnel, who, in effect, become the suppliers of mission-critical components of laboratory information products.

In this article, we use the term PPTS—not previously used in the literature to the best of our knowledge—as a catchall phrase to encompass testing systems designed to operate in close proximity to patients to decrease the turnaround time (TAT) of test results. Such systems include single-test devices such as those used to monitor blood glucose levels, small-scale automated instruments for performing a limited array of tests in physicians' private office laboratories (POLs) and inpatient settings like emergency departments, and home-testing kits that can be purchased over-the-counter by patients.

COMPETENCY AND QUALITY IN THE HOSPITAL LABORATORIES

Table 1 itemizes the major competencies and advantages enjoyed by hospital laboratories compared with those of their competitors—mainframe computer personnel, commercial reference laboratories, users of PPTS, and special function laboratories. The creation of such a list is an important first step for pathologists in cultivating a strategic point of view with regard to their professional activities. In Table 1, we have not mentioned whatever competency differences might exist between one group of hospital pathologists and another in a neighboring hospital because we cannot assume that such differences exist in a systematic way.

Table 1. Competencies and Advantages Enjoyed by the Hospital-based Clinical Laboratories Compared with Four Categories of Competitors

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<th>Comparison with hospital mainframe computer personnel:</th>
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<tr>
<td>• Greater familiarity with the information flow within the clinical laboratories</td>
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<td>• More focused performance objectives can be developed for LIS personnel</td>
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<th>Comparison with commercial reference laboratories:</th>
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<tr>
<td>• Physical proximity of hospital laboratories to hospital patients with potential for rapid test turnaround time and reduced cost of specimen transportation</td>
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<tr>
<td>• Established collegiality and good will between hospital pathologists and clinicians</td>
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<td>• Accessibility of hospital pathologists to clinicians for patient consultations</td>
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<tr>
<td>• Ability to take advantage of installed hospital information infrastructure and the willingness of hospital administration to invest resources in information technology</td>
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<td>• Creation of a long-term and integrated hospital clinical data base, fostering continuity of care</td>
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<th>Comparison with users of patient proximity testing systems:</th>
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<tr>
<td>• Greater accuracy and precision of test results</td>
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<td>• Greater repertoire of test offerings</td>
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<th>Comparison with hospital special function laboratories:</th>
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<tr>
<td>• Greater repertoire of test offerings</td>
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<td>• Greater familiarity with quality assurance requirements</td>
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One efficient way to build on the competencies and advantages of hospital laboratories and widen the competitive gap between pathologists and their competitors is to deploy information technology such as an LIS. The competitors of hospital laboratories also are free, however, to develop strategies that take advantage of LIS technology. Information technology, therefore, has the potential to work to the disadvantage of hospital pathologists. The transfer of activities from inside an organization to external organizations (for instance, submitting samples to commercial reference laboratories in lieu of hospital-based clinical laboratories) has a tendency to occur in environments in which information technology reduces the costs of coordination.\(^{10}\) We believe that healthcare is such a setting. Pathologists, therefore, must redouble their efforts to develop their own information technology competencies.

In defining the competencies and advantages of hospital laboratories, we frequently refer to the ability to deliver an information product of high quality. By this we mean a test product viewed by clients as superior on the basis of one or more of three components of quality: efficiency, effectiveness, and appropriateness. Pathologists, clinicians, hospital administrators, and patients often will assign different weights to these three quality components in relationship to test performance. Consider test TAT, which is an important measure of laboratory efficiency.\(^{9}\) A one-hour TAT for a blood glucose generally is considered acceptable stat performance by pathologists but is slow by some clinician and patient standards. Clinicians therefore are turning to PPTS such as blood glucose monitors, which can deliver a test result in minutes, with increasing frequency.

Part of this difference in perception on the part of clinicians and pathologists about what constitutes an acceptable TAT for a test is related to the fact that clinicians are not compelled to make cost-benefit trade-offs when ordering laboratory tests on an accelerated basis. Pathologists, however, characteristically assume responsibility for making such calculations and tend to favor batch testing of specimens, whenever feasible.

