

# Factors affecting laboratory test use and prices

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*The use of clinical laboratory tests has more than doubled during the past decade. Some observers of the health system feel that this growth is excessive and is a result of current payment systems. This article examines the effects of current reimbursement policies with regard to the use of laboratory tests and prices charged for tests. The results suggest the following:*

- The method of financing medical care, including cost sharing and prepaid group practice arrange-

*ments, affects the volume of laboratory testing through the number of patient contacts with the medical care system rather than through the number of tests used per patient contact.*

- Fee ceilings on physician time appear to be partially offset by higher test prices.
- Cost-based reimbursement for hospital services is associated with higher charges in hospital laboratories.

## Introduction

Spiraling costs of health care have been a major concern for more than a decade. Recognizing the relationship between increased medical spending and the adoption and use of new medical technologies, many now question whether technological innovations have yielded benefits commensurate with their costs. Highly visible and high cost technologies, such as organ transplants and the computed tomography scanner, have come under particular scrutiny. However, expenditures for the less costly, less glamorous technologies that are readily available to physicians, account for a large share of the growth in health expenses (Moloney and Rogers, 1979).

Clinical laboratory testing is an example of a relatively inexpensive procedure with high total costs. The number of laboratory tests performed grew 10 percent to 15 percent a year from 1950 to 1975; laboratory testing now accounts for \$11 billion in annual medical care costs (Bolsen, 1982). The number of ancillary services, such as laboratory tests and X-rays per episode of illness, has increased steadily both in and out of the hospital (Scitovsky, 1979). Inpatient laboratory testing and radiologic services account for up to 25 percent of hospital charges (Myers and Schroeder, 1981). Expenditures for outpatient testing compose in excess of 25 percent of charges for outpatient physician and ancillary services (Scitovsky, 1979). Although the growth in testing is due to several factors, many believe that current payment systems offer providers strong financial incentives to perform laboratory tests. Some argue that profit potential encourages physicians to substitute the use of the laboratory for the use of their own time. Hospitals are reimbursed, in large part, on a cost-reimbursement basis that offers them little incentive to hold down costs (e.g., by per-

forming fewer tests and other procedures). In addition, the patient has little economic reason to discourage the physician from ordering tests because a large fraction of the patient's bill is paid by third parties.

The conclusion that many draw from these arguments is that payment systems need to be modified to encourage cost containment and discourage excessive laboratory testing. In one effort to alter incentives, Medicare and Medicaid revised regulations in 1981, limiting reimbursement for laboratory tests to the lesser of the laboratory's actual charge to the physician or the laboratory's reasonable charge for the tests. More recently, new legislation established a prospective per case hospital payment system for Medicare that is expected to restore physicians' incentives to consider cost in ordering ancillary procedures, such as laboratory tests, for inpatients (U.S. Congress, Office of Technology Assessment, 1983). Another solution offered is to encourage cost consciousness on the part of the consumer by making the patient responsible for a larger share of costs. Yet another solution, is to restructure the delivery system by encouraging the growth of health maintenance organizations (HMO's) and other alternatives to the current fee-for-service system with third-party reimbursement.

The present research addressed the effect of current payment systems on the use of and charges for laboratory tests and the extent to which some of the proposed solutions might affect the use of laboratory tests. The question studied was: Do current payment systems encourage physicians to substitute the use of laboratory tests for other inputs, or does the growth in testing merely parallels the general growth in medical care utilization? In particular, does the use of laboratory tests vary:

- With the level of the patient's insurance coverage?
- Between a health maintenance organization (HMO) and the fee-for-service system?
- With the physician-laboratory billing arrangements?
- With regulation of the laboratory industry?

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Also investigated were the effects of Medicare's previous cost-based reimbursement policy on laboratory test costs and charges, and the effects of Medicare ceilings for office visit fees and room and board charges on laboratory test charges.

The research was both theoretical and empirical. For the empirical analysis, a number of extant data sources were used, including surveys conducted for the Department of Health, Education, and Welfare in 1975 and 1976 on physician practice costs and incomes (PPCI), data collected by Laboratory Management, and Medicare cost data. Data collected as part of the Rand health insurance experiment (HIE) have also been used. The experiment is a randomized trial in health care financing (Newhouse, 1974; Newhouse, et al., 1981). Families in six sites were enrolled in one of a number of experimental insurance plans that varied in the share of the bill that the family had to pay for medical expenditures. In one site—Seattle, Washington—some of the experimental participants were enrolled in an existing HMO, Group Health Cooperative of Puget Sound.

The main theoretical and empirical findings are divided into sections concerning: the use of laboratory tests by fee-for-service office-based physicians; the use of laboratory tests in a health maintenance organization; and cost-based reimbursement and hospital laboratory prices. Throughout, results are highlighted with only brief discussions of the methods used. Details of the theoretical developments, the methodologies, and the empirical analyses can be found in four technical reports prepared as part of the research (Danzon, 1980 and 1982; Marquis, 1982; and Manning, 1983).

