Association of Patient and Physician Characteristics with Follow-Up of Abnormal Laboratory Results

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Physician follow-up of patients with laboratory abnormalities in 12 commonly obtained blood tests was studied in the ambulatory setting. Nineteen white male physicians had 166 patients with 279 abnormal results. Overall, 38.6 percent of patients had abnormalities followed up. White male patients had a 56.6 percent follow-up, while other patients (black males, white and black females) had a 31.7 percent follow-up rate (P=.006). These higher rates for white males persisted when controlling for the effects of patient age, Medicaid status, type of medical problem for which laboratory tests were obtained, number of abnormalities per patient, degree of abnormality of the laboratory result, and physician year of residency. The scientific rationale for the higher follow-up rates for white males than for other patients was not elucidated by the present study.

The low physician follow-up rate of abnormal laboratory results has been well documented[1-5] but only partly explained. Degree of abnormality of the laboratory value, type of test, and type of medical indication for obtaining the test, have been found to have strong associations with follow-up.[6] The present study reports the association between patient and physician characteristics and follow-up.

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Methods

Patients in this study were aged 18 years or older and were clients of the Duke-Watts Family Medicine Center during the first four months of 1976. Included were residents' patients with one or more abnormal results from the following 12 laboratory tests: serum glutamic oxaloacetic transaminase (SGOT), total bilirubin, calcium, cholesterol, creatinine, glucose, potassium, sodium, triglycerides, uric acid, hematocrit, and white blood cells (WBC).

The data were abstracted from the patients' medical records and laboratory reports by the in-

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vestigators. The interval between date of laboratory test and date of abstract was one to six months, with a mean of 63 days. Abnormality of laboratory results was determined on the basis of the normal ranges published by the commerical laboratory* which performed the tests. Degree of abnormality was determined on the basis of the Labstand system[7] which establishes high and low abnormal ranges based upon clinical reports in the medical literature. For example, a value designated as 10 percent abnormal indicates that the result is abnormal to the extent of 10 percent of the abnormal range, ie, one tenth as abnormal as reported clinically for that particular laboratory test. For a value higher than normal, it would be one tenth of the range between the upper limit of normal and the highest value seen in disease. Using serum glucose as an illustration, the high abnormal range is 110 to 1,000 mg/100 ml, and a value 10 percent abnormal would be $[(1{,}000 - 110) \div 10] + 110 = 199$ mg/100 ml.

Follow-up of abnormalities was defined as repeat of the laboratory test, or change in diagnostic and/or therapeutic plans as a result of the laboratory value, or explanation by the physician in the progress notes as to why such steps were not taken.

Patients were considered to be in the follow-up group if at least one of their abnormal laboratory results were followed up, and to be in the not-followed-up group if none of their abnormalities were followed up. Similarly, if at least one of their abnormalities were greater than 10 percent abnormal, patients were assigned to the high degree abnormality group, and if all their abnormalities were 10 percent or less, to the low degree abnormality group.

Analyses for type of medical problem leading to performance of laboratory tests considered patients in three groups, ie, health maintenance only, major medical problems, and other medical problems. Since the most frequent major problems of patients in this study were hypertension, diabetes, and congestive heart failure, presence of one or more of these conditions was the criterion for inclusion in the major medical group.

Statistical methods included stratification and multiple regression analyses. Significance was tested using the chi-square statistic.

*National Health Laboratories, Winston-Salem, North Carolina

Results

There were 166 patients in the study group, with a total of 279 abnormal laboratory results. By age, 25.4 percent were 18 to 39 years, 37.3 percent 40 to 59 years, and 37.3 percent 60 years or older. By sex, 65.1 percent were female and 34.9 percent male. By race, 74.1 percent were white and 25.9 percent black. Twenty-six percent were covered by Medicaid insurance and 74.0 percent were not.

Only patients of the 19 white male physicians were included, because the number of patients of the four white female and two black male physicians was too small for adequate comparison of differences associated with race and sex of providers. The white male physicians represented 15 US and 1 foreign medical school. The 16 who took Part II of the Internal Medicine National Board Examination had scores ranging from 360 to 670 (national range 240 to 710). Seven were in their first year of training after medical school, eight in their second year, and four in their third year.

Reliability of demographic data abstraction from the medical records on separate audits by two observers was found to be 97.5 percent. This was performed on every case for patient's age, sex, race, and Medicaid status. Reliability for determination of follow-up using a five percent sample was 96.2 percent.