The lesson to be derived from this discussion about quality perceptions among different laboratory user groups is that it is meaningless for pathologists to speak about producing higher quality test results without discussing the various components of test quality, such as TAT, and without taking into consideration the needs and wants of the specific user group under consideration. Because hospital laboratories serve multiple user groups, pathologists must attempt to address the needs of them all.

These differences in user needs and wants are paralleled by differences in the advantages of the hospital laboratory with respect to competitors. Commercial reference laboratories differ significantly from other competitors, particularly users of PPTS, in one important dimension—the distinction between a service provider and a service user. A commercial reference laboratory essentially is in the same business as a hospital laboratory in that it collects samples, performs tests, and reports the test results to users. It is a service provider only. In the PPTS category, however, clinicians and patients are hospital laboratory clients (service users) and hospital laboratory competitors (service providers) alike.

A major advantage held by the hospital laboratory, compared with that
of a commercial reference laboratory, is its physical proximity to hospital patients. When the service provider and user functions are combined, however, as in the PPTS user category, this laboratory advantage rapidly erodes. Instead, a hospital laboratory finds itself at a competitive disadvantage to user-providers in the PPTS category because its test TATs will tend to be slower and its understanding of user needs will be less comprehensive. To compete effectively then, a hospital laboratory must build on its advantages differently for various users.

**USERS OF THE LABORATORY INFORMATION PRODUCT AND THEIR OPTIONS**

Having described the competencies and advantages of the hospital laboratories compared to those of competitors, we now turn to the identification of the various users of hospital laboratories and the testing options available. This will allow for an analysis of the testing needs and quality definitions of each group, and will permit an evaluation of the subsequent development of a competitive strategy that addresses these needs from an information-technology perspective. Users can be classified as traditional intramural users, nontraditional intramural users, extramural users, and suprahospital organizations and agencies.

**Traditional Intramural Users**

The traditional users of the hospital laboratory information product are clinicians and other health-care providers who work in a hospital that houses a clinical laboratory. These traditional users expect traditional services, with specimens transported to the laboratories in which they are processed using large-scale, high-volume analytical instruments designed primarily for batch operations. Traditional intramural users also expect to be able to select from a large repertoire of tests, some of which can be sent out to reference laboratories. At the same time, traditional users demand rapid TATs and have few qualms about ordering a test on a stat basis to obtain an enhanced level of service.

Clinicians caring for patients in hospitals often are obligated by hospital bylaws to use the services of the central hospital laboratories for local test performance and as a gateway for submitting tests to outside reference laboratories. Frequently, however, clinicians bypass the central hospital laboratories by introducing PPTS technology directly into patient care units, justifying such a change on the basis of the need for faster TATs and, as a result, enhanced patient care. Patient proximity testing systems tend to be introduced first in critical care units and emergency departments where such a rationale has the greatest credibility. A similar rationale is used to justify the use of blood glucose monitors for diabetic patients in general patient care units. Patient proximity testing systems thus are beginning to compete with centralized hospital testing services in selected product lines, because of the faster TAT provided by the technology.

For the pathologist, PPTS present several distinct challenges when the test procedures are performed by nonpathology personnel. The challenges
include possible loss of testing accuracy and precision, loss of control of test procedures by pathology, and the failure to integrate the test results into the long-term pathology data base. For clinicians, these concerns voiced by pathologists often are not perceived as significant enough to avoid the use of PPTS. Moreover, clinicians will respond that PPTS test results actually are recorded in patient medical records (although not included in the LIS-generated hardcopy laboratory reports).

Nontraditional Intramural Users

The nontraditional intramural user group consists primarily of hospital administrators who require aggregated laboratory utilization review statistics and ad hoc specialized reports with increasing frequency for budgetary control, quality assurance, and utilization review. Clinicians also are beginning to request retrospective laboratory reports for research purposes—a nontraditional demand from a traditional user group. Newer generations of LISs with data-base managers allow pathologists to satisfy easily all of these emerging demands for laboratory information from nontraditional intramural users.

