Factors Affecting Laboratory Test Use and Prices

Executive Summary

Patricia Munch Danzon, Willard G. Manning, Jr.,
M. Susan Marquis

35th Year Rand

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PREFACE

This report summarizes the results of four studies conducted by The Rand Corporation under Contract No. 500-78-0048 with the Health Care Financing Administration, U.S. Department of Health and Human Services. The research performed under the contract examines the effects of reimbursement policies on the use of laboratory tests ordered by physicians, and prices charged for the tests. Detailed analyses of the issues are presented in four companion reports:

- Profits in Hospital Laboratories: The Effects of Reimbursement Policies on Hospital Costs and Charges, Patricia Munch Danzon, R-2582-HCFA, September 1980.
- Economic Factors in the Use of Laboratory Tests by Office-Based Physicians, Patricia Munch Danzon, R-2525/1-HCFA, August 1982.
- Laboratory Test-Ordering by Physicians: The Effect of Reimbursement Policies, M. Susan Marquis, R-2901-HCFA, August 1982.
- The Use of Pathology Services: A Comparison of Fee-For-Service and a Prepaid Group Practice, Willard G. Manning, Jr., R-2919-HCFA, January 1983.

This summary report, less technical and detailed than the others, surveys the major findings of the research. It should be of particular interest to decisionmakers who formulate health policy.

SUMMARY

The research summarized here investigated the effects of reimbursement policies on the use of, and charges for, laboratory tests. Our principal findings are summarized below.

1. The percent of the bill that the patient's insurance coverage pays 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 the number of tests per single visit is invariant with respect to the generosity of insurance, but the number of physician visits increases as insurance generosity increases.

2. Laboratory use is lower in a Health Maintenance Organization (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. Further research will disaggregate the inpatient effect into reduced admissions and reduced use per admission. Because our results derive from only one prepaid group practice, however, they may not generalize to all prepaid groups.

3. Physicians who control test billing appear to 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 volume of tests rather than the cause of a high volume.

4. Fee ceilings on inputs other than laboratory tests, such as physician time, appear to be offset, at least partially, 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.

5. 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 services in this study 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.

ACKNOWLEDGMENTS

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I. INTRODUCTION

The rising costs of health care have been of major concern for more than a decade. During the 1970s, expenditures for health care rose more than 200 percent, increasing more rapidly than the Gross National Product. Many observers cite the adoption and use of high-cost medical technologies as a central cause of that trend. Others attribute more importance to the increasing reliance on less costly technologies that are readily available to physicians (Moloney and Rogers, 1979).

Clinical laboratory testing is an example of a relatively inexpensive procedure that accounts for high total costs. The number of laboratory tests performed grew 10 percent to 15 percent a year from 1950 to 1975 (Bolsen, 1982), and laboratory testing now accounts for $11 billion in annual medical care costs. Although that growth is due to several factors, many believe that current payment systems offer providers strong financial incentives to perform unnecessary laboratory tests. Some authors argue that profit potential encourages physicians to substitute the use of technologies for the use of their own time. Through government programs, hospitals are reimbursed in large part on a cost-reimbursement basis that offers them little incentive to hold down costs by performing fewer tests and other procedures. In addition, the patient has little economic reason to discourage his provider 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

unnecessary testing. In one effort to alter incentives, Medicare and Medicaid regulations were revised in 1981 to limit reimbursements to physicians, for laboratory tests performed, to the lesser of the laboratory's actual charge to the physician or the laboratory's reasonable charge for the tests. 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. Still other observers believe that the only long-run solution is to restructure the delivery system by encouraging the growth of health maintenance organizations (HMOs) and other alternatives to the current fee-for-service system.

Our research addressed these issues. Our objectives were to investigate the effect of current payment systems on the use of and charges for laboratory tests, and to assess to what extent some of the proposed solutions might affect the use of laboratory tests. We inquired whether current payment systems encourage physicians to substitute the use of laboratory tests for other inputs, or whether the growth in testing merely parallels the general growth in medical care utilization. In particular, we examined how the use of laboratory tests varies with the level of the patient's insurance coverage, between a health maintenance organization (HMO) and the fee-for-service system, with billing arrangements between physician and laboratory, and with regulation of the clinical laboratory industry. We also investigated how Medicare's cost-based reimbursement affects the costs and charges of laboratory tests, and to what degree Medicare ceilings on office visit fees and room and board charges have resulted in higher charges for laboratory tests.

