Costs, Service Differences, and Prices in Private Clinical Laboratories

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The factors that have led to the increased importance of laboratory testing in the provision of health care services have caused radical changes in the clinical laboratory industry. The first in a series studying ths economics of the industry, this article offers an examination of the varied structure of the industry and presents preliminary data on direct and indirect costs and prices. The paper focuses on the service component of the laboratory product, showing how service differences have influenced the structure of the industry and how they affect both the cost and price of laboratory tests.

Introduction

As a result of widespread concern over improving both the quantity and quality of health care in this country, the system of its delivery has been the subject of much study and analysis by governmental and academic authorities over the past several years. One area of health care delivery that has received almost no attention to date is the private clinical laboratory sector. This paper is the first of a series that will focus on policy and regulatory issues facing this overlooked subindustry. The research fundamental to an adequate understanding of these issues is still in progress,[1] with this paper concentrating largely on the supply side of the activities of private clinical laboratories. Later papers will concern issues more directly related to the demand for the industry's product and the complexity of relationships that exists with other components of the health care delivery system.

A combination of social, economic, and scientific trends have contributed to the rising importance of laboratory testing in the provision of health care services. The passage of Medicare-Medicaid in 1965 transformed a universe of people—the aged and the indigent—from people virtually without medical care to people with the ability to seek and pay for it. From their inception, these programs have

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covered laboratory testing for ambulatory and inpatient care. Growing emphasis on the potential value of early, preventive care provided to ambulatory patients as a possible means of offsetting future need for more expensive forms of inpatient curative care has increased the demand for routine screening tests across the population.[2] Standards of medical practice taught to medical students and advocated by active practitioners (by specialty boards, hospitals, continuing education programs, and medico-legal experts) stress the need for scientific determinations of disease and disorder wherever possible. The process of a physician ordering a laboratory test or a series of tests for a patient to confirm a suspected diagnosis is, in many cases, being supplemented by the ordering of a broad range of tests, with the expectation (hope?) that they will reveal one or more probable health problems. These, then, may indicate a need for other diagnostic efforts or additional, more specific batteries of tests. One way of describing the reasons for ordering tests, that is, the markets served by different laboratories, is shown by Bailey (1973).

In the sections of the paper that follow, we discuss a number of changes that have occurred in the structure of the private clinical laboratory within the past decade and how the industry remains in a state of flux. Further, we draw upon data from the study to examine the costs of producing a laboratory test, particularly as related to size of firm and type of market served. Finally, we compare the prices charged for similar tests in several firms to observe how different types of firms act in establishing prices and what services the prices may or may not include. This latter behavior is of special significance when considering public policies oriented to controlling the prices of laboratory tests.

Background

Many problems arise when an attempt is made to estimate the retail dollar value of testing done in private clinical laboratories, because these expenditures are frequently merged with outlays for medical care provided by physicians. That is, a physician may charge a patient or third-party insurer (public or private) for laboratory tests,

[2]Initial Medicaid legislation required health-screening tests for children receiving aid to families with dependent children through age 21. California has recently adopted a detailed program that schedules routine and special screens for these children.

along with charges for his professional services. Although the insurers may be interested in a breakdown of the components of these charges for purposes of justifying payment, they do not report the data with such detail. Hence, we have no basis for estimating just how rapidly total spending for laboratory tests by patients and insurers is increasing.

One set of data that illustrates expenditures made by Medicare for testing (but, in our opinion, substantially underestimates the total amount paid by Medicare for such tests because of other billing procedures used by physicians and laboratories) is provided in Table 1. Our informed guess is that the share of total testing paid for by Medicare and reported by this method is steadily decreasing. Thus, the annual rate of increase may be even greater than the compound average of 25 percent per year calculated from Table 1. Part of the reason for making such an assertion is awareness of the rate of increase in sales volume in many of the laboratories in our study. Several have experienced compound rates of increase in sales of 40 to 50 percent over the past five years; some have more than doubled sales each year. Only a few have barely maintained their volume or actually lost business. Given the share of total expenditures for medical care in this country that is made under Title 18, it seems reasonable to assume that the dollar outlays shown in Table 1 reflect little more than the tip of the iceberg. Medicare finances about three tenths of the public health care program. Medicare expenditures were $8.8 billion in 1971-72 (Cooper and Worthington, 1973).

TABLE 1
Independent Laboratory Reimbursements under Medicare

Year [a]	*Amounts Reimbursed* [b] *(in thousands)*	*Percentage Increase*
1968	$ 6,452	
1969	8,677	34.5
1970	9,406	8.4
1971	12,398	31.8
1972	16,508	33.2

Source: Monthly Benefit Statistics, DHEW Pub. No. (SSA) 73-11703. Washington: U.S. Department of Health, Education, and Welfare, May 16, 1973.

[a] Data reflect Medicare records of payment and not actual date of service. The lags in submitting and processing bills are not shown. Providers and beneficiaries have up to twenty-seven months to submit bills for payment.

[b] These data do not include payment for tests billed by a physician that were performed by an independent laboratory, where the physician bills the patient, who then submits his bills to Medicare, or where the laboratory bills the patient directly.

