

Changing patterns of laboratory utilization by physicians in prepaid group practice are analyzed. Significant differences among physicians are reported and only partially explained. The findings raise questions to be answered by further study.

# Determinants of Medical Care Utilization: Physicians' Use of Laboratory Services

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## Introduction

This paper analyzes changes in the patterns of laboratory utilization in a prepaid group practice. Factors relating to or accounting for changes over time in the use of the clinical laboratory are investigated. The laboratory plays an increasingly important role in the practice of medicine. Physicians rely heavily on the clinical lab for detection, diagnosis and treatment of disease, but there is little information on changes in rates or patterns of laboratory use or on the reasons for these changes. Such data are central to planning and administering the clinical laboratory to meet changing demands and provide input to allow monitoring productivity. Baseline information is necessary to evaluate the impact of innovations such as new types of equipment, new kinds of personnel, as well as changes in the administration or organization of the laboratory. Finally, these data are useful to health planners generally because they allow assessment of the role of the laboratory in the total medical care system.

The literature is limited with respect to analyses of changes in the use of the laboratory. The total number of laboratory procedures is reported increasing at an annual rate near ten per cent.<sup>1</sup> Several studies cite changes in the use of the laboratory for inpatient care. The 1962 McNerney study reported that between 1938 and 1948 the rate of laboratory tests per day of hospital care increased by two-thirds and by 1958 this rate had increased 100 per cent over the 1938 figure.<sup>2</sup>

A study by the American Medical Association in 1964, on the cost of medical care also indicated a greater intensity in use of the clinical laboratory over time. The mean units of lab procedures per study admission increased from 3.19 in 1946 to 6.36 in 1961.<sup>3</sup> Again, the data apply only to the hospital setting and explanation for changes reported was somewhat limited.

A recent study on the use of the laboratory in a teaching hospital points to the clinical laboratory as a major contributor to today's hospital costs. This study indicates major increases over the past decade in type and volume of tests performed in hospital laboratories and suggests that new patterns of laboratory use may bear little relation to the needs of the patient. Furthermore, follow-up laboratory studies are often excessive.<sup>4</sup> An editorial in the same journal asked whether the enormous expansion in the use and costs of clinical laboratory services has resulted in a commensurate benefit to the patient or more effective care.<sup>5</sup>

None of the studies cited above provided any data on changes in the use of the laboratory for outpatient care. Presumably, important changes have taken place, but the information to identify these changes and evaluate their impact on the medical care system is not readily available. This study concentrates primarily on analyzing the use of the laboratory for outpatient care in a comprehensive group practice setting. Specifically, the study analyzes changes over time in total laboratory services and in the use of the laboratory by department, by type of test and by morbidity. The extent to which there are differences in the patterns of lab use by physicians and the consistency of the individual physician's pattern of lab use over time are studied. Finally, the relationship between physician characteristics and laboratory use patterns is analyzed.

## Study Setting and Source of Data

The Kaiser-Portland Health Plan membership of 150,000 people represents approximately 15 per cent of the population of the Portland metropolitan area. This diverse population represents a cross section of occupations and socioeconomic groups. Eighty per cent of the members use at least one medical care service per year.<sup>6</sup> Service is provided at a central complex including a 250-bed capacity acute hospital, a large outpatient facility and all supporting services. In addition, there are five clinics located in population centers through the metropolitan area.

Medical services are provided by The Permanente Clinic, a partnership of physicians including more than 100 full-time specialists. All major specialties are represented and medical care is provided on a 24-hour basis. Services are financed through monthly prepayment and most member medical care costs are covered. Physicians are paid in a fixed proportion of capitation revenue to provide needed services. There is no financial incentive to use the lab or other services unnecessarily. Automated multiphasic screening is not performed in the Oregon region, although it is used in Northern California and elsewhere in the Kaiser system.

The total medical record of a sample of five per cent of the Kaiser Health Plan population has been computerized on an ongoing basis and all contacts with the medical care system have been recorded since January 1, 1967.