Overall, only 38.6 percent of patients had one or more of their abnormalities followed up. In search of an explanation for this low follow-up rate, analyses were performed correlating certain factors with follow-up. As shown in Table 1, the highest associations are exhibited by degree of abnormality of the laboratory result ($r=.34$) and sex and race of the patient ($r=.23$). These two factors explained ten percent and five percent, respectively, of the variation in follow-up. The others, ie, age of patient, year of training of physician, type of problem, and Medicaid status, accounted for an additional three percent, for a total of only 18 percent of follow-up variance explained by the factors studied.

The follow-up rate for patients with high degree abnormal results was 60.0 percent, while that for those with low degree abnormal results was 25.3 percent ($P<.0001$). This association persisted

Table 1. Association Between Follow-Up of Abnormal Laboratory Values and Various Factors*

Factor	Simple r	Change in r^2	Percent of Follow-Up Variation Explained
Degree of Abnormality	.34	.103	10
Sex and Race of Patient	.23	.053	5
Age of Patient	.12	.010	1
Year of Training of Physician	.10	.009	<1
Type of Indication Problem	.03	.006	<1
Medicaid Status	.004	.000	<1
Total		.181	.18

*These results are from a regression analysis on 164 cases. Simple r is a correlation co-efficient indicating strength of association. Change in r^2 indicates the proportion of variation in follow-up explained by the factor being analyzed

when controlling for the other factors listed above, and statistical significance was exhibited at less than the 0.05 level for all strata except the 18 to 39 year patient age group, the health maintenance type of indication problem, and the first year of physician training.

White male patients (N=46) had a follow-up rate of 56.5 percent, white females (N=77) had a rate of 33.8 percent, black females (N=31) 29.0 percent, and black males (N=12) 25 percent (P=.03). Because of the similarity in follow-up rates of these latter three groups, they were considered together as "other patients" when compared with white male patients in all other analyses.

As shown in Table 2, follow-up for white male patients was almost twice that for other patients (56.5 vs 31.7 percent, P=.006). This trend persisted when controlling for the effects of degree of abnormality, patient age, year of physician training, type of problem, and Medicaid status. The stratum with the highest statistically significant difference was non-Medicaid patients (P=.003). In contrast, there was no significant difference in Medicaid patients (P=.98), where the follow-up rate for white males was not much higher than that for other patients (44.4 vs 37.1 percent). Follow-up for white males ranged from 40.0 percent for low degree abnormal results to 88.9 percent for major medical problems, while follow-up for other patients ranged from 19.2 percent for low degree abnormals to 51.1 percent for high degree abnormals.

Follow-up by type of laboratory test was calculated using the individual laboratory test as the unit of analysis. As many patients had more than one test, these test groupings were not mutually exclusive. The follow-up rates for hematocrit, glucose, WBC, uric acid, and potassium were higher for white male patients than for others, though not statistically significant. Examples are: hematocrit (N=53), 83.3 percent for white males and 42.6 percent for others, and glucose (N=49), 63.6 percent vs 42.1 percent, respectively. Rates were nearly equal for triglycerides. The other six tests had frequencies too low for individual analyses, but collectively they were higher for white males (63.0 percent) than for others (46.5 percent).

Follow-up rates for individual physicians also were compared. The 19 white male physicians had an average of 8.7 patients with laboratory abnormalities, with a median of eight, minimum of one, and maximum of 20. Of the eight physicians who had 10 or more patients, six showed higher follow-up rates for white males than other patients, though none were statistically significant. Of all 19 physicians, 12 had higher follow-up rates for white males than others, six had higher rates for others, and one had equal rates for both groups.

Table 2. Follow-Up of Laboratory Abnormalities of White Male Patients Compared with Other Patients

Factors	Number of Patients	White Male Patients	Other Patients	P Value of Chi-Square
All Patients	166	56.5*	31.7	.006**
Degree of Abnormality				
Low	99	40.0	19.2	.07
High	68	76.2	51.1	.09
Age of Patient				
18-39 years	41	44.4	21.9	.4
40-59 years	60	65.0	30.0	.02**
60 + years	62	53.3	38.3	.5
Years of Training of Physician				
First	32	63.6	38.1	.3
Second	77	58.8	33.3	.1
Third	57	50.0	25.6	.1
Type of Indication Problem				
Health Maintenance	20	63.6	33.3	(Fisher's test=.2)
Miscellaneous Medical	92	42.3	27.3	.3
Major Medical	54	88.9	37.8	.01**
Medicaid Status				
Medicaid	44	44.4	37.1	.98
Not Medicaid	122	59.5	29.4	.003**

*All follow-up rates expressed as percentages
**Statistically significant at the .05 level or lower

Seventy-five percent of those in their second and third years of residency had higher rates for white males than others, while only 43 percent of those in their first year showed this trend.