## **Use of laboratory tests by office-based physicians**

### **Issues**

Out-of-hospital laboratory tests increased almost 70 percent between 1972 and 1977 (Gibson, 1979). Some believe this growth is due to the financial incentives inherent in test ordering. Bailey (1979) argues that the profit potential in laboratory testing for physicians who perform tests in-house (i.e., in their own offices) and for those who purchase tests from laboratories and then bill their patients for the tests, encourages them to overuse tests. Bailey concludes that "moving the physician out of the financial transaction in testing—via direct billing laws—is the only workable means of discouraging testing based on economic incentives" (Bailey, 1979).

The growth of insurance coverage is also cited as a factor in the growth of laboratory tests. Neither patients nor physicians, acting on behalf of their patients, have an economic incentive to hold down the number of tests ordered because a large share of the bill is paid by insurance. Although generous insurance

is widely believed to contribute to increased laboratory testing, previous empirical work has not investigated the effects of the level of the patient's insurance coverage on the physician's decision about the number of tests to order for a patient visit.

Another concern is that charges for tests by physicians are excessive relative to their production cost. In particular, are cost savings, brought about by automation of many routine tests, captured by physicians rather than passed on to consumers?

### **Theoretical findings**

The economic model used in this article assumes that physicians face a demand for visits that depends on the price consumers pay for a visit and the quality (level of care), per visit (Danzon, 1982; Marquis, 1982). Physicians are assumed to produce quality by combining their own time and laboratory tests. They are also assumed to choose these quantities (and hence the quality level) and to set prices for their time and for tests so as to maximize profits. Insurers, however, may place limits on the charges they allow for time and tests. Fee schedules limit charges in some insurance plans; other plans have fee screens based on the usual, customary, and reasonable charge for the service.

The model predicts that a physician will substitute laboratory tests for time to produce a unit of quality if the cost of tests decreases or if third-party allowable charges are reduced. However, changes in these factors may also affect the level of quality produced, and the direction of this change is theoretically uncertain. Thus, the theory does not predict how a decrease in the cost of tests or in third-party allowable charges will affect the absolute number of tests per visit or the length of the visit, although the ratio of tests to time will increase.

For similar reasons, the effect of an increase in the level of insurance coverage on the number of tests ordered per visit is uncertain. An increase in insurance coverage reduces the price that consumers pay for health care. Total health care consumed is expected to increase in response to this price decrease, but the direction of change in quality per visit is ambiguous. When a product has both a quality and quantity dimension, theory does not predict whether the increase in total consumption of the product will be due to an increase in quantity, an increase in quality, or both (Willis, 1973). Although total health care consumed and the total volume of laboratory tests are expected to increase if insurance coverage increases, the number of tests per visit may rise, fall, or remain unchanged.

As noted earlier, there is an increase in the ratio of tests to time resulting from reductions in third-party allowable charges. However, this prediction holds only if there are binding controls on charges for both tests and time. Third-party payers are believed to be

more lenient in their review of charges for laboratory tests than for other services because laboratory charges on any one claim are typically small (Bailey, 1979). If reimbursement for tests is not constrained, but there are limits on charges for physician time, the physician will vary test prices to achieve the optimum total price for the visit. (The physician will be able to do so if patients care only about the total charge for a visit and not how charges are divided between services.) That is, a decrease in the allowable charge for physician time will lead to an offsetting increase in the charge for tests. The use of tests per visit and visit length, however, will not be affected. Similarly, a constraint on fees for tests alone will not affect the number of tests or time per visit, but there will be an offsetting increase in fees for time.

Some have suggested that physicians who bill patients directly for tests have an incentive to order more tests than physicians who do not bill directly. As stated earlier, a reduction in the cost of tests leads physicians to substitute tests for time to produce each quality level. Therefore, if laboratories charge higher prices to patients than to physicians, one would expect physicians who control test billing to use more tests per visit for a quality level than physicians who do not. If the market is competitive, test use would not be expected to differ between physicians who control test billing and those who do not, absent differences in laboratory price schedules. Bailey (1979) argues that laboratories do use different price schedules for physicians and patients, and that this results in greater use of tests by physicians who control test billing. Different price lists do not necessarily mean that laboratories practice price discrimination, however. Laboratories argue that the price differences are due to cost differences; significant cost savings may be realized by billing a doctor for patients treated instead of billing each patient for each test.