**Table 1—Total Laboratory Utilization for the Health Plan Membership, 1967-1970\***

	1967	1968	1969	1970	Per cent change 1967 vs. 1968	Per cent change 1968 vs. 1969	Per cent change 1969 vs. 1970	Per cent change 1967 vs. 1970
OPD procedures	239,652	266,654	309,567	399,704	+11.3	+16.1	+29.1	+66.8
Annualized per 1,000 members	2,547	2,510	2,572	3,006	(-1.5)	+2.5	+16.9	+18.0
Per doctor office visit	0.752	0.758	0.805	0.894	+0.8	+6.2	+11.1	+18.9
Inpatient procedures	76,491	78,408	113,606	132,623	+2.5	+44.89	+16.7	+73.4
Annualized per 1,000 members	813	741	944	997	(-8.9)	+27.4	+5.6	+22.6
per inpatient day	1.760	1.716	1.918	2.223	(-2.5)	+11.8	+15.9	+26.3
Total procedures	316,143	344,062	423,173	532,327	+8.8	+23.0	+25.8	+68.4
Annualized per 1,000 members	3,360	3,251	3,516	4,003	(-3.2)	+8.2	+13.9	+19.1

\* Data obtained from Health Plan Records.

Data recorded about each of these contacts include time, place, type of service, type of provider, presenting and associated morbidities, symptoms, episodes and information concerning the nature of the medical care services provided. The related lab, X-ray and other procedures are recorded for each contact and for presenting and associated morbidities. The data for this study were obtained from the information system described above.

## Results

### Total Utilization

Table 1 shows the lab utilization of the Health Plan membership for the period 1967 through 1970. Lab use increased substantially during this period for both outpatient and inpatient care. The total number of outpatient lab procedures increased approximately 67 per cent. In 1967 there were 2,547 lab procedures performed per 1,000 members compared to 3,006 procedures per 1,000 members in 1970—an increase in utilization of approximately 18 per cent.

An analysis of total procedures, however, does not allow a determination of the major components of change or the relative contribution of certain factors in affecting lab utilization. In an attempt to delineate the components of rising lab use, changes in the ratio of lab procedures to doctor office visits (DOV) by department between 1967 and 1970 were analyzed. These data are presented graphically in Figure 1. The ratio of lab procedures to doctor office visits for all departments shows a fairly steady rise with a very sharp upsurge in the last six months of 1969. Physicians in the department of medicine (internists) have a consistently higher ratio of lab tests per doctor office visit than other departments. The most striking increase in this ratio occurs in the time period 1969 to 1970, ranging from 1.38 in the first six months of 1969 to 2.02 in the first six months of 1970. The ratios for urology and Ob-Gyn are below medicine but consistently higher than other departments.

Table 2 presents the distribution of physicians in the department of medicine by lab procedure/DOV ratio and by