Our approach was both theoretical and empirical. For the empirical analysis, we drew on a number of extant data sources, including surveys conducted for the Department of Health, Education, and Welfare in 1975 and 1976 on Physician Practice Incomes and Costs, data collected by Laboratory Management, and Medicare cost data. We also have used data collected as part of the Rand Health Insurance Experiment (HIE).[1] The experiment is a randomized, controlled trial in health care financing. Families in six sites are enrolled in one of a number of experimental insurance plans that vary in the share of the bill that the family has to pay for medical expenditures. In one site, Seattle, Washington, some of the experimental participants are enrolled in an existing HMO, Group Health Cooperative of Puget Sound.

This Executive Summary summarizes our main theoretical and empirical findings, with only brief discussions of the logic and methods used. The companion reports (see Preface) present the theoretical developments, the methodologies, and the empirical analyses in more detail. Section II below presents our results concerning the effects of reimbursement policies on the use of laboratory tests by office-based physicians in the fee-for-service system. Section III compares laboratory use in the fee-for-service system with use in an HMO. Section IV summarizes the analyses of the effects of cost-based reimbursement on hospital laboratories.

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[1] For a description of the experiment, see Newhouse (1974) or Newhouse et al. (1981).

II. 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 that the use of tests has become excessive and is due to the financial incentives inherent in test-ordering. Bailey (1979), among other authors, 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, p. 5).

The growth of insurance coverage is also cited as a factor in the growth of laboratory tests. It is contended that neither patients, nor doctors 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 cost of production. In particular, it is sometimes alleged that cost-savings brought about by automation of many

routine tests are captured by physicians rather than being passed on to consumers.

THEORETICAL FINDINGS

The economic model of physician behavior developed in this research (see Danzon, 1982) assumes that physicians combine their own time and laboratory tests to produce a given level of care (or quality) per visit. The physician faces a demand for visits that depends on both the quality of a visit and on the price the consumer pays for a visit. The total visit price is the sum of the price of tests and the price of the physician's time. The patient may pay only some fraction of the total visit price if the patient has medical insurance. Physicians are assumed, in this model, to have discretion in how they combine their time and laboratory tests to produce quality; they are also assumed to make these choices so as to maximize profits.

The theory does not predict whether increases in the level of insurance coverage--that is, the percentage paid by a third party--will lead to an increase or decrease in the number of tests ordered per visit (see Marquis, 1982). An increase in insurance coverage reduces the price that consumers pay for health care by reducing both the price of additional visits and the price of improved quality for a single visit. We expect total health care consumed to increase in response to this price decrease. When a good has both quality and quantity dimensions, however, other analysts have shown that economic theory cannot predict whether the increase in total consumption of the good, induced by the price reduction, will be due to increased quantity, higher quality, or both (see, e.g., Willis, 1973). Therefore, total health care consumed is expected to increase if insurance coverage

increases, but the number of tests per visit may rise, fall, or remain unchanged.

The theory also does not predict the direction of change in the number of tests per visit following a change in the cost of producing tests or a change in the implicit cost of physician's time (Marquis, 1982). For example, a decrease in the cost of tests would cause physicians to use more tests per visit to produce a given quality of care. However, a decrease in the cost of tests also lowers the cost schedule for the quantity of visits; adjustments in quantity may lead to changes in the level of quality produced and hence in the level of testing per visit.

The model does predict that physicians who control test billing will use more tests per visit to produce a given level of quality than physicians who do not, if the laboratories charge higher prices to patients than to physicians. 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 all his patients instead of billing each patient for each test.

Practices of third-party payors may also affect the number and prices of tests performed. Insurance plans typically place limits on

charges they allow for services. Fee schedules limit charges in some plans; other plans have fee screens based on the usual, customary, and reasonable charge for the service. Third-party payors 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 there are no third-party constraints on the reimbursement for tests, 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.

Third-party ceilings on reimbursement for tests will have no effect on the use of tests per visit as long as the charges for some other components of the visit are unconstrained and patients are concerned only with the total price of the visit, not the component charges. Binding constraints on allowable charges for both tests and physician time will lead physicians to substitute tests for time. However, binding controls on both charges may also affect the level of quality; consequently, the effect on the absolute number of tests per visit cannot be determined from theory.