There are three major models for processing laboratory information in hospitals, and therefore three potential sources for the information pertaining to laboratory activity required by hospital administrators: a stand-alone LIS as the sole locus for the laboratory data base, a stand-alone LIS with test results copied to the hospital mainframe computer, and an LIS module running on the mainframe computer. Depending on the local situation, hospital administrators can obtain reports pertaining to laboratory test utilization and quality assurance from pathology or from the mainframe computer group which is under their administrative control. As mentioned earlier, we consider mainframe computer personnel as direct competitors of hospital pathologists.

Extramural Users

Extramural users of testing services include clinicians practicing in smaller neighboring hospitals that do not offer a full range of laboratory testing services, clinicians who may turn to the hospital in which they have admitting privileges for private office patient laboratory services, and the patients themselves. In this extramural user category, a hospital laboratory competes with commercial reference laboratories and PPTS.

Office-based PPTS likely can provide rapid TAT for routine laboratory tests, but these often are associated with increased overhead costs for clinicians that include equipment amortization, training costs, and reagent costs. Patients generally do not have direct access to clinical laboratory services, whether commercial or hospital-based, and, so, traditionally, they have had to depend on testing choices made for them by their physicians. With the availability of over-the-counter kits, however, patients now can perform a limited repertoire of tests at home without the direct intervention of clinicians.

Suprahospital Organizations

Suprahospital organizations include third-party payors, governmental agencies, and accreditation agencies such as the Joint Commission on
Accreditation of Healthcare Organizations. Here the need for access to the laboratory data base is not driven by a requirement to deliver health care, but rather by mandates to supervise and regulate the professional activities of and reimbursements to physicians and hospitals. Because suprahospital organizations are seeking information about tests already performed, their only option is to turn to the performing laboratories for such information. The cost for extracting, manipulating, and creating reports for these supraorganizational groups is borne by the hospital and individual departments such as pathology.

BUILDING ON LABORATORY COMPETENCIES WITH THE LABORATORY INFORMATION SERVICE

Pathologists have several ways of responding to the demands for services from the various test user groups already discussed. One option, the status quo option, is to make no change at all in current laboratory operations. Such a direction generally is counterproductive and leads to the decline in the competitiveness of the individual hospital laboratory as more effective commercial and PPTS options arise in the marketplace. In this section, we describe the strategic actions available to pathologists, most of them LIS-related, on which they can build their special competencies and advantages with respect to each user. We also argue that hospital laboratories can use economies of scale and scope to obtain cost advantages over competitors.

One of the major strategic advantages of hospital laboratories depends on the creation of switching costs for existing users. We define switching costs as resources that must be used to change suppliers of a product (such as laboratory test results). In addition to the “cost” to the physician and patient of using incorrect test results in the diagnosis and treatment of disease, examples of switching costs include the acquisition costs of PPTS equipment and new supporting products such as software, and the costs of training hospital or office employees to deal with new suppliers. The greater the cost of switching from existing laboratory services, the greater the benefit that must be provided by the new option in order for the switch to be advantageous.

Services for Traditional Intramural Users

The basic response with respect to the increasing demands by traditional users of hospital laboratories for high quality services should be to increase the information content of laboratory reports and to streamline traditional testing systems through enhancements of test order-entry, sample collection, and test result distribution. Many such improvements can be mediated through the LIS. In addition, however, the LIS also can be used to deliver new testing services or to add value to tests, all of which will bind traditional intramural clients more tightly to the hospital laboratories. We describe two such services: pathology-operated PPTS and enhanced electronic access by clinicians to the pathology data base through terminals and microcomputers.
We recommend that pathologists meet the challenge of PPTS directly by becoming the primary purveyors of such services in hospitals. Pathology-controlled laboratories should purchase PPTS equipment and perform selected tests directly in inpatient and outpatient settings. Such programs would not be meant to supplant centralized testing completely, only to supplement it for those tests in which a TAT of minutes is considered necessary. Because "data ports" can be installed throughout patient care units, PPTS operators can upload test results to the LIS at frequent intervals directly from the test performance sites, facilitating rapid access to results by clinicians through the electronic pathology data base. Such a pathology-directed PPTS program would overcome the problems that arise from the participation of nonpathology personnel in such programs—by giving control over test quality assurance to pathology and by ensuring that test results are integrated rapidly into the pathology data base.