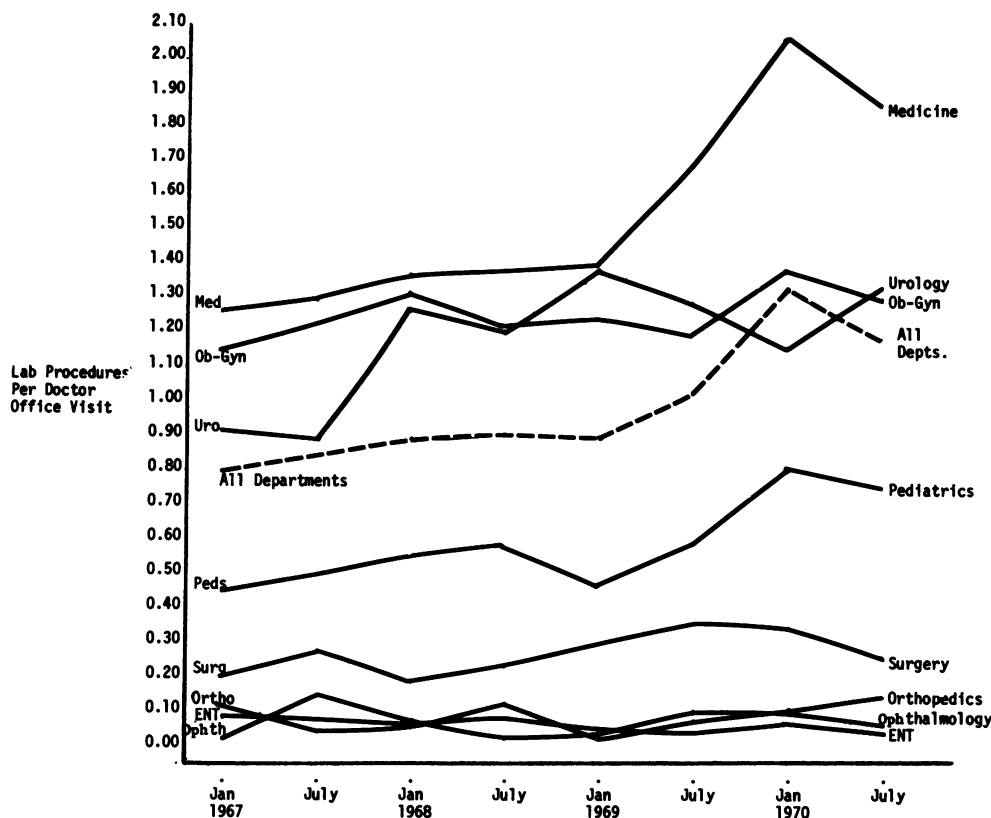
time period. In the first six months of 1967, approximately 77 per cent of the physicians had a lab/DOV ratio of less than 1.5 compared to only 22 per cent in the last six months of 1970. There was a marked trend for internists to increase their use of the lab over the four years.

The data in this table also indicate considerable variation in the way individual physicians use the lab. In each time period there are physicians who use the lab very intensively as well as those who have a very low use rate. It can be assumed that most Kaiser internists, each of whom have adult general medical caseloads, see similar diagnostic mixes of patients and have comparable patient loads. It appears that a number of physicians depart considerably from the norm in their use of the lab.

These findings show striking differences between medicine and other departments in the use of the laboratory and, as Table 3 shows, the department of medicine consistently accounts for over 60 per cent of the total tests performed. As a further indication of the major role of this department in laboratory utilization, Table 4 shows the per cent of total tests of a given type accounted for by this department over the study period. For the total time period, 73 per cent of total blood counts, 63 per cent of urine tests, 88 per cent of glucose tests, 98 per cent of cholesterols and 81 per cent of PBIs were ordered by the department of medicine. In addition, approximately half of the Pap smears, throat cultures and urine cultures were ordered by medicine. These selected tests accounted for over 60 per cent of the total tests performed during this study period. The variation in lab utilization cannot be explained by differences in the types of tests used over time since distributions of test types from one time period to another are quite similar.

Since a major part of the variation in lab use was located in the department of medicine, laboratory utilization within this department was analyzed in greater detail. The studies cited previously on patterns of hospital care suggested a relationship between changes in morbidity and lab utilization. That is to say, changing disease patterns appeared to affect the intensity of lab use by physicians for inpatient care and such changes presumably would affect their pattern of practice for outpatients as well. If the nature