## Empirical findings

### Effects of patient's insurance coverage

The evidence suggests that the patient's insurance coverage is not an important factor in the number of laboratory tests ordered during a visit. A summary of findings analyzing data from the 1976 PPCI is given in Table 1. The numbers in the table are based on a logit regression explaining test frequency; they show how the probability that the physician orders a test during an outpatient visit changes if the patient has insurance that differs from Blue Shield coverage (Danzon, 1982).<sup>1</sup> The change in probability given a change in insurance varies as the values of the other explanatory variables vary. The results in the table evaluate the probability change at one point in the distribution, namely at the mean values for the other explanatory characteristics. The change in probability for a physician with mean characteristics is not the

same as the mean change over all physicians. The results suggest that if the patient is uninsured, the probability that the physician performs any laboratory tests is 8.7 percentage points lower than if the patient has Blue Shield coverage. Although this difference is not statistically significant, it might suggest that physicians are more likely to order tests as the insurance coverage of the patient increases. However, the signs and rankings of the results for the other insurance plans are not consistent with this hypothesis. Medicare, supplemented by private insurance, and Medicaid are the plans in which out-of-pocket costs to the patient are likely to be lowest. If more generous insurance induced an increase in tests per visit, physicians would order more tests for patients with Medicaid or supplemented Medicare than for patients on any other plan. However, the results show that the probability of ordering a test is lower for patients with Medicaid or supplemented Medicare; only for Medicaid patients is test ordering significantly lower.

Table 1

### Effects of patient's insurance coverage on test frequency: Physician practice costs and incomes data results

| Patient's insurance plan | Change in test frequency relative to Blue Shield Plan 1 |      |
|--------------------------|---|------|
|                          | Percent   |      |
| No Insurance             | -   | 8.7  |
| Medicaid                 | 2 -   | 13.9 |
| Medicare only            | -   | 7.4  |
| Supplemented Medicare    | -   | 9.6  |
| Other insurance          |   | 0.8  |

<sup>1</sup>Estimated by fitting a logit equation for test frequency. The change estimate is evaluated at mean of nonplan factors.

<sup>2</sup>Significantly different from zero.  
SOURCE: Danzon (1982), Table 3.

In sum, the PPCI data do not show a consistent relationship between the patient's out-of-pocket cost and the probability that the physician performs a test during an office visit. In general, differences in test-ordering frequency for patients with different levels of insurance coverage are not statistically significant. Because patients on the different insurance plans also differ in other characteristics, a true effect of the level of insurance coverage on the number of tests ordered per visit may be masked in the PPCI data. Medicaid patients include a large number of children; Medicare patients are elderly and disabled. Clinical factors associated with the health problems and needs of these different groups may dominate any true effect of the level of insurance coverage on physician's test-ordering behavior. Another factor in these data that might offset an effect of generous insurance benefits is differences in the cost for public and private copayers.

The HIE data provide a better evaluation of the relationship between the patient's insurance and the number of tests ordered per visit. For the HIE study, families were randomly assigned to the experimental

<sup>1</sup>In addition to the insurance coverage indicator variables, other explanatory variables include the physician's specialty, and characteristics of the physician's practice and the local laboratory industry.

insurance plans so that the health and sociodemographic characteristics of families on one insurance plan were like those of families on any other plan. Except for the level of insurance benefits, reimbursement factors did not differ across plans. The HIE data confirm the conclusion that insurance coverage is not a significant determinant of the number of tests ordered per visit. Estimates from the HIE show how the probability of a physician's ordering a test during an outpatient visit changes as the share of the bill the patient pays (cost sharing) rises from zero (see Table 2). The results shown in Table 2 are for all outpatient visits; results for the probability of ordering a test during a routine examination are presented in Table 3. When specifically controlling for diagnosis, the results are similar to those for all visits; and the probability of ordering a test neither increases nor decreases consistently as the patient's cost sharing increases. Further, differences in the probability of ordering tests for patients with varying levels of cost sharing were not significant.

**Table 2**  
Effects of patient's insurance coverage on test frequency: Outpatient visits

| Patient's cost sharing <sup>2</sup> | Difference in test frequency relative to no cost sharing (free care) <sup>1</sup> |               |
|-------------------------------------|---|---------------|
|                                     | Adult patient   | Child patient |
| <b>Coinsurance percent</b>          | Percent change  |               |
| 25                                  | 0.8   | -2.5          |
| 50                                  | 6.3   | -6.0          |
| 95                                  | -0.4  | 2.0           |
| <b>Outpatient services only</b>     |   |               |
| 95                                  | 5.7   | 0.0           |

<sup>1</sup>Estimated by fitting a probit equation for test frequency. The change estimate is evaluated at the mean of nonplan factors in the regression including the physician's specialty, and other characteristics of the physician.

<sup>2</sup>The coinsurance rate applies until the family's out-of-pocket expenditure reaches a specified amount that depends on the level of family income. The maximum out-of-pocket expenditure faced by any family is \$1000.

SOURCE: Marquis (1982), Tables 2 and 3.