Until about the mid-1960s—a time of greatly increased demand throughout the health care industry—the independent, nonhospital, laboratory industry was made up primarily of two kinds of laboratories. (Excluded from consideration are small laboratories located in the offices of a solo M.D. or small group medical practices, since they are not required to be licensed by the state inasmuch as they are not performing laboratory services for other than their own patients.) Small laboratories owned and operated by one or a few medical technologists or bioanalysts provided mostly routine and simple diagnostic tests for physicians in a closely defined local geographic area. Laboratories owned by a pathologist or pathologist group—the traditional professionals of the laboratory industry—offered a wider range of both simple and complex tests to a larger community of physicians. These pathologist laboratories were often affiliated in some way with a hospital setting where the pathologists served in a staff capacity. Other laboratories—some run by internists and some small corporate reference laboratories—accounted for a very small percentage of the total laboratory market. An advantage offered by the small technologist- or bioanalyst-owned laboratories was their availability; unable to command as high earnings as pathologists, they were located where the market would not support a pathologist. Generally, they stressed a number of convenience features for the physician, including the drawing of specimens and ready access by phone or in person to discuss test results. Pathologist-operated laboratories have been traditionally high-status laboratories. The hallmark of these laboratories has been the reputation of high technical standards in the performance of all tests (usually accompanied by higher prices) and the availability of expert advice and consultation for the interpretation of findings when required.

Near the middle of the last decade, a number of factors combined to introduce sweeping changes in the complexity of the industry. As mentioned earlier, the Social Security amendments of 1965 providing the financing of medical care for the aged and the poor led to expectations within the industry of sharply increased demand for laboratory tests. These feelings were strengthened by a series of private reports from management consulting firms, predicting a boom in the laboratory field. Growing recognition of the willingness of third-party health insurers to pay for laboratory tests, coupled with an increasing proportion of the population's having such insurance coverage, added to the optimism of expansion-minded laboratory owners or would-be owners. Concurrently, laboratory technology was advancing to the point where high

volumes of tests, especially those in the basic blood chemistry series, could be handled quickly and, it was presumed, cheaply on automated equipment.

With interest enhanced by these developments, a number of large corporations already functioning in other sectors of the health care industry showed a desire to move into laboratory testing. These corporations usually possessed substantial amounts of working capital and easy access to long-term capital markets that would provide the wherewithal for the introduction of automated equipment on a grand scale when deemed economically feasible. Many of these firms had the advantage of established reputations in the medical field and experience in marketing products to physicians. This put them in a good position to develop markets within the laboratory industry. Pharmaceutical firms, in particular, presumed that laboratory tests, like drugs, could be presented and sold to the physician by personal contact in his office, using sales personnel similar to their detail men. Corporations outside the health care sector also became interested in the prospects of earning high, long-term profits from laboratory testing on a large-volume basis. Many of the corporations were actively looking for opportunities to diversify into new, growth-oriented industries. With so much national publicity directed at the virtually unlimited needs for health care and the investing public's interest in new private nursing home and short-term hospital ventures, corporate decisions to move into laboratory testing understandably increased. By now, many large corporate laboratories have been formed, usually by acquisition of existing laboratories. In so doing, part of what has been called "the last of the cottage industries" in the health care delivery system has given way to a highly technological, heavily capitalized industry.

These corporate firms are different from the smaller established laboratories in more ways than size alone. To compete with the more traditional laboratories and with each other, and aided by a growing demand for more health testing, the larger laboratories have introduced a number of new ways of doing business in the industry. Competition has developed largely along two lines—price and service.

Price competition, promoted either by sales personnel or by the general mailing of unsolicited fee schedules, once was ruled out by professional ethics. For a discussion of the ethics of advertising in the field of health care, see Kessel (1958). Not bound by such professional constraints, "lay" laboratories have brought a new price consciousness to the industry. Moreover, larger laboratories have made use of advanced technology and high volumes to drive

certain production costs down, thereby enabling them to undercut prices of other, older laboratories. Regardless of whether lower prices are passed on to the patient or his insurer, or serve to provide the physician with a higher profit on laboratory work, price has taken on new significance to all parties concerned with laboratory testing.

Price alone is not enough to attract a large share of the laboratory-testing market. Most large laboratories have decided that they must compete throughout the nation, both among themselves and with smaller laboratories that are serving local markets. Since they are often located hundreds or even thousands of miles from the markets they serve, the large laboratories have had to develop ways of approximating the convenience of their more local competitors. Mail and delivery services that pick up specimens from the client, coupled with air freight and night-shift test processing, have enabled these laboratories to serve national markets from one location. Test results are reported by telephone or teletype to the physician in the same time interval that is customary with local laboratories.

Another change in the way of doing business in the industry in recent years is the growing emphasis on panel testing. Automated equipment allows a panel of twelve or more blood chemistry tests to be run simultaneously on one machine, the cost of doing all twelve tests being no greater than the cost of doing one on such equipment. Even when there is no such dramatic cost saving involved, the practice of combining several different tests in one package can be marketed as a method of economical health screening or as a unique diagnostic tool for securing more information than from a single test. In this area, too, the larger laboratories have been the leaders, both because of their technological capabilities and their tendency to think in terms of marketing strategies that are followed up by innovative marketing techniques. Since all of these newer laboratories have a strong profit orientation, incentives exist for them to encourage continued growth in sales. By their aggressive actions and efforts to assume a leadership role in the field, they have transformed the ethic of the industry from a predominantly professional one to one with a more strictly business emphasis. To the extent that some of their business practices are obscured from the patient-consumer by virtue of the derived-demand nature of much laboratory testing, these laboratories have created a number of new problems for health professionals and policy makers.

With all of the changes that these large laboratories have in-

fluenced, however, the industry still remains in a state of flux and, hence, is quite diverse. The cottage industry of the tiny "mom-and-pop" laboratories is still quite strong. That part of the industry associated with pathologist laboratories is not only strong but, for the most part, thriving. Why hasn't one form of laboratory been able to gain complete control of the industry and drive the others out? The discussion of some of our early findings presented in the next section may explain why diversity still exists and why we expect the industry to remain this way in the near future.