**Figure 1—Laboratory Procedure/Doctor Office Visit Ratio by Department Semi-Annually 1967-1970**



**Table 2—Distribution of Physicians in the Department of Internal Medicine by Lab/DOV Ratio, 1967 - 1970**

Lab/DOV ratio	1967		1968		1969		1970	
	1-6/67	7-12/67	1-6/68	7-12/68	1-6/69	7-12/69	1-6/70	7-12/70
	%	%	%	%	%	%	%	%
Less than 1.00	17.6	5.6	11.1	9.1	17.4	11.1	0.0	3.6
1.00 - 1.49	58.9	77.7	44.5	59.1	30.4	18.5	10.7	17.9
1.50 - 1.99	17.6	5.6	33.3	18.2	39.1	33.4	28.6	42.8
2.00 - 2.49	5.9	11.1	11.1	13.6	13.1	25.9	35.7	25.0
2.50 +	0.0	0.0	0.0	0.0	0.0	11.1	25.0	10.7

**Table 3—Distribution of Total Tests by Department Semi-Annually, 1967 - 1970**

Department	1-6/67	7-12/67	1-6/68	7-12/68	1-6/69	7-12/69	1-6/70	7-12/70	1967-1970
	%	%	%	%	%	%	%	%	%
Medicine	64.4	61.3	62.1	61.3	61.1	65.1	66.8	64.7	63.6
Ob-Gyn	15.7	18.0	18.7	19.8	20.8	15.7	16.6	16.2	17.6
Ophthalmology	0.1	0.6	0.3	0.1	0.1	0.3	0.1	0.1	0.2
Orthopedics	0.7	0.2	0.3	0.6	0.1	0.3	0.3	0.4	0.4
Pediatrics	13.0	12.8	13.1	12.3	11.3	11.7	11.2	12.1	12.1
Surgery	2.6	4.3	2.4	3.1	4.0	4.7	2.7	2.6	3.3
Urology	3.2	2.6	2.9	2.5	2.4	2.1	2.2	3.8	2.7
ENT	0.3	0.2	0.2	0.3	0.2	0.1	0.1	0.1	0.1
<b>Total</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>

**Table 4—Per Cent of Selected Tests Ordered by the Department of Internal Medicine, Semi-Annually, 1967-1970**

Type of Test	1-6/67	7-12/67	1-6/68	7-12/68	1-6/69	7-12/69	1-6/70	7-12/70	Average
Blood counts	72.21	70.55	70.15	71.73	70.64	73.60	77.35	76.00	73.09
Urine	63.63	60.15	63.32	60.37	63.59	61.93	66.37	61.65	62.63
Glucose	66.67	100.00	83.33	85.71	90.00	81.25	94.29	92.31	88.89
Pap smear	51.21	47.47	45.12	45.45	39.60	49.24	50.44	47.50	46.86
Cholesterol	100.00	100.00	100.00	98.33	96.83	98.84	98.08	97.69	98.38
PBI or T-4	0.00	85.71	78.18	87.88	78.31	83.56	80.00	90.91	81.49
Throat culture	55.86	46.89	47.28	53.74	49.59	50.21	44.23	41.95	48.14
Urine culture	53.70	46.96	44.44	51.16	55.29	55.83	50.62	48.46	50.83
All tests	64.45	61.27	62.06	61.32	61.15	65.21	66.72	64.77	63.58

**Table 5—Distribution of Doctor Office Visits for the Health Plan Membership for Internal Medicine by Morbidity, 1967 - 1970**

Clinical behavioral disease classification	1-6/67 %	7-12/67 %	1-6/68 %	7-12/68 %	1-6/69 %	7-12/69 %	1-6/70 %	7-12/70 %	1967-1970 %
Non-disease or refractive error	15.7	15.6	15.4	16.9	14.8	16.8	18.8	18.8	16.7
Diseases requiring hospitalization	4.2	3.0	3.4	3.0	3.0	3.1	3.2	3.4	3.3
Diseases with high emotional component	16.0	15.4	14.9	15.0	15.1	15.2	13.7	13.8	14.8
Chronic disease, no symptoms or nontreatable symptoms	2.0	1.4	1.4	1.5	1.7	2.6	2.5	2.1	1.9
Chronic disease, treatable symptoms	32.5	34.8	35.4	35.0	34.6	33.4	32.8	34.9	34.2
Acute micro-organism disease	15.6	12.3	14.3	14.0	15.5	12.3	12.8	10.7	13.3
Acute non-micro-organism disease	2.4	2.7	2.3	2.2	2.2	2.3	2.1	2.1	2.3
Symptoms	8.8	11.8	10.8	10.4	11.0	12.0	11.8	11.6	11.1
Pregnancy and complications	0.2	0.2	0.1	0.1	0.2	0.2	0.2	0.3	0.2
Injuries and adverse effects of external cause	2.6	2.8	2.0	1.9	1.9	2.1	2.1	2.3	2.2
All other	—	—	—	—	—	—	—	—	—
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