**Table 3**  
Effects of patient's insurance coverage on test frequency: Routine examination

| Patient's cost sharing <sup>2</sup> | Difference in test frequency relative to no cost sharing (free care) <sup>1</sup> |               |
|-------------------------------------|---|---------------|
|                                     | Adult patient   | Child patient |
| <b>Coinsurance percent</b>          | Percent change  |               |
| 25                                  | 0.2   | 5.1           |
| 50                                  | -8.8  | -5.6          |
| 95                                  | -0.3  | -2.7          |
| <b>Outpatient services only</b>     |   |               |
| 95                                  | 0.0   | 4.0           |

<sup>1</sup>Estimated by fitting a probit equation for test frequency. The change estimate is evaluated at mean of nonplan factors in the regression, including the physician's specialty, and other characteristics of the physician.

<sup>2</sup>The coinsurance rate applies until the family's out-of-pocket expenditure reaches a specified amount that depends on the level of family income. The maximum out-of-pocket expenditure faced by any family is \$1000.

SOURCE: Marquis (1982), Tables 2 and 3.

However, one should not conclude from these results that physicians' decisions about ordering tests are insensitive to the level of their patients' cost sharing. Although the health characteristics of individuals assigned to any one plan are the same as characteristics of individuals on other plans, the health characteristics of patients actually seeking care may not be balanced across plans. Patients with generous insurance benefits are more likely to consult a physician (Newhouse et al. 1981) and, therefore, may be, on average, less sick than patients on other plans who seek care. Physicians may tend to order more tests per visit for patients with generous coverage than for other patients who are equally sick; however, there is no observable effect of insurance on test ordering frequency because of the greater health needs of patients with less generous insurance. The results show that different influences on physicians' test-ordering decisions roughly balance. Hence one would not expect to observe an increase in the number of tests ordered per visit in response to an increase in the share of outpatient care charges paid by third-parties.

Both the PPCI and HIE data suggest that insurance coverage is not a significant determinant of the number of laboratory tests ordered during a visit; however, one can expect to find that changes in insurance coverage will substantially alter the total volume of laboratory tests. Data from the HIE have demonstrated that the extent of insurance coverage does affect the number of physician visits (Newhouse et al. 1981) and the number of episodes of illness treated (Keeler et al. 1983). Individuals with full coverage for medical care have 46 percent more physician office visits than individuals who are responsible for 95 percent of their medical expenditures. Because tests per visit do not vary as insurance varies, annual test volumes for outpatient care would be expected to vary across insurance plans about the same percentage as physician visit rates.

#### Effects of third party ceilings on allowable costs

Analysis of the 1975 PPCI data supports the hypothesis that controls on office visit fees are at least partially offset by higher fees for laboratory tests. A \$1 decrease in the Medicare allowable charge for an office visit is predicted to increase the fee for a complete blood count (CBC) by 5 percent (or about 50 cents); a \$1 decrease in the Medicaid allowable charge is predicted to lead to a 4 percent increase in the price of a CBC (Danzon, 1982).

If physicians who are faced with constraints on office visit fees adjust test prices to achieve the optimum total price, greater variability between physicians in prices charged for tests than in office visit fees can be expected. A comparison of the coefficients of variation for fees for a routine followup office visit with those for a CBC can be seen in Table 4. For each of the five physician specialties and for the group as a whole, the coefficient of variation is higher for the CBC fee than for the physician visit fee.

**Table 4**  
**Variation in physician fees by specialty**

| Specialty             | Coefficient of variation <sup>1</sup> |                          |
|-----------------------|---------------------------------------|--------------------------|
|                       | Office visit fee                      | Complete blood count fee |
| <b>Total</b>          | .37                                   | .59                      |
| General practice      | .22                                   | .70                      |
| General surgery       | .38                                   | .65                      |
| Pediatrics            | .31                                   | .34                      |
| Obstetrics/gynecology | .39                                   | .49                      |
| Internal medicine     | .30                                   | .35                      |

<sup>1</sup>The coefficient of variation is the standard deviation divided by the mean. Because it is a relative measure, free of the units in which the variable is measured, the coefficient of variation is useful for comparing the spread of variables measured in different units or with different mean. For the total sample, the mean office visit fee was 12.0 and the standard deviation was 4.4; the mean for the complete blood count fee was 8.0 and its standard deviation was 4.8.

SOURCE: Danzon (1982), Table 8.

### Effects of test location and test-billing arrangements

The PPCI data showed that the size of the physician's practice was positively correlated with the decision to perform tests in-house and the frequency of ordering tests. The two results imply a positive correlation between the frequency of tests and doing tests in-house. The HIE data also showed a positive relationship between testing in-house and the rate of test ordering.

Further, the HIE data weakly indicated that physicians who purchased tests and billed their patients performed more tests than physicians who referred patients to laboratories that directly bill the patient. The probability that the physician ordered a test during a visit by an adult was 10 percentage points higher if the patient was tested in-house than if the patient was referred to a laboratory that billed directly; for visits by children, the difference was 12 points. If the physician purchased tests and billed the patient, the probability of ordering tests for an adult was 6 percentage points higher than if the laboratory billed the patient; the difference in test frequency for children was 7 percentage points. Although the results evidenced consistently greater test frequency among physicians who control test billing than among those who do not, the estimates were imprecise and not statistically different from zero.