Costs, the Laboratory Product, and Ancillary Services

Among laboratories, vast differences exist, not only in size of firms, but in the quality of the test product and the range of ancillary services offered. As with industry in general, firms attempt to develop a competitive advantage in certain markets and, accordingly, adopt product and service packages that will attract and maintain customers. The products and services offered by different kinds of laboratories are determined by the ssessment of meet demand and cost constraints. Other constraints include those imposed by the existing state of technology in the laboratory and by the need to maintain certain quality standards mandated by state and federal regulations. Since the latter are a constant for all laboratories functioning in a given state, attention should focus on understanding the differences between products, services, costs, and resulting pricing policies, if we are to be able to formulate intelligent public policy toward the laboratory industry.

Direct Costs

For the purpose of studying the cost structures of different kinds of laboratories, we have isolated two areas of cost: the direct cost of the actual performance of the test, and the indirect costs of all of the service, marketing, and overhead components. Direct costs—frequently referred to as "bench costs"—are gathered through observation of inputs into the production of the test itself. We have selected the direct costs of performing a routine urinalysis in five of our sample laboratories to show how costs vary in different kinds of laboratories. These five include one small laboratory owned by a group of physicians but operated by a bioanalyst that performs about 11,000 tests per year; a small bioanalyst-owned and operated laboratory that produces 20,000 tests a year; a medium-size

pathologist-owned laboratory that performs 54,000 tests a year; a larger pathologist-owned laboratory that performs 87,000 tests a year; and a very large corporate laboratory that performs nearly a million tests each year.

Since all laboratories perform routine urinalyses by virtually the same method, it is assumed that performance and quality differences may be minimal. Performance of the test involves three basic procedures: a "dip-stick" analysis of urine chemistries, a measurement of specific gravity, and a microscopic examination of the specimen. Dip-stick analysis, as the name implies, involves dipping a reagent strip into the sample to measure simultaneously a number of different chemical substances. Specific gravity is measured by a refractometer or a total solids meter, simple devices that give an optical reading from a very small sample of urine. The microscopic examination involves placing a small sample of urine on a slide and inspecting it under a microscope for color and certain sedimentary substances.

Direct costs at the bench are comprised of the cost of the reagent strip, control samples, microscope slide and coverslip, and other small supplies; amortization of the microscope and total solids meter; and labor costs. Table 2 gives absolute and percentage breakdowns of the direct costs gathered in the five sample laboratories. As is apparent, most of the dollar variation in direct

TABLE 2
Direct Costs in the Production of Urinalysis Tests, Selected Laboratories

Laboratory	A		B		C		D		E	
Daily Urinalysis Volume	2		9		13		20		225	
	$	%	$	%	$	%	$	%	$	%
Total Direct Cost (per unit)	1.08	100	.68	100	.74	100	.58	100	.51	100
Reagents	.12	11	.11	16	.15	20	.15	26	.11	22
Other supplies	.01	1	.04	6	.02	3	*	*	*	*
Quality control	*	*	.01	1	*	*	*	*	*	*
Slide and coverslip	.01	1	*[a]	*	.01	1	.01	2	.01	2
Equipment	.11	10	.07	10	*	*	.03	5	*	*
Labor [b]	.83	77	.45	66	.56	76	.39	67	.39	76

* Cost per test less than $.005.
[a] This laboratory uses reusable microscope slides.
[b] Does not include fringe benefits.

costs among the laboratories can be attributed to equipment and labor costs. The costs of microscopes and total solids meters are fairly similar among the laboratories and, for purposes of comparison, we have used the same straight-line method of depreciating the equipment in each laboratory. It follows that the equipment costs should vary inversely as the daily volume of urinalyses increases. In Laboratories C and E, the equipment was fully depreciated and there was not a chargeable cost.

Labor costs form the largest component of direct costs. As the daily volume of urinalyses increases, the labor time for each test decreases to a limited extent. With a small test volume, each test is done separately. When the number of urinalyses increases, the tests can be batched into labor-saving runs resulting in a time savings as shown in Table 3.

Another important reason why labor costs vary among laboratories is the increased division of labor possible in larger laboratories. There are limits on the amount of labor substitution that can occur in the production of urinalyses inasmuch as the microscopic part of the test procedure must be done by a laboratory technologist. In Laboratory E, the largest firm in terms of annual total volume in this example, the dip-stick segment of production is performed by a laboratory assistant while the microscopic examination is done by a licensed technologist. In other laboratories, the entire process is done by technologists. The total labor cost per test is not lower in Laboratory E despite the use of a laboratory assistant, however, because that laboratory pays higher wages to its technologists than any of the others. Division of labor may effect

TABLE 3
Labor Time and Cost per Urinalysis,
Selected Laboratories

Laboratory	*Daily Urinalysis Volume*	*Reported Labor Time per Test (minutes)*	*Labor Cost per Test* [a]
A	2	10	.83
B	9	5	.45
C	13	7	.56
D	20	5	.39
E	225	5	.39

[a] Does not include fringe benefits

more substantial labor cost differences for other kinds of tests.

Sources of smaller variations in direct costs among the sample laboratories include the costs of other supplies, reagents, and quality control. The cost of other supplies stems from slight differences in the production process, including the use of pipette tips, extra tubes, or other small supplies. Quality-control costs depend on the number of control samples run relative to the number of tests performed. If a control is run every day, for example, the control cost per test in a laboratory performing only five tests daily is much higher than the cost to a laboratory performing 200. Unlike some other tests, frequent control of urinalysis quality is thought unnecessary in most laboratories, and the effort expended here with its subsequent control cost is very small.