of the problems and the disease patterns of patients were changing, particularly in areas which required intensive and more complex diagnostic work-ups, then corresponding changes in lab use would be expected.

Tables 5, 6, and 7 present data on the distribution of doctor office visits, total lab tests, and the ratio of lab tests to doctor office visits by morbidity for the department of medicine for the time period 1967 through 1970. Disease patterns did alter somewhat over time and an increasing proportion of total lab tests and doctor office visits were in the preventive category. This category includes most of the preventive services performed, such as physical exams and immunizations. In the first six months of 1967, preventive services accounted for approximately 16 per cent of the total doctor office visits and 48 per cent of the lab tests. By 1970, this had increased to 19 per cent of the DOVs and 58 per cent of the lab tests.

In the category of non-disease or preventive services, the ratio of lab tests per DOV increased approximately one-third. The data in Table 7 would seem to suggest an increasing emphasis on preventive services within the Kaiser Portland system, a change which has occurred without an automated multiphasic screening program. This may reflect the growing awareness and commitment of physicians to the concept of preventive care as well as a rising demand on the part of patients for these health services. These tables indicate that the increase in use of the lab is due not so much to a difference in the pattern of disease, but to an increasing emphasis on preventive services. One factor in this increase may be that the newer physicians place more emphasis on preventive care and order more tests per DOV. Two other possibilities were investigated and can be dismissed: there were no changes in the method of recording lab procedures which could account for the big jump between 1969 and

**Table 6—Distribution of Total Laboratory Tests for the Health Plan Membership for Internal Medicine by Morbidity, 1967-1970**

Clinical behavioral disease classification	1-6/67 %	7-12/67 %	1-6/68 %	7-12/68 %	1-6/69 %	7-12/69 %	1-6/70 %	7-12/70 %	Total %
Non-Disease or refractive error	48.0	50.0	51.8	53.8	50.5	52.5	54.7	57.9	52.9
Diseases requiring hospitalization	5.8	3.8	4.0	2.3	1.8	3.6	3.0	4.5	3.6
Diseases with high emotional component	7.8	5.2	5.3	5.5	6.4	4.9	5.4	4.2	5.5
Chronic disease, no symptoms or nontreatable symptoms	2.1	1.1	1.6	0.7	2.2	3.1	1.9	1.1	1.8
Chronic disease, treatable symptoms	15.7	18.9	18.1	18.8	19.9	18.0	15.5	15.8	17.4
Acute micro-organism disease	11.6	11.2	10.7	10.2	11.2	8.7	10.0	8.2	10.0
Acute non-micro-organism disease	0.8	0.9	1.2	1.2	0.8	0.7	1.1	0.9	0.9
Symptoms	5.3	7.3	6.3	6.7	6.6	7.1	7.7	6.2	6.7
Pregnancy and complications	0.6	0.7	0.1	0.2	0.2	0.3	0.3	0.3	0.3
Injuries and adverse effects of external cause	2.3	0.9	0.9	0.6	0.4	1.1	0.4	0.9	0.9
All other	—	—	—	—	—	—	—	—	—
<b>Total</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>