Although the results suggest that the frequency of test ordering is higher if the physician performs tests in-house or otherwise controls test billing, the results do not necessarily support Bailey's assertion that direct billing requirements would lower the rate of tests ordered. Because of scale economies for in-house testing, physicians who decide to test in-house are likely to be those who anticipate a high test volume. An expected high test volume may also provide an incentive to control the billing for purchased tests. That is, the causation may run from test volume to decisions about whether to produce tests or to obtain billing control rather than the reverse. With the available data, the causality cannot be disentangled. Thus,

one cannot conclude that physicians who perform tests in-house or who control billing of tests are induced to order more tests than other physicians.

### Effects of cost of production

Automation has dramatically reduced the cost of performing many tests. The concern that the cost savings have not been passed on to consumers but have been captured by physicians has been noted earlier. Although direct measures of the cost to physicians of purchasing tests were not available, characteristics of the local laboratory industry likely to be associated with costs were included in the analysis of the PPCI data.

Characteristics expected to be associated with a lower cost of purchased tests were significantly related to lower fees charged to patients for a CBC. This implies that, at least to some degree, cost savings are passed on to patients. Lower costs of purchased tests are also expected to result in a higher total test volume; however, the effect of lower costs on tests per visit cannot be predicted from theory and is an empirical question. The analysis showed that characteristics associated with a lower cost of tests were also associated with an increase in tests per visit.

### Effects of regulation

Some laboratory work is regulated. The basic regulations include personnel qualifications, quality control, and record keeping requirements. The Centers for Disease Control regulate independent laboratories operating in interstate commerce. In addition, any independent laboratory performing tests for Medicare patients is subject to regulation. Many States have also adopted some form of regulation of independent laboratories. In contrast, laboratories located in physicians' offices are, in general, exempt from these regulations.

The effect of regulation is generally to raise the cost of operation of independent laboratories; thus, regulation would be expected to affect prices for tests and test frequency in the same way as any change in the cost of production. Regulations may have other consequences as well. Those that raise operating costs of independent laboratories but exempt physician office laboratories may confer a cost advantage to in-house testing. Regulations, such as anti-rebate laws and truth-in-billing regulations, are aimed at reducing the profit potential of tests for physicians; these regulations would also be expected to increase physicians' incentive to perform tests in-house in order to realize the profit potential in testing.

After controlling for characteristics of the local laboratory industry, there were no significant effects of regulation on test frequency or the decision to do tests in-house (Danzon, 1982). However, there is a correlation between the structure of the industry and the degree of regulation of the industry, and this confounds estimation of the net effects of each. Regulation may well affect the characteristics of the industry, the frequency of testing, and the propensity of

local physicians to test in-house, but it is itself probably also affected by these factors (Danzon, 1982). Some unresolved issues are the direction of causation among the structure of the laboratory industry, the prescribing practices of physicians, and the regulation of the laboratory industry.

## **Use of laboratory tests in a health maintenance organization**

### **Issues**

A number of observers of the health care sector believe that a restructuring of the delivery system is necessary to alter the financial incentives that have resulted in rampant inflation in medical care (Enthoven and Noll, 1979). These observers argue that regulatory efforts at cost control have not been effective and that increased cost-sharing in the fee-for-service medical system would place an undesirable amount of the burden of economizing on consumers. Proponents of this view feel that institutional arrangements such as health maintenance organizations (HMO's) provide incentives to physicians to use resources efficiently.

An HMO provides health services to its members for a fixed, periodic payment that is set in advance and is independent of the use of services. In this system, physicians do not receive additional income when they provide a greater number of, or more expensive, services. Therefore, advocates believe that the provider will not overprescribe treatment because the HMO bears the full cost of additional care. In contrast, in the fee-for-service system, physicians receive additional payment for additional service. HMO advocates suggest that payment-for-service, coupled with extensive insurance coverage, which shields the patient from the full cost of additional services, encourages providers to overprescribe treatments.

Much of the empirical evidence that HMO's are more cost conscious than fee-for-service providers is weak because of two flaws in most available data (Luft, 1980). First, in many comparisons of fee-for-service with HMO's, the amount of cost sharing required of patients differs between the alternative systems; that is, it is not clear whether cost-sharing differences or institutional structures drive the results. Second, the empirical evidence may be biased by self-selection. HMO enrollees have voluntarily chosen the HMO over the fee-for-service system. If HMO's attract healthier or sicker people than the fee-for-service system, then differences between the systems may reflect differences in the (usually unmeasured) health status of members instead of institutional differences.

This research, using data from the HIE, investigated differences in the use of laboratory services between the fee-for-service system and an HMO. Because the HIE is a randomized, controlled trial, these data do not exhibit flaws inherent in previous studies.