The routine urinalysis test was selected for comparison to minimize performance differences. The data exhibit a pattern of decreasing direct costs as the daily volume of urinalyses increases. The cost structures experienced by the five sample laboratories are relatively similar, with labor and reagent expenditures forming the bulk of the costs. Most of the cost variation is accountable to differences in labor time and equipment amortization. For other laboratory tests, performance differences can be much greater with costs varying more dramatically. Certain blood chemistry analyses, for instance, may be performed manually in a small laboratory; on single-channel automated equipment in a medium-size laboratory; and on faster multiple-channel equipment in the large firms. Automation may drastically alter the direct cost structure, substituting increased equipment costs for the labor costs of the manual methods. Whether automation results in a lower total direct cost for any given test depends on the daily volume of that test.

One of the unrecognized truisms of the industry is that as production methods vary, the laboratory product changes. Although the urinalyses performed by the five sample laboratories are essentially the same, blood glucose determinations performed in those same laboratories may vary not only in cost but in terms of the final product as well. Specifically, there may be significant quality differences depending on the method used. Direct cost data in such instances can reflect differences in production methods, costs of reagents and controls, and so forth. Variations in direct cost assume greater importance in studying such questions as the cost of higher quality. With further information from continuing research, we will address such questions.

The Laboratory Product

Laboratories serving certain markets naturally try to provide both the basic products and ancillary services desired by their customers. For purposes of clarity, let us define the laboratory test as a *product,* recognizing that there may be quality variance of a purely technical nature among such tests, both between laboratories and even within the same laboratory. Moreover, there may be service differences between laboratories. Specifically, services vary with respect to the method used for collection of the specimen, interpretive consultation, reporting turn-around time, and the billing process. Prices charged for laboratory tests may thus vary for several reasons: (1) different technical inputs, and (2) different services provided (as well as the degree of competition).

To illustrate differences in services provided by different laboratories, we return to the illustration of the urinalysis test. Basically, four distinct steps are included in providing the final product of a routine urinalysis: a specimen must be obtained from the patient, a laboratory test is performed, results are reported to the requesting physician, and the patient or insurer must be billed. How these functions are performed may vary considerably depending on what kind of laboratory performs the test.

A urinalysis, as well as some other routine tests, may be performed in the physician's office. In such instances, the patient provides his urine specimen in the office, the test is performed by either a medical technologist or laboratory aide under the supervision of the physician, the results are reviewed, and the patient is billed by the physician. However, for a number of economic or quality reasons, the physician may decide to have the test done by an independent clinical laboratory. He then must decide among an array of different kinds of laboratories offering a number of different services.

As one option, the physician can send the patient to a small local laboratory. This kind of laboratory, usually owned and operated by a bioanalyst or one or a few medical technologists, receives the specimen from the patient, performs the test, reports the results to the physician, and ordinarily bills the patient.

As another alternative, the physician may choose a larger pathologist laboratory to perform the work. These laboratories may have several ways of collecting the specimen. If the laboratory is nearby, the patient may go directly there. In other instances, these laboratories will operate "drawing stations" small laboratories where the specimen is received from the patient and where very

routine tests may be performed. More complex or high volume tests will normally be forwarded to the main laboratory. If neither of these alternatives is convenient, the pathologist laboratory probably has a pickup service that receives specimens that have been drawn in the physician's office. Although traditionally pathologists always billed the patient directly, many now maintain a general account for the ordering physician, who will bill the patient.

If the physician chooses a large corporate laboratory to perform the test, there may be a number of service options. Because these laboratories serve a national market, they receive only a very small percentage of their specimens directly from the patient. Only in major urban areas where the volume of business warrants it will the large laboratories use a number of drawing stations. More likely, the laboratory will provide a pickup service to client physicians who have taken a specimen from the patient, and the laboratory will ship or mail the specimen to the central laboratory. Or, the physician may mail the specimen directly to the laboratory in postage-paid containers. The laboratory then performs the test and relates the results to the physician by telephone or wire. Most large laboratories are reluctant to bill the patient directly but prefer to bill the physician who, in turn, bills the patient.

For urinalysis and other routine tests, the small local laboratories have a distinct locational advantage in serving the physician because of the range and individualization of the services they offer. To overcome some of these service advantages and to convince physicians of other advantages, the large pathologist laboratories and the large corporate laboratories must adopt costly service and marketing programs and other inducements of a price- or quality-differentiating nature.

The diagrammatic representation in Fig. 1 shows the different ways a test request may be handled from the time the specimen is taken from the patient through the final billing process. Each notation indicates a function in which costs are incurred. Except for the actual "performance" step, all of these functions involve indirect costs (although certainly not all indirect costs are represented here). These costs are not easily calculated, since within any given laboratory there may be several different avenues of normal processing, i.e., different ancillary services offered, according to physician demand. Tracing these costs in the small laboratory is relatively easy because their method of operation tends to be standardized, whereas the methodological problems of assessing indirect costs are multiplied with increasing firm size.