**Table 7—Lab/DOV Ratios by Morbidity, 1967 - 1970**

Clinical behavioral disease classification	1-6/67 Ratio	7-12/67 Ratio	1-6/68 Ratio	7-12/68 Ratio	1-6/69 Ratio	7-12/69 Ratio	1-6/70 Ratio	7-12/70 Ratio	Average Ratio
Non-disease or refractive error	2.10	2.25	2.55	2.51	2.60	2.63	2.74	2.76	2.55
Diseases requiring hospitalization	0.94	0.92	0.90	0.60	0.44	0.97	0.89	1.18	0.87
Diseases with high emotional component	0.34	0.24	0.27	0.29	0.32	0.27	0.37	0.27	0.30
Chronic disease, no symptoms or nontreatable symptoms	0.75	0.58	0.87	0.39	1.01	1.00	0.72	0.50	0.75
Chronic disease, treatable symptoms	0.33	0.38	0.39	0.42	0.44	0.45	0.44	0.40	0.41
Acute micro-organism disease	0.51	0.64	0.57	0.57	0.55	0.60	0.74	0.69	0.60
Acute non-micro-organism disease	0.22	0.22	0.38	0.44	0.27	0.25	0.51	0.38	0.33
Symptoms	0.42	0.44	0.44	0.51	0.46	0.50	0.61	0.47	0.49
Pregnancy and complications	2.25	2.00	0.40	1.00	0.75	1.07	1.08	0.74	1.15
Injuries and adverse effects of external cause	0.62	0.23	0.34	0.23	0.14	0.44	0.19	0.36	0.33
All others	—	—	—	—	—	—	—	—	—
<b>Total</b>	<b>0.69</b>	<b>0.70</b>	<b>0.76</b>	<b>0.79</b>	<b>0.76</b>	<b>0.84</b>	<b>0.94</b>	<b>0.89</b>	<b>0.80</b>

1970; and no automated or multichannel equipment was added during this period.

A final factor which might have a major effect over time is the out-of-pocket cost to the patient for laboratory services. In August, 1969, a change in health plan policy removed the 50 per cent charge for lab and X-ray tests for dependents of subscribers in certain categories. As a result, a limited test of this factor could be made. The lab/DOV ratio was calculated for the group of dependents who changed from 50 per cent to 100 per cent coverage and compared to the lab/DOV ratio for all others in the plan. This was done for the period immediately before the change in coverage and for a one-year period after the change. The group that changed had a 52 per cent increase in lab/DOV ratio, while the others increased only 42 per cent. This indicates a tendency for a patient to receive more lab tests when the financial barrier is removed. It could result from the patients' willingness to use more services and to make more office visits for non-serious conditions and preventive care when they are not faced with a potential lab bill. At any rate, the degree of co-payment does appear to affect lab use in this system, although not to the extent that might have been assumed. This factor and its effect on both patient and physician should be investigated further.

### The Relationship between Utilization Patterns and Physician Characteristics

Two questions are examined in this section. First, does a physician's pattern of lab use remain constant over time? Second, is there a relationship between lab use and identifiable background characteristics of the physician?

To answer the first question, a mean was calculated of the ratio of lab tests to DOVs for each of the sixteen internists providing service for the entire study period. The individual physician's lab/DOV ratio was divided by the overall mean and scored for each time period. These sixteen physicians were then ranked by their scores and Spearman's Rank Correlation was used to test the degree of association between the rankings from one time period to the next. The findings indicate a consistent relationship between physician's patterns of lab use over time. The degree of correlation ranged from 0.62 between 1967 and 1970 to 0.84 between 1968 and 1969. These relatively high correlations among rankings indicate that physicians tend to be consistent in their relative lab use.

The second question is more complex. Variation in lab use among physicians in the department of medicine was assessed using an index based upon a physician's average ranking over the time period from 1967 to 1970. On the basis of this index, physicians were classified high or low on lab use. A number of characteristics of the physicians were then related to this rating. Twenty-nine internists who had been with Kaiser for at least a year between 1967 and 1970 were studied. A composite of the results of testing these variables as they relate to lab use is presented in Table 8.