Such a change will require a strategic about-face on the part of pathologists. First of all, they will be forced to acknowledge that the advantages of batch testing in a centralized laboratory are outweighed in selected cases by the more rapid TAT demanded by clinicians and achieved by PPTS. Certain economies over centralized testing may even be realized by using PPTS technology because specimen transportation costs are minimized or eliminated, although the costs of establishing the new program will reduce these savings somewhat. Perhaps even the cost of disposables could be reduced with PPTS if blood is collected directly in the specimen-processing receptacles, avoiding the use of test tubes as transport media. Patient proximity testing services will "roll-up" the duties of the phlebotomist, the specimen transportation messenger, and the medical technologist into a single laboratory employee, so that some personnel savings also can be achieved. More importantly, a partial conversion to PPTS technology is a potent signal that pathologists are beginning to think more strategically about the cost-quality trade-offs of test performance and how to achieve advantages over competitors by responding to expressed client needs.

The idea of providing clinicians with easy electronic access to the pathology data base, as well as to other hospital clinical data bases, is hardly new. What may be new about the idea is its analysis from a strategic point of view. Pathologists should lobby actively in the hospital for the installation of terminals and microcomputers throughout the hospital and also in private offices. We define a terminal as a "dumb" device used solely for order-entry and result reporting. A microcomputer would have local information processing and storage capabilities in addition to its use as a communication tool and would provide a more sophisticated display of information. The cost of such devices would be borne by the hospital.

Access to microcomputers in their offices will allow clinicians, or at least their assistants, to perform multiple computer applications. Such applications include admitting patients to the hospital, generating a variety of test orders for patients, reviewing test results, or scheduling surgical procedures from remote sites. As a lagniappe for clinicians, the functionality of the private office microcomputers could be enhanced by installing software to support private-office management applications.

Offering such computer-mediated services to clinicians provides them
with the efficiency tools that they have come to value highly as their clinical work load and reporting requirements have increased. The installation of microcomputers in physicians’ offices also bonds the clinicians more tightly to the hospital and to the laboratories by increasing the switching costs of admitting patients to other area hospitals that might not offer such services. This is an example of electronic data interchange, whereby information is exchanged between two organizations (the hospital and the physician’s private office) using a standardized format.

Analyzing this microcomputer initiative strategically, and with the vested interests of pathology in mind, it can be appreciated just how the natural advantages of the hospital pathologist come into play. By providing the clinician easy access to the long-term hospital pathology data base for results reporting, the private office microcomputer encourages the clinician to submit outpatient samples to hospital laboratories. The major incentive here is the integration of office test results with the total complement of test results for a particular patient, as well as the opportunity to take advantage of the value-added features of the LIS. The active political support for such a program also firmly aligns the pathologist to the information processing goals of hospital administrators who want to bond clinicians more firmly to the hospital. Lastly, the pathologist capitalizes on the willingness of hospital administrators to invest resources in the information technology infrastructure of the hospital in a way that also will benefit the laboratories.

The installation of terminals and microcomputers throughout the hospital and in private offices achieves economies of scale and scope for the pathologist and for the hospital alike. Economies of scale are achieved by using the same resource to produce more output (that is, added value for all health-care professionals who use the devices). Piggybacking on the hospital’s information resources provides economies of scope for the pathologist in that the same device produces several types of output (for example, the microcomputer in the private office can be used for applications other than those provided by the LIS).

Providing the clinicians direct and easy access to the LIS applications and the pathology data base also paves the way for pathologists to offer clinicians other LIS-mediated options in the future. For example, the LIS can provide clinicians with clinical practice and decision-support tools that allow them to use laboratory services more effectively, as is increasingly being demanded by third-party payers. Such services would include notification of the clinician about duplicate testing and guidance in the use of testing protocols for patients. The extent to which clinicians are encouraged to use hospital laboratories for all patient testing requirements also will allow the LIS to generate summaries of test utilization per patient per diagnosis-related group so that clinicians can respond easily to the anticipated test utilization reporting demands of third-party payors. Although not all of these applications will be considered valuable by clinicians today, their worth will be appreciated more in the future.