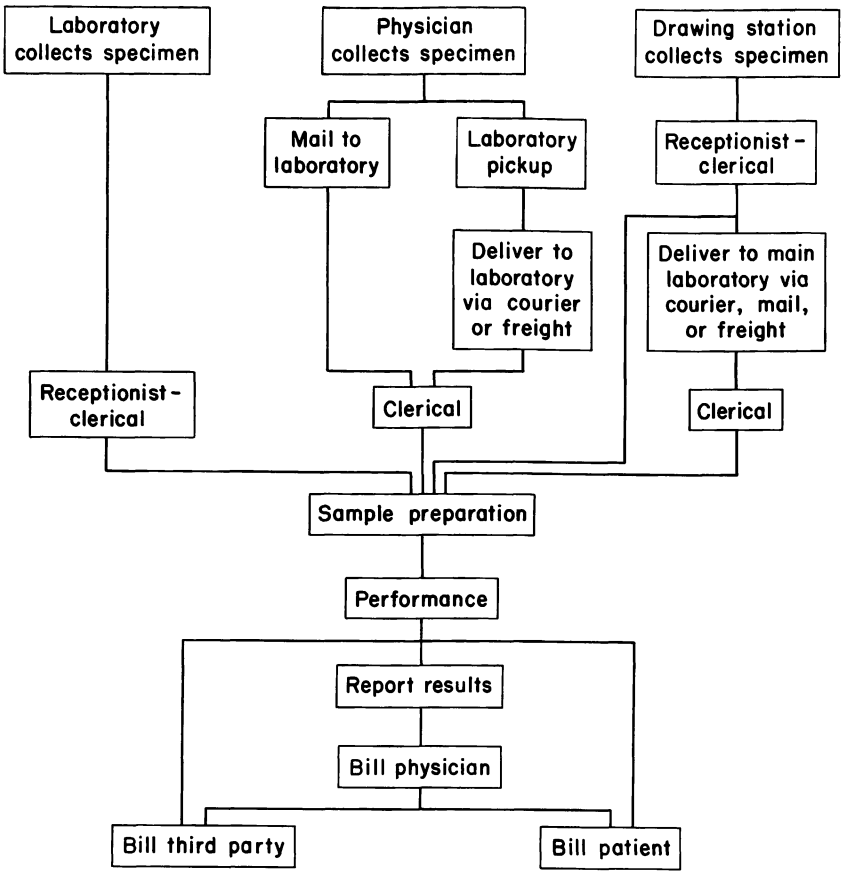

FIG. 1. Specimen Collection, Processing, Reporting, and Billing Procedures.

Indirect Costs

Fig. 1 points to a number of areas of indirect costs and illustrates how varied the cost structures may be among different kinds of laboratories. The costs involved in the functions displayed in Fig. 1 depend, in some instances, on the test requested and, in other cases, on the kind of laboratory performing the test. The cost of specimen collection is related to the type of specimen obtained. The drawing of a blood specimen involves a significant cost, while the cost of collecting a urine sample may be almost negligible. Likewise, the preparation of the sample depends on the kind of test to be performed and the method of testing to be used. Other costs

are more closely related to the kind of laboratory, that is, to size and the services offered. Clerical functions in a small laboratory, for example, may all be handled by one office person who works as receptionist and typist, handles test requests and other communications, reports test results, and does all the billing. In the large laboratory, each of these clerical functions may be delegated to a specific department where a clerical staff, aided by data processing facilities, discharges the necessary duties. The work flow indicated, where specimens are collected by someone other than the laboratory, depends also, to some degree, on the kind of laboratory, as was shown before. The method of reporting results depends, to a large extent, on the immediacy of the testing need and, to some extent, on the kind of laboratory. Finally, billing costs depend on who is billed. A monthly bill to a client physician or laboratory for all referrals during that month is less costly than individual bills sent to each patient. This is true not only in terms of bill preparation but also in the collection of accounts receivable.

It should be suspected from the above that "normal" indirect cost is an elusive figure, especially in the larger laboratories. To examine indirect costs, we originally envisioned a cost study of each step in Fig. 1, such as was done to determine direct costs. But the many possible deviations in the production flow within any one laboratory—and particularly between different kinds of laboratories—made such a study infeasible without information that the laboratories were unable to supply. As an alternative to our desired costing methodology, we have been forced to look at indirect costs from a grosser point of view, extracting expense data from yearly income statements and allocating these expenditures among the total annual volume of tests. Acknowledging that income statements may often distort true operating costs, we have chosen to analyze the indirect cost structures of different kinds of laboratories in Table 4 using the five sample laboratories selected earlier.

The expense data obtained from laboratory records are grouped into categories in Table 4 to represent the costs incurred in certain functions. Although these groupings do not parallel the cost centers in Fig. 1, all such costs are represented in the present categories.

Clerical salaries and supplies include salaries paid for support activities: handling, office, clerical, managerial; payroll taxes applicable to those salaries; nonlaboratory supplies consumed in those activities; and office equipment expense. Relating the flow diagram in Fig. 1 to Table 4, the cost centers included in this

TABLE 4
Average Indirect Cost per Test by Function Categories
for Selected Laboratories, 1971
(in dollars)

Laboratory [a]	A	B	D	C	E
Total Annual Volume [b]	11,000 (2)	20,000 (1)	54,000 (5)	87,000 (5)	953,000 (3)
Cost Categories					
Administrative and clerical salaries and supplies [c]	1.10	.82	1.65	2.12	2.09
Electronic data processing	0	0	0	0	.27
Specimen acquisition	.16	.06	.12	.46	.41[d]
Communications	.04	.04	.19	.04	.24[d]
Sales, advertising, promotion	0	.04	0	0	.67
Rent, maintenance, and other grounds expenses	.73	.25	.57	.43	.95
Other costs	.40	.54	.90	.87	1.49
Total indirect cost	2.43	1.75	3.43	3.92	6.12

[a] Note that the order of presentation depends on total annual test volume and not on the average daily number of urinalyses performed, which was the basis for assigning a letter designation to the laboratories in Table 2.
[b] Number in parentheses is number of laboratory locations, including satellites.
[c] Although managerial costs are included for all laboratories, pathologists' salaries or drawings that are more related to the professional practice of the pathologist than to regular laboratory functions are not included for the two pathologist-owned laboratories.
[d] Postage of $.10 was arbitrarily split: $.05 to acquisitions, $.05 to communication.

category are the receptionist and clerical activities, sample preparation in the largest laboratory (though not in the smaller firms), the reporting of results, and billing operations.