EMPIRICAL FINDINGS

Effects of Patient's Insurance Coverage

Our evidence suggests that the patient's insurance coverage is not an important factor in the number of laboratory tests ordered during a

Table 1

EFFECTS OF PATIENT'S INSURANCE COVERAGE ON TEST FREQUENCY: PPCI DATA RESULTS

Patient's Insurance Plan	Change in Test Frequency Relative to Blue Shield Plan (%)[a]
No insurance	-8.7
Medicaid	-13.9[b]
Medicare only	-7.4
Supplemented Medicare	-9.6
Other insurance	0.8

[a] Estimated by fitting a logistic equation for test frequency. The change estimate is evaluated at mean of nonplan factors.

[b] Significantly different from zero at p = 0.05.

visit. Table 1 summarizes findings from an analysis of data in the 1976 Physician Practice Costs and Income Survey (PPCI). The numbers in the table are based on a logistic 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.[1] For example, the results suggest that if the

[1] The full logistic equation is given in Danzon, 1982. The change in probability, given a change in insurance, varies as the values of the other explanatory variables vary. The results in Table 1 evaluate the probability change at one point of the distribution, namely at the mean values for the other explanatory characteristics. The change in probability for a physician with average characteristics is not the same as the mean change over all physicians.

patient is uninsured, the probability that the physician performs any laboratory test 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 be more likely to order 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, although only for Medicaid patients is test ordering significantly lower.

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. However, a true effect of the level of insurance coverage on the number of tests ordered per visit may be masked in the PPCI data, because patients on the different insurance plans also differ in other characteristics. Medicaid patients include a large number of children; Medicare patients are the 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 that might offset an effect of the generosity of the insurance benefits in these data is differences in the cost of billing public and private copayors.

The HIE data provide a better evaluation of the relationship between the patient's insurance and the number of tests ordered per visit, because families are assigned to the experimental plans so that the characteristics of families on one insurance plan are like those of families on any other plan and, except for the level of insurance benefits, reimbursement factors do 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. Table 2 shows estimates from the HIE of how the probability of a physician's ordering a test during an ambulatory visit changes as the share of the bill the

Table 2

EFFECTS OF PATIENT'S INSURANCE COVERAGE ON TEST FREQUENCY: HIE DATA RESULTS

Patient's Cost-Sharing (% Coinsurance)[b]	Change in Test Frequency Relative to No Cost-Sharing (Free Care) (%)[a]	
	Adult Patient	Child Patient
25% on all services	0.8	-2.5
50% on all services	6.3	-6.0
95% on all services	-0.4	2.0
95% on outpatient services	5.7	0.0

[a]Estimated by fitting probit equation for test frequency. The change estimate is evaluated at the mean of non-plan factors in the regression.

[b]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.

patient pays (cost-sharing) rises from zero. Results shown in Table 2[2] are for all ambulatory care visits, but similar results were obtained when we controlled for the medical problem. 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 are not significant.[3]

We should not conclude from these results that physicians' decisions about ordering tests are not influenced by the level of their patients' cost-sharing. Patients with generous insurance are more prone to consult physicians (Newhouse et al., 1981), and therefore may be, on average, less sick than other patients who seek care. Even if physicians do tend to order more tests per visit for patients with generous coverage than for other patients who are equally sick, we may not observe an effect of insurance on test-ordering frequency because of the greater health needs of patients with less generous insurance. Our results do show that the different influences on physicians' test-ordering decisions balance; consequently, 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 ambulatory care charges paid by third-parties.

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[2] The numbers in Table 2 are derived from a probit equation explaining the probability of ordering at least one test during a visit. Again, the probability change is for a physician with mean characteristics and is not the mean response over all physicians.

[3] A few of the univariate probit t-statistics are significant. However, the univariate t-statistics are too high because of intracluster correlation. The coefficients are not significantly different from zero after applying an upper-bound adjustment for the intracluster correlation.

Although 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, we can still 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 doctor 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 ambulatory care would be expected to vary across insurance plans by 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 leads to a 4 percent increase in the price of a CBC.[4]

If physicians who are faced with constraints on office visit fees adjust test prices to achieve the optimum price, we expect there will be greater variability between physicians in prices charged for tests than

[4] See the regression analysis in Danzon (1982). The Medicare and Medicaid fee limit variables taken singly were not significantly different from zero, but the two taken together were.

in office visit fees. Table 3 compares coefficients of variation[5] for fees for a routine follow-up office visit with those for a complete blood count. 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 office visit fee.