A physician's use of the lab and pattern of practice is presumably influenced by what he was taught in medical school. Physicians who went to medical school a generation ago when the clinical laboratory did not play its present central role may be less likely, when compared to recent graduates, to rely on the lab. This study found there is a ten-

**Table 8—Characteristics of Physicians in the Department of Medicine By Percentage of Low Users of Laboratory Services**

Physician characteristic	Number	Percentage of low users
<i>Graduation from medical school</i>		
Before 1957	15	66.7
1957 or later	14	35.7
$X^2 = 2.778, 1 \text{ df}, p < .10$		
<i>Geographic location of medical school</i>		
Northeast, Chicago, California	10	70.0
Other U.S. (non-U.S. excluded)	14	35.7
$X^2 = 2.743, 1 \text{ df}, p < .10$		
<i>Joined Kaiser staff</i>		
Before July, 1966	15	60.0
July 1966 or later	14	42.9
$X^2 = 0.852, 1 \text{ df}, p < .40$		
<i>Leadership role in Kaiser</i>		
Leader	10	70.0
Non-leader	19	42.1
$X^2 = 2.042, 1 \text{ df}, p < .20$		
<i>Utilization of clinic chief</i>		
Low	13	76.9
High	16	31.2
$X^2 = 5.992, 1 \text{ df}, p < .02$		
<i>Age</i>		
40 or older	16	62.5
Less than 40	13	38.5
$X^2 = 1.659, 1 \text{ df}, p < .20$		
<i>Board certification</i>		
Yes	18	61.1
No	11	36.4
$X^2 = 1.674, 1 \text{ df}, p < .20$		

dency for earlier graduates to use the laboratory less. Of the physician's graduating before 1957, 66.7 rank low on lab use compared to 35.7 per cent of physicians graduating in 1957 or after.

Medical schools vary in quality as well as in approach to medical education. Some are more conservative in the sense that they rely to a greater extent on detailed history-taking and thorough physical examination as opposed to relying on the laboratory and ancillary services. Others stress the importance of preventive services and rely on extensive use of laboratory tests and procedures. For the purpose of this analysis it was posited that physicians trained in the older, more established medical schools located in the northeast, in the Chicago area, and in California would have different patterns of lab use than those trained in other sections of the United States. These more-established schools may be more likely than others to emphasize the critical application of laboratory tests for developing bedside skills and clinical judgment and to teach that any specific laboratory test is difficult to justify unless there is a reasonable chance that it will add useful information. They would tend, therefore, to take a conservative approach to utilization of the laboratory.

A relationship was found between where physicians attended medical schools and their pattern of lab use. Physicians trained in medical schools in the northeast, in California and in the Chicago area were more likely than

physicians from other areas to be low on lab use. However, a combination of factors may be operating here. Since prior to 1960, the department of medicine recruited mainly from eastern medical schools, the differences found could just as well reflect age, period of graduation from medical school, or time associated with Kaiser.

If the organization and its policies, procedures and leadership influence physician behavior, lab use should vary by the amount of time spent with Kaiser. There did appear to be a slight relationship between lab use and length of time associated with Kaiser. Physicians low in lab use tend to have been with Kaiser for a longer period of time.

The physician's leadership role within the organization was also found to be related to lab utilization.\* Most leaders (70%) were low in lab utilization whereas a majority of non-leaders (58%) were high. This suggests that physicians in official leadership and administrative positions tend to be more conservative in lab use, possibly due to their greater awareness of organizational problems and costs.

An issue somewhat related to the leadership question is the role played by the chiefs of service of the various clinics in affecting lab use. The question arises as to whether physicians in the various clinics are influenced by or follow the pattern of the chief of service. There is a strong relationship between lab use and the utilization pattern of the chief of service in this system. In the clinics where the chief has a low use rate, more than three-fourths of the other physicians are low users. When the chief of service is a high utilizer, so are most of the physicians who work with him.