Closely related to the clerical activities is the cost of electronic data processing in the largest laboratory. Although some of this cost should more properly be included in direct expenses, it is fair to say that computer technology is now being used in most laboratories more for clerical purposes than directly in the control of test production.

The specimen-acquisition category includes the costs of automobiles, messenger salaries, courier service expenses, freight costs, and an estimate in the largest laboratory of postage costs involved in mail-order operations. The average costs of drawing a specimen are not included here, since it is impossible in any but the smallest laboratories to determine what percentage of the tests were drawn by the laboratory, either in drawing stations or at the main laboratory. The smaller the laboratory, the more significant these drawing costs are, which leads to an underestimation of the

costs in those laboratories. However, since the indirect costs will be used here in addition to direct costs to give an average total cost of performing a urinalysis, this omission is not believed to be crucial. As mentioned before, specimen-collection costs for urinalysis are negligible.

Communication costs include the costs of telephone and telegraph and postage costs related to correspondence. These are further expenses incurred in the clerical, reporting, and billing functions.

Sales, advertising, and promotion costs include the salaries of sales representatives, commissions and bonuses, travel and entertainment expenses, display costs, and other promotional outlays.

The building rent, maintenance, and grounds-expense category includes rent on all buildings in the organization, janitor salaries, plant maintenance expenses, and other costs directly related to the upkeep and protection of the physical plant. These costs are mentioned here as a specific category because of their relationship with the number of locations of each organization. Numerous locations usually necessitate higher service costs, since it is difficult to keep all of them functioning at or near capacity.

The "other costs" category includes such costs as legal and accounting fees, consultant fees, charges for outside laboratory services, insurance, taxes and licenses, and other sundry and general expenses. Both the amount and number of such expenses are generally greater in the large laboratories.

Straight comparison of cost categories between laboratories is not precisely valid for two reasons. First, especially in the smaller laboratories, many functions overlap. For example, in the smallest laboratory in this sample, an office aide (whose cost is shown in the clerical expenses) is responsible for picking up specimens and delivering them to the laboratory. Thus, the full cost of this function is not shown in the proper category, while in the largest laboratory there is no such overlap in the acquisition function. Second, as already seen, different laboratories offer different services. In the largest laboratory, for example, clerical costs seldom include the billing of patients, while in the smallest they almost always involve this service.

Another word of caution concerning comparison of these figures seems appropriate. This costing methodology yields only an average figure for the laboratory's total volume. But many of the costs could more correctly be allocated among a smaller number of

tests. For instance, the cost of air freight is divided among all tests, although only a portion of specimens actually come in by air freight. If only half the specimens involve air freight, then the average freight cost of receiving these specimens would be double the freight cost included in Table 4. But, as has been mentioned, the methodological problems of studying each cost center are overwhelming and the averages obtained are informative, certain inadequacies notwithstanding.

The costs presented in Table 4 highlight differences among the five sample laboratories. They also serve as the basis for questioning whether cost advantages promised from high-volume automation are real, since these indirect costs must be spread over all tests. The costs involved in building a large volume of business and in providing the services to maintain that volume are reflected in general comparisons among the five sample laboratories.

The cost of generating higher sales volume is a significant component of the marketing costs of the largest laboratory. This laboratory spends an average of 67 cents per test on sales, advertising, and promotional endeavors. Included in this figure are salaries and commissions paid to more than 20 sales personnel, expenditures for advertising space in medical and industry journals, costs of displays and exhibits, and travel and entertainment expenses. Whether these indirect costs can be claimed to result in more services to physicians and their patients or are merely a necessary part of penetrating and developing a market large enough to yield other scale economies remains to be seen.

Higher marketing costs are not the only reflection of expenses involved in building sales volumes. A more pervasive addition to overhead is represented by all the costs involved in operating more than one laboratory location. A localized laboratory faces a limited market. By increasing its number of locations, a laboratory increases the size of the market in which it is competing. The acquisition or start-up costs of opening a new location must be quite large, but those costs are not included in operating expenses. Even in the operating expenses, some higher costs can be traced to the number of locations a firm operates. Clerical costs, the costs of specimen movement between branches and the main facility, and rent and plant maintenance costs all increase on an absolute scale as the number of locations increases. Whether this increases the cost per test depends, of course, on the volumes generated relative to the absolute cost increases. Figures from Table 5 indicate the

TABLE 5
Average Total Cost per Routine Urinalysis, Selected Laboratories

Laboratory [a]	A	B	D	C	E
Total Annual Test Volume	11,000	20,000	54,000	87,000	953,000
Direct cost	1.08	.68	.74	.58	.51
Indirect cost	2.43	1.75	3.43	3.92	6.12
Total cost	3.51	2.43	4.17	4.50	6.63

[a] Note that the order of presentation depends on total annual test volume and not on the average daily number of urinalyses performed, which was the basis for assigning a letter designation to the laboratories in Table 2.

likelihood that insufficient volume is yielded vis-a-vis the higher absolute costs in the multilocation firms in this sample.

In the same way, indirect costs are increased by the larger laboratories' other efforts to provide convenient services to physicians. Specimen-acquisition cost is the obvious example of an expense that the laboratory serving a large community—whether citywide or national—must incur to offer the convenience of proximity that is inherent in the small laboratories.

If not to localize but rather to personalize service, the larger laboratories' clerical costs rise in addition to the increases effected by multiple locations. In a small firm, a physician's query concerning a test request can be answered by dialing the phone or walking down a corridor. In a large laboratory, the same question may be handled by a special communications staff with the aid of sophisticated data-retrieval systems.