Table 3

VARIATION IN PHYSICIAN FEES BY SPECIALTY

	Coefficient of Variation	
Specialty	Office Visit Fee	Complete Blood Count Fee
General practice	.22	.70
General surgery	.38	.65
Pediatrics	.31	.34
Obstetrics/gynecology	.39	.49
Internal medicine	.30	.35
Total	.37	.59

Effects of Test Location and Test Billing Arrangements

The PPCI data showed that test frequency was positively associated with the size of the physician's practice. Practice size was also a positive determinant of the decision to perform tests in-house. The two results suggest 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 purchase tests and bill their patients perform more tests than physicians who refer patients to laboratories that directly bill the patient. The probability that the physician ordered a test during a visit by an adult

[5] The coefficient of variation is the standard deviation divided by the mean.

was 10 percentage points higher if the physician tested in-house than if he referred the patient to a laboratory that bills directly; for visits by children, the difference was 12 percentage 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.[6]

Although our results suggest that the frequency of test ordering is higher if the physician performs tests in-house or otherwise controls test billing than if he does not, the results do not necessarily support Bailey's assertion that direct billing requirements would lower the rate of tests ordered. If the anticipation of high test volumes provides the physician with an incentive to perform tests in-house (because of economies of scale) or to control the billing for those tests, our results overestimate the net effects of billing control on test volume. 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 available data, we were unable to disentangle the causality. Thus, we cannot conclude that physicians who perform tests in-house or who control billing of tests are induced to order more tests than other physicians.

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[6] The univariate probit t-statistics showed significant effects. When we applied the full upper-bound adjustment for intracluster correlation, however, the results were not significant.

Effects of Cost of Production

Automation has dramatically reduced the cost of performing many tests. We noted the concern that the cost savings have not been passed on to consumers but have been captured by physicians. 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 physician offices are, in general, exempt from these regulations.

The effect of regulation is generally to raise the cost of operation of independent laboratories; regulation therefore 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 aimed at reducing the profit potential of tests to physicians, such as anti-rebate laws and truth-in-billing regulations, would also be expected to increase the 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 correlation hampers 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. The direction of causation among structure of the laboratory industry, regulation of the laboratory industry, and prescribing practices of physicians are among the unresolved issues.

III. 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 (see, for example, Enthoven and Noll, 1979). They 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 (HMOs) provide more appropriate 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, proponents argue, 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 HMOs are more cost-conscious than fee-for-service providers is weak, however, because of two flaws in

most available data.[1] First, in many comparisons of fee-for-service with HMOs, the amount of cost-sharing required of patients differs among 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 HMOs 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.

Using data from the HIE, this research 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

The analysis compared test use among three groups of participants in the HIE that are of interest to the fee-for-service/HMO comparison. One group is a random sample of the Seattle, Washington, population enrolled by the HIE in a free (no cost-sharing) fee-for-service plan. The second is a similar group enrolled by the HIE in a free HMO plan at Group Health Cooperative of Puget Sound (GHC). The third is a random sample of persons 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.

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[1] Luft (1981) provides an excellent review of the issues and the literature.

The empirical analysis of data from the first two years of the study revealed no significant differences in annual ambulatory laboratory test use among 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 persons in either HMO group. These results accord with other findings in the literature, which show that differences in utilization between the fee-for-service systems and HMOs are concentrated in inpatient rather than outpatient care.

Predicted annual laboratory use per person in each of the groups is shown in Table 4. To obtain the predictions, two behavioral equations were used to model annual ambulatory laboratory testing, and two behavioral equations for inpatient testing.[2] Annual per-person laboratory use is then predicted for each group, assuming that each group has the same distribution of age, sex, health, and family characteristics as the free and GHC experimental population.

Controlling for socioeconomic and health characteristics, predicted annual laboratory use is about the same for both the GHC controls and GHC experimentals (Table 4). However, we might expect differences in actual use between the GHC controls and experimentals (i.e., before adjusting the groups to a common set of characteristics) because the controls are a self-selected group. In actual practice, individuals are not randomly assigned to HMOs 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

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[2] Details of the methodology are given in Manning (1983).

Table 4

PREDICTED ANNUAL PER PERSON USE OF LABORATORY TESTS IN FEE-FOR-SERVICE AND AN HMO

(Standard errors in parentheses)

Group	Ambulatory Use[a]		Inpatient Use[a]	
Free fee-for-service	31.8	(2.6)	12.3	(2.6)
GHC experimental	34.0	(1.7)	6.9*	(1.3)
GHC controls	34.7	(2.5)	6.0*	(1.3)

NOTE: Reference population consists of GHC experimentals and free fee-for-service plans.