Commercial reference laboratories recognize that the ability to integrate their test results into the long-term hospital laboratory data base has strategic value. In order to achieve this goal, some vendors are trying to
develop the ability to generate reports formatted on the basis of a standard protocol and accompanied by complete patient demographic information. One major strategic advantage of pathologists—control of the laboratory data base—is seriously threatened by such an initiative. Strategically, therefore, it makes sense for pathologists to attempt to block requests from commercial laboratories to integrate their test results into the local pathology data base, whenever this occurs.

The issue of denying commercial laboratories access to the data base goes beyond the self-interests of pathology. Although multiparty write-access to the pathology data base is technically feasible, problems associated with the coordination and assignment of responsibility for such a practice appear formidable. Even if write-access to the pathology data base is restricted to laboratory personnel who then would enter test results generated by outside vendors into the pathology data base, pathology still would be held responsible (either formally or informally) for the consequences of errors occurring in such a process. This would happen even if departmental personnel were not actually responsible for causing the error; therefore, refusing access to hospital data bases by outside reference laboratories continues to be an appropriate and defensible action.

Services for Nontraditional Intramural Users

Because of the sophisticated data-base management capabilities now available with stand-alone LISs, pathologists running such systems are well positioned to respond to the demands from hospital administrators for recurring and ad hoc reports extracted from the pathology data base. As long as the pathology data base is maintained properly and the information needs of hospital clinicians are being met by pathology, the incentives for hospital administrators to switch to an LIS module running on the mainframe, or even to an outside vendor of laboratory services, remain low.

The argument in favor of installing a pathology-controlled stand-alone LIS, rather than an LIS software module on the mainframe computer or implementing test order entry-result reporting through the mainframe, also goes beyond self-interest on the part of pathologists. Instead, the stand-alone system in pathology may provide lower over-all costs and fewer problems in a hospital in which costs are narrowly defined as the expenditure of time and money and problems are defined as difficulty in meeting goals. Williamson has pointed out that when several ways of organizing a system may be technically possible, the most effective method will be that which produces the lowest combined technical and organizational cost. Organizational costs are interpreted broadly to include consideration of differing abilities to meet the preestablished goals. Although the mainframe options mentioned above may be technically feasible, they also may create serious organizational costs and problems for pathology and for the hospital.

The assessment of costs and problems involves trade-offs between the expenses and the difficulties of deploying and operating systems using integrated versus multiparty control. Because of the complexity of the comparison, we will not discuss differences in the purchase and operating costs of standalone and mainframe module systems; we note, however, that mainframe LIS modules tend to have less functionality than stand-alone
systems and require similar or greater expenditures to run. In keeping with the strategic bent of this article, we focus on the comparative difficulty of processing laboratory information under the different organizational options. The management trade-off is affected by the simplicity, generality, and certainty of operating the system as well as the speed of response when the inevitable operational problems arise.

A pathology-controlled LIS is an example of an integrated control system. Conversely, running an LIS module on the mainframe computer is an example of a multiparty control system for which the responsible parties include, at the very least, hospital mainframe personnel and pathologists. Such multiparty control systems work best when there are simple and general relationships among the components of the system, when there is a high degree of certainty about the interactions of the various components of the system, and when the primary coordination tasks of the system involve overview and retrospective management control. If the components of a system are complexly as well as idiosyncratically linked, if plans for future development of the system are uncertain, and if quick action must be taken when system problems arise, it usually is more effective for a single organization, such as pathology, to serve as the locus of system control.  

A complex linkage between components of a system is difficult to design, implement, and operate but may be similar to the linkages in other systems. The order-entry result reporting backbone embedded in all LIS software that supports each of the individual laboratory modules is an example of such a complex linkage. An idiosyncratic linkage, however, is special-purpose and transaction-specific. The interfaces between the large-scale automated laboratory instruments and the LIS are transaction-specific and not replicated outside the LIS environment.