Yet, even with these higher service costs, the laboratory serving a national market cannot routinely provide as much service as the small local laboratory. It rarely receives patients for specimen collection or drawing, nor does it routinely bill the patient or third party. So, if there is no more service given in the larger laboratories, whether these extra service components are cost-justified depends entirely on the extent to which high volumes thus generated can sufficiently decrease the direct costs of producing a given test to yield a total cost for comparable services lower than that of their competitors.

Table 5 adds the direct and average indirect cost per test in the five sample laboratories to illustrate that, at least in the case of a

routine urinalysis, direct cost savings attributable to higher volumes are generally outweighed by the increased indirect costs of servicing those volumes.

Since these laboratories all use the same method to perform a routine urinalysis, the figures cannot reflect cost savings attainable through laboratory automation—there are none. But, as mentioned before, we suspect that there may be substantial product differences between automated and manual testing procedures when considering tests that can be produced in either fashion. Certainly, analysis such as the above would give different conclusions concerning total cost when comparing automated and manual methods. The determination of how much this difference would be attributable to real cost savings in production and how much to differences in the final product cannot be dealt with at this stage of our research.

The purpose of this discussion of costs has not been to give an ultimate or definite figure for the cost of any specific test, but rather to show that the direct production cost of a test may be quite small in relation to the indirect service costs. It has also been shown that the average indirect costs are generally higher in larger laboratories. This leads to the next question of interest to people outside the industry who maintain a public policy viewpoint: how do the prices of laboratory tests compare among different kinds of laboratories?

Laboratory Prices

The imposition of multiple "phases" of general price controls on laboratory prices over the past few years creates certain difficulties in attempting to explain price behavior in this industry. As in many other sectors, price controls have resulted in a certain artificiality in laboratory fees, with some charges doubtless too high and some too low. One must add to this situation the existence of an unstable competitive environment in the industry at the time Phase I was initiated. It appears reasonable to predict that these general price controls have merely interrupted a period of price shakeouts that are inevitable. With the end of controls on health care prices, we expect to be able to analyze more realistically the pricing policies in the laboratory industry. For the time being, we are unprepared to make a definitive statment on the general behavior of laboratory fees, yet we believe that a few comments seem necessary.

Our analysis of laboratory costs indicates that this is an in-

dustry in which the service component is more costly than the actual production of tests at the bench. Moreover, our sample shows that the larger laboratories currently incur higher average total costs, at least for some tests. Paradoxically, it is these same large laboratories that have developed a national image of offering tests at inordinately lower prices than their competitors. How can the cost figures be reconciled with the conventional wisdom of the price structure of different firms in the industry? Table 6 provides some insights into the issue. In this table, the prices charged for three tests are presented for each of the five sample laboratories. The figures reveal a pattern of differences, especially within the larger laboratories, that appear to be directly related to the number and type of ancillary services offered.

The three tests were selected from different areas of laboratory operations. As mentioned earlier, urinalysis is a common test that is performed by the same manual method in each laboratory. The blood culture is an example of a less routine test that is also performed manually. The blood glucose test is a common test that can be performed manually or on automated equipment. All prices are for the test when requested alone—i.e., not as part of a panel.

A preliminary way to examine Table 6 is to concentrate on the columns. Here the price spread between the provision of no ancillary services and a complete package increases substantially with firm size. Perhaps this occurs because the larger laboratories have experienced costly difficulties in obtaining the necessary information to bill patients or third-party insurers and, therefore, need to charge more to cover expenses. Perhaps it is due to the fact that losses on accounts receivable are higher when a patient receives a bill from some unknown laboratory on the other side of the country than when it comes from a local laboratory where he went to provide a specimen for testing. Probably both explanations are true. Again, it seems obvious that the competitive advantages of small firms lie in their emphasis on "full service," whereas the largest laboratories concentrate on providing basic test data, leaving the physician with the problem (opportunity?) of assuming the other service functions that are an integral part of laboratory testing.

A second way to analyze Table 6 is to regard the price for any of the tests across the row. Here a general pattern emerges as follows:

1. The price of the basic laboratory product tends to decline with increasing firm size when the physician draws the

TABLE 6
Laboratory Price According to Service,
Selected Laboratories, 1973
(in dollars)

Work Performed by Laboratory:	A [a]	B [a]	D	C [b]	E [c]
Urinalysis					
Basic test only [d]	5.00	3.00	3.00	2.00[e]	2.75[e]
Basic test, collects specimen, bills patient	5.00[e]	3.00[e]	4.00[e]	4.00	4.75
Blood Glucose [f]					
Basic test only	6.00	5.00	4.90	3.00[e]	2.25[e]
Basic test, collects specimen, bills patient	6.00[e]	5.00[e]	6.50[e]	6.50	8.25
Blood Culture					
Basic test only	10.00	10.00	10.50	6.00[e]	11.00[e]
Basic test, collects specimen, bills patient	10.00[e]	10.00[e]	14.00[e]	15.00	16.00

[a] Laboratory tests for these firms include full services customarily—they do not encourage provision of the basic test alone.
[b] This laboratory charges an additional $1.00 fee for each insurance form completed.
[c] Has a lower-price fee scheduled for high-volume clients. Certain prices have been changed slightly in a way that will not distort the analysis in order to protect the confidentiality of this laboratory.
[d] Physician draws specimen and bills patient.
[e] Distributed fee-schedule price. Other fee schedules may exist but are made available routinely only to selected customers.
[f] Automated method used in laboratories D and E.

specimen and bills the patient. This seems to imply either that the larger laboratories have a competitive advantage in those areas that revolve around economies in production at the bench, passing these economies on to the physician-purchaser, or that these prices do not reflect their total costs at all but are used as loss leaders to attract business away from other firms.