## **Empirical findings**

In the analysis, a comparison was made of tests used between three groups of participants in the HIE. One group is a random sample of the Seattle, Washington population enrolled by the HIE in a plan with no patient cost sharing; this is referred to as the "free fee-for-service" plan because patients face no out-of-pocket charges for their medical care. The second is a similar group enrolled experimentally by the HIE in an HMO plan at Group Health Cooperative of Puget Sound (GHC); these individuals were not charged for any services obtained from GHC. The third is a random sample of individuals who had already belonged to GHC—a control group. GHC subscribers are not charged for services used other than prescriptions, supplies, and certain mental health procedures.

The group assigned to the free fee-for-service plan and those assigned to GHC are random samples from the same population, and both have the same insurance benefits. Therefore, any difference in the use of laboratory testing between the groups can be attributed to different incentives inherent in the fee-for-service system and HMO's. The comparison is not confounded by self-selection or differences in cost-sharing requirements. A comparison of the GHC experimental group and the GHC control group measures any self-selection into the GHC: The two groups differed only in that one group had voluntarily chosen the GHC over fee-for-service.

The empirical analysis of data from the first two years of the study revealed no significant differences in annual outpatient laboratory test use between these three groups, after controlling for health status and socioeconomic characteristics. However, inpatient testing for those in the fee-for-service system was almost twice that for patients in either HMO group. These results accord with other findings in the literature, which show that differences in utilization between the fee-for-service system and HMO's are concentrated in inpatient rather than outpatient care. The results of previous empirical work, which has found a lower rate of hospital admissions in HMO's as compared with the fee-for-service system, suggests that part, if not all, of the difference in the volume of inpatient laboratory use between the systems is due to differences in admission rates rather than testing per admission. This is similar to the finding about cost sharing; that is, cost sharing affects the volume of outpatient laboratory tests in the fee-for-service system through effects on the number of patient contacts rather than test use per contact. In subsequent research, the estimate of the difference between the systems in inpatient laboratory test use will be disaggregated; this will show the effect due to differences in admissions and the effect due to differences in test use per admission.

Predicted annual laboratory use per person in each of the groups is shown in Table 5. To obtain the predictions, two behavioral equations were used to model annual outpatient laboratory testing and two behavioral equations were used for inpatient testing (Manning, 1983). Annual per person laboratory use is then predicted for each group, assuming that individuals in each group have the distribution of age, sex, health and family characteristics observed in the free and GHC experimental population.

Controlling for socioeconomic and health characteristics, predicted annual laboratory use by the GHC control group is the same as use by the GHC experimental group (Table 5). However, one might expect differences in actual use between the GHC control group and experimental group (i.e., before adjusting the groups to a common set of characteristics) because the control group is a self-selected one. In actual practice, individuals are not randomly assigned to HMO's but choose between an HMO and a conventional insurance plan. The issue of self-selection is important in the debate over the financing of medical care services because many feel that HMO's hold down costs by attracting low utilizers and screening out sickly patients.

**Table 5**  
**Predicted annual per person use of laboratory tests in fee-for-service and an HMO<sup>1</sup>**

| Group                                 | Outpatient use <sup>2</sup> | Inpatient use <sup>2</sup> |
|---------------------------------------|-----------------------------|----------------------------|
| Free fee-for-service                  | 31.8 (2.6)                  | 12.3 (2.6)                 |
| Group Health Cooperative experimental | 34.0 (1.7)                  | 3 6.9 (1.3)                |
| Group Health Cooperative controls     | 34.7 (2.5)                  | 3 6.0 (1.3)                |

<sup>1</sup>Reference population: GHC experimental group and free fee-for-service group.

<sup>2</sup>Use is measured in expenditure units which are obtained by multiplying California Relative Value Scale units by \$.90 for 1976 services, \$1.00 for 1977 services, and \$1.10 for 1978 services.

<sup>3</sup>Significantly different from fee for service.

NOTE: Standard errors are in parentheses.

SOURCE: Manning (1983), Table 4.2.

The effect of self-selection is assessed by contrasting laboratory use by GHC controls under two assumptions: first, that the control group has the same distribution of measured characteristics as the randomly selected experimental group; second, that the control group has the observed distribution of characteristics. The results, given in Table 6, show that the adjustment for population characteristics does not alter predicted inpatient laboratory use, but it has a small effect on outpatient use. Predictions for outpatient laboratory services suggest that the GHC control group uses 7 percent more services than they would if they were a representative sample of the community. Thus, individuals who self-select into an HMO do not appear to be lower than average utilizers, at least in

this example. However, these results are for one HMO in one site and may not generalize to other sites or to other prepaid group practices.

**Table 6**  
**Predicted annual laboratory use by Group Health Cooperative of Puget Sound**

| Reference group                   | Outpatient use <sup>1</sup> | Inpatient use <sup>1</sup> |
|-----------------------------------|-----------------------------|----------------------------|
| Experimentals                     | 34.7 (2.5)                  | 6.0 (1.3)                  |
| Group Health Cooperative controls | 37.3 (2.2)                  | 6.1 (1.4)                  |

<sup>1</sup>Use measured in expenditure units, see footnote 2 in Table 5.