Unless there are extreme purchase and operating cost advantages to an LIS mainframe module and it is known to be comparable to a stand-alone system, it is not only reasonable but also efficient for pathology to control the test result generation as well as information processing within the laboratories. First, the LIS is complexly and idiosyncratically linked to each of the individual hospital laboratories and to the information product of each; the LIS itself contributes substantial value to that product. Only pathology personnel understand both LIS technology and information flow within the laboratories. Second, innovation in the LIS, and therefore the impact of the LIS on the laboratories, is uncertain and strongly influenced by the attitudes and experience of laboratory personnel. Third, LIS operational problems must be dealt with quickly and effectively because of the mission-critical nature of LIS applications. The tight integration of the LIS into total laboratory operations guarantees a short feedback loop within pathology whenever such problems arise.

The need for hospital administrators to control the clinical laboratories, including LIS operations, as well as to obtain information from the pathology database can be accomplished relatively easily through budgetary control of pathology. As long as the hospital laboratories maintain laboratory and LIS operations within satisfactory limits and remain within the budgetary guidelines established by the administrators, there is little incentive for
administration to take direct control of information processing within pathology.

These conclusions are appropriate only as long as the LIS continues to function efficiently and effectively under the stewardship of pathology. If the LIS operates poorly or is allowed to become outdated, hospital administrators committed to a pathology-controlled LIS will face significant difficulties in finding an adequate replacement. Friedman² has highlighted the dilemma in which laboratory personnel grow accustomed to an LIS that is not providing maximum functionality and are reluctant to upgrade to a state-of-the-market system. The argument in favor of having pathology control the LIS depends on the long-term ability of pathologists to operate the system smoothly.

Services for Extramural Users

The idea of providing hospital clinicians with ready access to the pathology data base from their private offices using microcomputers already has been discussed. Laboratory information services provide incentives for submitting samples from private office practices to hospital laboratories. Electronic access to the pathology data base also can be provided to clinicians from neighboring hospitals who submit samples to the laboratories on a reference laboratory basis. The information needs of these clinicians are similar to those of the clinicians on the local medical staff, with value being placed on electronic access to the laboratory data base in addition to the distribution of high-quality hardcopy cumulative laboratory reports.

Services for Suprahospital Organizations

Needless to say, most pathologists and hospital administrators are rather ambivalent about the increasing demands for information from regulatory, quality assurance, and third-party payer organizations, but they have no option other than to respond to such requests. In such situations, the most favorable outcome is to reduce the cost of data extraction and report development to the minimum. Of course, this requires a sophisticated LIS to achieve these tasks.

As an extension of this discussion and to develop a fresh outlook on the provision of services for suprahospital organizations, we suggest that the potential value of the pathology data base as a source of revenue for the hospital laboratories is being overlooked. There are many external organizations that would be willing to compensate an individual hospital laboratory, or a consortium of such laboratories, for access to information contained in the laboratory data base. Such information could be used for research, marketing, and other purposes by regional blood centers, manufacturers of automated testing equipment and reagents, and pharmaceutical firms. Specific information of interest to data-base clients would include use of blood and blood components by operation and discharge diagnosis, performance characteristics of automated laboratory instruments, and the sensitivity of bacterial isolates to various antibiotics. It would be efficient to create such hospital laboratory information consortia based on the client list of an individual LIS vendor. This would ensure that all participating
laboratories would have similar laboratory file structures and would be using similar data extraction software.

We acknowledge that capitalizing on the value of the laboratory data base for purposes other than patient care and for local hospital management may be a novel idea. Nevertheless, we are entering an era in which the value of information is beginning to be appreciated. If adequate safeguards are introduced into such programs to preserve the confidentiality of hospital-specific and patient-specific information, the realization of some of the value of the pathology data base should be explored. By using the LIS and pathology data base to generate revenue, it even may be possible to offset some of the overhead of the LIS, or to contribute to an upgrade of an existing, but inadequate, LIS.

**ORGANIZATIONAL CHANGES NECESSARY TO RESPOND TO COMPETITORS**

In order to use the LIS to achieve strategic advantages over various competitors to hospital laboratories, it is a necessary but not a sufficient condition to have a well-tuned and sophisticated LIS installed in pathology. It is a well-known fact in the medical computing field that good systems often fail in some departmental or hospital environments because of factors unrelated to the quality of the system. Such failures often are attributable to organizational defects or inefficiencies. We already have commented on some of the inefficiencies introduced by multiparty control of the LIS, which can jeopardize total laboratory operations.