2. When the most complete set of ancillary services is offered, the tendency is for prices to increase with larger firm size. Perhaps this is due to the fact that the smallest firms differentiate themselves from all others as "full service" laboratories. By economizing on the collection of specimens, billing of patients and third-party insurers, and maintaining close personal contact with their physician clientele, they are able to offset production bench diseconomies with other ancillary service economies. It may also be that the larger firms want to discourage offer-

ing such complete service packages and, hence, are willing to leave those markets to others.

The two smaller laboratories charge a standard fee regardless of the services performed. Basically, what is reflected here is that these laboratories typically provide their physician-customers with a complete set of ancillary services that are accepted as their standard operating procedure. The physicians who use these laboratories do not want to be bothered with the drawing of specimens, billing patients for services the laboratory provides, or filling out insurance forms for third-part reimbursement. Hence, only one set of fees is published in the laboratories' fee schedules. Laboratory D, a somewhat larger, pathologist-owned laboratory, attempts to compete in more than one market and therefore grants a 25 percent discount from published fees if the physician draws the specimen and does the billing. Laboratory C maintains two fee schedules—one for physicians who collect the specimen and bill for services, and one for cases where the laboratory collects the specimen and bills the patient directly. The fee schedule regularly distributed by Laboratory E covers only performance of the basic test. If other ancillary services are desired, the laboratory charges a considerably higher price. (This laboratory also maintains a schedule of even lower fees for especially high-volume users who purchase only the basic test.)

A final note to be advanced, methodological problems notwithstanding, is to urge consideration of the over-all differences in price between the distributed fee schedules of the largest and smallest laboratories when all services have been included. What are the great price advantages for the consumer? If these price differences are more ephemeral than real, why are the largest laboratories growing and smaller ones gradually losing their share of the expanding market? Is it because of the larger laboratories' ability to attract most of the business in the new health-screening markets that they are becoming predominantly wholesale firms doing work for smaller laboratories on both automated procedures and more esoteric determinations, or are there other explanations?

To the patient and the third-party payers, the difference between published fees and the actual fee paid has great significance. From the viewpoint of public policy toward laboratory prices, the distinction is vital. Any effort to establish reimbursement rates or schedules of "reasonable fees" to be paid for laboratory tests by third parties must take these differences into

consideration. Allowable laboratory charges should not be derived strictly from a compilation of fee schedules. Nor is a mere caveat concerning the vagaries of laboratory fee schedules sufficient for the establishment of intelligent public policy related to laboratory prices. We will discuss these issues in greater detail in later papers when our data and experience permit.

Conclusions

In view of the factors contributing to its rapid growth and its important position in the delivery of health care services, the clinical laboratory industry is becoming more and more subject to public scrutiny. Sound public policy must be based on a better understanding of the laboratory industry than has been available heretofore. Specifically, evolving public policy must be based on an understanding of costs, product and service differentiations, and quality differences that exist among laboratories, as well as prices.

In this paper we have shown that, contrary to accepted wisdom, laboratory costs generally increase in larger firms. Given the total volume of tests produced in the five sample laboratories, no reduction in direct costs (even to zero) would be sufficient to offset the high indirect costs of the larger laboratories. Whether they are troubled by their high-cost position depends upon a number of factors: (1) the time perspective that the firm is comfortable with (short-run losses endured to reap long-term gains), (2) their ability to price other tests high enough to more than cover any losses on these tests, or (3) the fact that they are not yet sure where their profitable competitive advantage lies. Future changes in product or service mix, markets served, and the broadening or narrowing of over-all operations may be anticipated as the industry moves toward more of an equilibrium state.

An awareness of the total package of services that must accompany the provision of a laboratory test is extremely important. Public concern should focus on the ultimate price that the patient pays for laboratory determinations. It is easy to be misled and assume that quoted laboratory prices include comparable services. Because of the difficulty of obtaining retail prices for laboratory tests under all circumstances, we should, as a minimum, compare laboratory prices that reflect identical service components and insist that all relevant service offerings and their applicable price schedules be available to physicians, patients, and third-party insurers.

We have been forced to pass rather quickly over methods for evaluating the technical quality of a laboratory's work and, further, how to relate price to quality. Two points deserve mention: (1) high price does not necessary reflect high quality, and (2) quality differences can be defended on a number of medical and economic grounds—not *all* must be of the highest quality.

Pricing policies in laboratories are not related solely to cost or to services offered. We have attempted to show that, among the five sample laboratories, much of the price differential may be based on the number of ancillary services offered. But we have not shown direct relationships between costs and prices, even in the urinalysis example that was used. The laboratory may use price to attract a certain physician, group, or other clientele. Some laboratory-testing markets are highly competitive, others highly monopolistic. We have not delved into issues of market power in the setting of laboratory prices in this paper.

An intriguing subject that requires more research and analysis is the relationship between the physician and the laboratory. Conflicts between professional considerations and economic incentives in the ordering of laboratory tests must be delineated, since the derived-demand characteristics of such tests diminish the orderly functioning of competitive market transactions. The problem of physicians' use of laboratory testing parallels certain issues faced earlier by the profession in the ordering of prescription drugs.

Finally, we need to consider the state of transition the industry is in for the purpose of evaluating desired points for public policy decisions. At the moment, it appears that odds favor the continued growth of large corporate laboratories. Whether this is an advantageous development for the delivery of high-quality health care in the U.S. is subject to much debate. We hope that this paper has raised a number of questions in the reader's mind about such an evolutionary trend.

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