NOTE: Standard errors are in parentheses.

SOURCE: Manning (1983), Table 4.4.

## Cost-based reimbursement and hospital laboratory prices

### Issues

Retroactive cost-based reimbursement is considered by many to be a principal cause of the rapid inflation in hospital costs. Some private insurance plans use cost-based reimbursement formulas; since the introduction of Medicare and Medicaid in 1966, this method of reimbursement has accounted for over half of hospital revenues. It is often argued that cost-based reimbursement offers little incentive for hospitals to be cost conscious in their delivery of services because additional costs generate additional revenues. Rising hospital costs have become a serious problem for the Medicare program and cost-based reimbursement is often cited as the cause. Recently, Congress legislated a prospective per-case payment system for the Medicare hospital insurance program, which is intended to restore the appropriate incentives absent under prior cost-based reimbursement policies.

Cost based reimbursement is also criticized for its effects on the structure and level of charges to charge-paying patients (Davis, 1973; Hellinger, 1975). Charge paying patients are those with no insurance and patients with insurance that reimburses on the basis of hospital prices rather than cost. In addition, recent attempts to control costs by Medicare, Medicaid, and State rate-setting commissions are said to have forced hospitals to increase their charges to charge-paying patients in order to cover their costs (Iglehart, 1979).

### Theoretical findings

A theoretical model to analyze the effects of Medicare's reimbursement policies on charges and costs in hospital laboratories was presented in one of the series of reports for this study (Danzon, 1980). The basic Medicare formula is intended to pay for the share of hospital costs incurred on behalf of Medicare beneficiaries. The thesis of the theoretical model is that

accounting costs reported for reimbursement purposes should not be interpreted as economic costs, but rather as prices to cost-paying patients. If the hospital serves both Medicare (or other cost-paying patients) and charge-paying patients, it can set two price schedules. Charges are the prices to charge-paying patients; fully allocated costs are the prices to cost-paying patients. The hospital sets charges in each department and allocates overhead costs among departments to maximize revenue.

The effect of cost-based reimbursement is to raise charges in all departments above the level that would be set by a profit maximizing monopolist in the absence of cost-paying patients. Both charges and costs in the hospital laboratory (or other department) are predicted to increase as the fraction of total laboratory (or other department) services provided to Medicare patients increase, and as allocated overhead cost increase. The optimum allocation of overhead requires that the Medicare share of services be the same in all departments; if the Medicare share is not uniform, revenue maximization requires allocating as much overhead as possible to the department used most intensively by Medicare patients.

Medicare's reimbursement policies incorporate two constraints designed to control costs. First, Medicare imposes a ceiling on the per diem cost for daily services (basic room and nursing services). Second, Medicare reimbursement is limited to the lesser of either costs or charges.

It is predicted that a ceiling on allowable costs for daily services will increase the fraction of overhead allocated to the laboratory. This, in turn, implies some offsetting increase in both costs and charges in the laboratory.

The constraint that Medicare reimbursement be the lesser of either costs or charges is also predicted to raise the level of laboratory costs and charges.<sup>1</sup> The increase will be greater, the greater the laboratory's share of total Medicare charges across all departments.

In sum, the theoretical analysis suggests that both costs and charges in the laboratory will be higher:

- The greater the fraction of laboratory services provided to Medicare patients.
- The greater the laboratory share of total hypothetical charges for Medicare patients.
- The lower the ceiling on per diem costs.

### Empirical findings

The predictions of the theoretical model were tested with 1976 data on a sample of short-stay general hospitals in California; the data are from Medicare cost reports and the California Health Facilities Commission. The California Medicaid program, Medi-Cal, uses a reimbursement formula similar to that of Medicare, so the theoretical predictions should apply to both programs.

<sup>2</sup>This result may not hold if an increase in charges leads to a large reduction in the fraction of billed charges actually collected.

The empirical analysis supports the theoretical prediction that cost-based reimbursement results in higher laboratory costs and charges. Table 7 summarizes the effects of reimbursement variables on fully-allocated costs and charges. These results were obtained by regressing reimbursement variables and other explanatory variables on costs and charges (Danzon, 1980). Summary results from two regressions are reported for both costs and charges. The first includes only the Medicare and Medicaid share of laboratory services as reimbursement variables. These are the factors that reflect the effect of cost-based reimbursement in the absence of Medicare cost controls. The second set of results adds the fraction of the total Medicare charges incurred in the laboratory and the limit on daily services costs. These additional reimbursement variables reflect the effect of the cost controls.