Physician's age, board certification and membership in the local medical society were also tested for a relationship to laboratory utilization. Age has been found to be an important variable in affecting medical practice.<sup>7</sup> In this study, there is a slight relationship between age and lab use, with older physicians tending to be low utilizers and younger physicians high utilizers.

Board certification has been used as a surrogate measure of quality. When the relationship between board certification and lab use was analyzed in this study, there was a tendency for board certified physicians to have lower rates than other physicians. Most Kaiser physicians are either board eligible or board certified so this variable was not expected to usefully differentiate physicians with respect to their patterns of practice. There was no relationship found between membership in the medical society and laboratory utilization.

Two other variables were tested which did not show a relationship to lab use in this system. These, as well as medical society membership, were not included in Table 8. The first variable concerns the type of setting where the physician took his residency and its influence on his pattern of practice. It was posited that residency training in government or university hospitals would produce physicians who ordered significantly more lab tests, due to less cost constraint in these settings, than physicians trained in community or private hospitals. There was, however, no relationship between setting of residency training and lab use.

\* Leadership was defined as an individual holding such posts as department chairman, medical director or assistant medical director, chairman of a hospital committee or clinic chief at any time during the study period.

The relationship between lab use and number of patients seen per day was the other variable analyzed. It was hypothesized that the busier the physician, the more he would rely on the lab. It has often been asserted that, as their workload increases, physicians make inappropriate demands on the lab as a substitute for clinical judgment. The twenty-nine physicians were ranked by their average daily patient load for the study period. Spearman's rank order correlation was used to test the relationship between the average daily patient load and lab use. The test showed no relationship between these variables.

## Summary and Conclusions

A preliminary analysis of lab utilization patterns in a comprehensive group practice prepayment plan is presented. Laboratory utilization rose steadily between 1967 and 1970. Not only did the total number of procedures increase yearly, but more significantly, the number of procedures per subscriber and the number of procedures per doctor office visit increased markedly over this time period. The increase was greatest in the department of medicine and it is this department which accounts for the majority of lab tests and procedures.

Analyzing lab use over time by morbidity, a substantial part of increased lab use was in the category of non-disease or preventive services. Considerable individual variation in the pattern of lab use exists among physicians, particularly in the department of medicine, but these individual patterns are fairly consistent over time.

Variation in lab use within the department of medicine was found to be related to when and where physicians attended medical school. To a lesser degree, lab use was associated with age, board certification and time spent with Kaiser. An important but unexpected finding was the lack of any relationship between patient load and lab use.

Leadership role seems to be a factor in lab utilization and in particular there was a strong tendency for physicians in the various clinics to have patterns of lab use similar to their respective chiefs of service. This finding suggests that change would be most successful if introduced through the chiefs of service.

A significant increase in laboratory utilization was found to be related to the elimination of charges for laboratory and X-ray tests in some prepayment contracts.

The laboratory plays an increasingly important role in modern medical practice. Utilization is likely to continue upward, thereby placing considerable demand on the available resources. Health care administrators will have to either increase resources or use current resources more efficiently to meet this demand.

Laboratory services significantly affect medical care costs and as lab use increases it is important to determine the degree of inappropriate use and take steps to ensure optimal use. Common reasons for rising lab use are not totally satisfactory and further study is needed. A particularly important question to be answered is whether or not the rising cost associated with increased lab use has resulted in commensurate benefits to the patient.

This study reports significant differences among physicians in the way they use the laboratory, but these differences are only partially accounted for or explained. Besides the lack of detailed information on the physicians,

the present study was limited by a paucity of previous research in this area and the need for a conceptual framework to guide further analysis.

The variation in lab use found among physicians raises the question of the degree to which there is variation in other areas of practice and suggests the need for investigations to identify factors that account for any differences. Finally, it is necessary to specify implications of differences found for the cost and quality of care.

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