Our basic belief, and one which echoes throughout this article, is that pathology must exercise direct control over the LIS in order to maximize the potential of the system as a strategic tool. If the mainframe group runs the LIS software on the mainframe computer, or even has responsibility for hardware support, the strategic goals of pathology may become subservient to those of the hospital-at-large, or efficient laboratory operations may be held hostage to the deficiencies of the mainframe group. The strategic importance of the LIS for laboratories is related to the fact that virtually all mission-critical, front-end laboratory operations such as order-entry and result reporting are processed through the LIS. For this reason, we advocate control of mission-critical resources, such as the LIS, by clinical laboratories to whatever extent feasible. Loss of LIS control by pathology is a loss of forward vertical integration.

Laboratory information system operations within pathology should be the responsibility of a dedicated group of personnel who have special expertise in pathology informatics, as well as in normal laboratory operations. Because of the complexity of pathology informatics and the extent to which the LIS and other emerging information technology impact on all pathology operations, we further recommend the creation of a section of pathology informatics operating parallel to the traditional departmental sections of clinical pathology and anatomic pathology. At the very least, the LIS group should have the organizational status of an individual clinical
laboratory. The LIS section, or unit, should be under the supervision of a pathologist-director.

Two major reasons exist for providing high organizational visibility to LIS operations within pathology. The first is that purchasing and operating an LIS is resource-intensive. The LIS obviously is a big-ticket item. Additional resources are required for hardware and software support and to attract and retain highly skilled personnel to staff the LIS unit. A cadre of competent personnel within the LIS unit who have a record of success in implementing new applications will help the director lobby for such resources in a highly competitive environment.

The other major reason for creating high visibility for the LIS unit is that hospital administrators are beginning to recognize the strategic value of all hospital data bases, the laboratory data base included. Accordingly, hospital chief executive officers (CEOs) are creating a new position—the Chief Information Officer (CIO). Often included in the portfolios of these hospital CIOs is managerial responsibility for all hospital information systems. Although the threat of having the manager of the hospital main-frame computer exercise direct control over LIS operations has been somewhat vague in many hospitals in the past, it is less so now, with the emergence of CIOs who will often try to exert direct control over all information processing in hospitals. Control of clinical systems is considered particularly strategic by CIOs because of the pressing need to control health care costs. Part of the influence of a CIO over central hospital administration can be offset by the emergence of a pathologist within the clinical laboratories who is knowledgeable about information systems as well as laboratory information flow, and who can interact with the hospital CIO and CEO as a peer.

Another suggestion that may help laboratories to reach some of their information processing goals is the appointment of a physician as hospital CIO. Such a person may be more apt to understand the special needs of the laboratories and also be sympathetic to some of the strategic objectives of pathology. Friedman has suggested that few physician informaticians would be interested in CIO positions because of the heavy involvement with financial and administrative applications. He therefore has suggested the possibility of creating a new position in hospitals—the Chief Medical Information Officer who is responsible for the coordination of clinical systems, for hospital-wide quality assurance, and for utilization review. Because of their long-standing involvement with LISs, many pathologists would be suitable candidates for such positions.

CONCLUSION

The competitors of hospital pathologists are commercial reference laboratories, hospital special function laboratories, pathology groups in neighboring hospitals, hospital mainframe computer personnel, and users of PPTS. Focusing on commercial laboratories, mainframe personnel, and PPTS users, we have argued that the LIS can provide strategic advantages over these competitors. The advantages are created by matching, exceeding,
or substituting for their perceived capabilities, and also by creating switching costs for clinicians, administrators, and patients.

In order to build on laboratory competencies with the LIS, pathologists should initiate programs to satisfy the needs of laboratory users, such as the installation of microcomputers in clinicians' private offices or the production of computer-generated laboratory utilization reports for hospital administrators. Pathologists also should become the primary purveyors of PPTS services in the hospital.

Pathologists should exercise direct control over the LIS to maximize the potential of the system as a strategic tool. Laboratory information systems operations within pathology should be given high visibility in order for the unit to compete effectively for resources and to offset initiatives on the part of a Chief Information Officer in the hospital to gain more effective control over clinical information systems.

REFERENCES


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