[a]Use is measured in expenditure units, which are obtained by multiplying California Relative Value Scale units by $0.90 for 1976 services, $1.00 for 1977 services, and $1.10 for 1978 services.

*Significantly different from fee-for-service.

observers contend that HMOs hold costs down by attracting low utilizers and screening out sickly patients.

The effect of self-selection is assessed by contrasting laboratory use by GHC controls under two assumptions: first, that the controls have the same distribution of measured characteristics as the randomly selected experimental participants; second, that the controls have their observed distribution of characteristics. The results, given in Table 5, show that the adjustment for population characteristics does not alter predicted inpatient laboratory use, but has a small effect on outpatient use. Predictions for outpatient laboratory services suggest that controls use 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

Table 5

PREDICTED ANNUAL PER PERSON USE OF LABORATORY TESTS BY GHC CONTROLS, USING DIFFERENT REFERENCE POPULATIONS

(Standard errors in parentheses)

Reference Group	Ambulatory Use[a]	Inpatient Use[a]
Experimentals	34.7 (2.5)	6.0 (1.3)
GHC controls	37.3 (2.2)	6.1 (1.4)

[a]Measured in expenditure units; see footnote to Table 4.

least in this example. Because results are for one HMO in one site, however, they may not generalize to other sites or to other prepaid group practices.

IV. 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 the hospital sector. Some private insurance plans use cost-based reimbursement formulas, and 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.

Cost-based reimbursement is also criticized for its effects on the structure and level of charges to charge-paying patients--that is, patients with no insurance and patients with insurance that reimburses on the basis of hospital prices rather than cost (Davis, 1973; Hellinger, 1975). 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 (Betjemann, 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 be higher the greater the fraction of total laboratory (or other department) services provided to Medicare patients, and the higher the allocated overhead cost. 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 costs and the hypothetical charges Medicare would pay if it reimbursed on the basis of charges.

A ceiling on allowable costs for daily services is predicted to increase the fraction of overhead allocated to the laboratory (or other

ancillary departments). 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 hypothetical costs or hypothetical charges is also predicted to raise the level of laboratory costs and charges.[1] The increase will be greater, the greater the laboratory's share of total hypothetical Medicare charges across all departments.

In sum, the theoretical analysis suggests that both costs and charges in the laboratory will be higher (1) the greater the fraction of laboratory services provided to Medicare patients; (2) the greater the laboratory share of total hypothetical charges for Medicare patients; and (3) 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.

The empirical analysis supports the theoretical prediction that cost-based reimbursement results in higher laboratory costs and charges. Table 6 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

[1] This result may not hold if an increase in charges leads to a large reduction in the fraction of billed charges actually collected.

Table 6

EFFECTS OF REIMBURSEMENT FACTORS ON LABORATORY COSTS AND CHARGES

Percent change in costs or charges from 1 percent change in variable

Variable	Excluding Cost-Control Measures; Dependent Variable:		Including Cost-Control Measures; Dependent Variable:	
	Cost	Charges	Cost	Charges
% lab services Medicare	0.82*	0.93*	0.40*	0.23*
% lab services Medicaid	0.86	1.17*	0.72*	0.90*
Lab share of Medicare, %	--	--	1.26	2.12*
Actual/per diem limit	--	--	0.14	0.05

*Significantly different from zero at p = 0.05.

charges.[2] Summary results from two regressions are reported for both costs and charges. The first includes only the Medicare and Medicaid share of laboratory services (% Lab Services Medicare, % Lab Services Medicaid) 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 total hypothetical Medicare charges incurred in the laboratory (Lab Share of Medicare, %) and the limit on daily services costs (Actual/Per Diem Limit). These additional reimbursement variables reflect the effect of the cost controls.

Results using the Medicare and Medicaid shares of laboratory services as the only reimbursement variables show that a 10 percent increase in the Medicare 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

[2] The full regressions are found in Danzon (1980).

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, reimbursement variables capturing the effect of cost controls are added. The laboratory share of hypothetical 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, that 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.

V. CONCLUSIONS

Our 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, our theoretical results showed 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 our theory. It suggested 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. It was beyond the scope of this study to address the consequences of the growth in test use for patient outcomes; other research must assess whether the additional laboratory tests have produced patient benefits that are commensurate with the additional costs.

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