**Table 7**  
Effects of reimbursement factors on laboratory costs and charges<sup>1</sup>

| Dependent variable    | Excluding cost control measures |         | Including cost control measures |         |
|-----------------------|---------------------------------|---------|---------------------------------|---------|
|                       | Cost                            | Charges | Cost                            | Charges |
| Lab services          |                                 |         |                                 |         |
| Medicare percent      | 28.2                            | 29.3    | 24.0                            | 22.3    |
| Lab services          |                                 |         |                                 |         |
| Medicaid percent      | 8.6                             | 211.7   | 27.2                            | 29.0    |
| Lab share of          |                                 |         |                                 |         |
| Medicare percent      | —                               | —       | 12.6                            | 221.2   |
| Actual/per diem limit | —                               | —       | 1.4                             | 0.5     |

<sup>1</sup>Percent change in costs or charges from 10 percent change in variable.

<sup>2</sup>Significantly different from zero.

SOURCE: Danzon (1980), Table 3.

Using the Medicare and Medicaid shares of laboratory services as the only reimbursement variables, the results show that a 10 percent increase in the Medicaid share increases fully allocated laboratory cost by 8.2 percent and laboratory charges by 9.3 percent; a 10 percent increase in the Medicaid share results in an 8.6 percent increase in fully allocated laboratory cost and an 11.7 percent increase in charges. Thus, as predicted by the theoretical model, an increase in the fraction of laboratory services provided to cost-paying patients increases both costs and charges.

In the second set of results, additional reimbursement variables that capture the effect of cost controls are added. The laboratory share of total Medicare charges has a positive effect on both costs and charges, as predicted if the lesser of costs and charges constraint is binding. The limit on per diem costs does not appear to affect either costs or charges. The per diem ceilings were not binding on most hospitals during the year covered by the data, so the absence of a positive effect is not a valid test of the hypothesis that a ceiling on costs for daily services increases costs and charges in the laboratory.

The analysis of laboratory charges did suggest that cost control efforts by Medicare result in higher prices to charge-paying patients. As noted earlier, some have argued that cost control efforts have forced hospitals to shift nonreimbursed costs from their cost-paying patients onto their charge-paying patients; that is, charge-paying patients are subsidizing Medicare, Medicaid, and other cost-paying patients. This argument requires that charges exceed costs. Among the sample of California hospitals in 1976, laboratory charges did exceed laboratory costs, indicating a shifting from cost-paying to charge-paying patients. However, total operating costs exceeded total operating charges, though by only 1 or 2 percent. This evidence suggests that shifting from cost- to charge-paying patients in some departments is more than offset by a reverse shift in other departments.

## Summary of findings and conclusions

In this research, the effects of reimbursement policies on the use of, and charges for laboratory tests were investigated. The principal findings are:

- The level of the patient's insurance coverage does not influence the number of tests ordered during an outpatient visit. Nonetheless, further increases in the share of ambulatory care expenditures paid for by third parties would result in higher total test volumes because physician visit rates are higher the more generous the insurance coverage.
- Laboratory use is lower in an HMO than in the fee-for-service system. The difference is concentrated in inpatient use of the laboratory; no differences were detected in ambulatory laboratory use between the two systems.
- Physicians who control test billing order more tests per visit than other physicians. It may be that physicians who expect to perform many tests have an incentive to do the tests in-house or to purchase tests and bill their patients, rather than to have the laboratory bill the patients directly. Hence, physician control of test billing may be the result of an anticipated high test volume rather than the cause of a higher test-ordering frequency.
- Fee ceilings on inputs other than laboratory tests, such as physician time, are partially offset by higher test prices. Medicare and Medicaid fee ceilings on office visit fees were associated with higher fees for tests. Hospital laboratory charges were not affected by per diem ceilings on basic room and nursing services, but the ceilings were not binding on most hospitals.
- Cost-based reimbursement for hospital services appears to increase costs and charges in hospital laboratories; the larger the share of laboratory services attributable to cost-paying patients, the higher are hospital laboratory costs and charges. Further, charges for laboratory service exceeded, on average, the costs of services, suggesting that charge-paying patients subsidize hospital laboratory use by Medicare and other cost-paying patients. For the hospital as a whole, however, there was no evidence of such a cross subsidy.

This research has shown that the method of financing medical services, including cost sharing and prepaid group practice, can affect the volume of laboratory tests. Some policy initiatives under consideration may reduce the trend toward greater use of tests. Under present reimbursement policies, testing has increased to a point that some observers fear may be excessive. However, the theoretical results summarized in this article show that reimbursement policies will not induce an excessive substitution of tests for other inputs unless there are constraining fee controls on all inputs. Our empirical work tended to support this theory. The empirical work suggests that much of the growth in laboratory testing reflects the impact of reimbursement policies on the number of patient contacts with the medical care system, rather than an increased use of tests per contact. Addressing the consequences for patient outcomes of the growth in test use was outside the scope of this study; other research must assess whether the additional laboratory tests have produced patient benefits that are commensurate with the additional costs.

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