An effort was made to identify differences other than sex and race between the white male group and other patients that might explain the differences in follow-up rates. Comparison of the characteristics of white male patients with those of other patients revealed similar distributions for age, Medicaid, degree of abnormality, and year of residency of their physicians. For example, 19.6 percent of white males and 29.2 percent of others were Medicaid patients (P=.3). However, there were statistically significant differences (P=.005) with regard to type of medical problem for which the laboratory test was indicated. For white males 23.9 percent of problems were health maintenance, while for others only 7.5 percent were in this category. On the other hand, white males had lower relative frequencies of major problems (19.6 percent) than the other patients (37.5 percent). Rates for miscellaneous problems were similar (56.5 and 55.0 percent, respectively).

A more detailed analysis of the medical problems of white males and others was done to search for evidence that white males might have had other serious illnesses which would explain their higher follow-up rates (Table 3). Except for the higher relative frequency of alcoholism and/or cirrhosis as indicators for laboratory tests in white males, there was little evidence white males were sicker than other patients. Furthermore, white males had lower relative frequencies of the indication problems of heart disease, diabetes, abdominal pain, and anemias than did the other patients.

Recognizing that these indication problems were only a partial reflection of a patient's problem status, and that one of the major problems treated in ambulatory practice, ie, coronary heart

Table 3. Comparison of White Male Patients with Other Patients Regarding Frequency of Clinical Problems for Which Laboratory Tests Were Performed

Indication Problems for Laboratory Tests	White Male Patients (N=46)	Other Patients (N=120)
1. Health maintenance only	23.9*	7.5
2. Hypertension	15.2	16.7
3. Diabetes mellitus	2.2	11.7
4. Congestive heart failure	2.2	9.2
5. Abdominal pain and/or nausea, vomiting	2.2	9.2
6. Malaise, fatigue, dizziness, syncope, headache, anorexia, and/or weight loss	6.5	5.8
7. Back pain, joint pain, osteoarthritis, and/or rheumatoid arthritis	4.3	5.0
8. Alcoholism and/or cirrhosis	10.9	0.8
9. Chest pain	2.2	3.3
10. Anxiety or depression	4.3	2.5
11. Anemias	0.0	3.3
12. All other problems (frequency less than 3 patients for each)	26.1	25.0
Total	100.0%	100.0%

*All relative frequencies expressed as percentages

disease, was not listed as an indication for the 12 laboratory tests in this study, a separate audit was performed to establish the prevalence of coronary disease and associated risk factors within the study group. No statistically significant differences were found between white males and other patients with regard to prevalence of coronary heart disease, hypertension, diabetes mellitus, hypercholesterolemia, cigarette smoking, or family history of myocardial infarction. Prevalences for white males were somewhat higher than those for other patients for coronary heart disease (19.2 percent vs 14.2 percent) and cigarette smoking (41.3 percent vs 29.2 percent), but were lower for the other conditions. The laboratory test follow-up rate for white males carrying a diagnosis of coronary heart disease (N=9) was 77.8 percent contrasted to 41.2 percent for other patients (N=17) with the same diagnosis. (Fisher's exact test = .08.)

Comparison of the two sex race groups with regard to the number of laboratory tests revealed that 37.0 percent of white males and 41.7 percent of others had more than one abnormal test result each. Overall, only 12 patients had more than three abnormalities and the average was 1.7 per patient. In patients with only one abnormality each, white males (N=29) had 48.3 percent follow-up and others (N=70) 22.9 percent (P<.02). In those with more than one each, white males (N=17) had 76.5 percent follow-up and others (N=50) 44.0 percent (P<.025). In both sex race groups those with more than one abnormality had higher follow-up rates than those with only one.

Discussion

The low overall follow-up rate of 38.6 percent is similar to that reported by other investigators. Huntley et al[1] found a 40 percent follow-up of a battery of tests which included hematocrit and WBC. Williamson et al[3] reported a 35 percent follow-up for abnormal urinalyses, blood glucoses, and hemoglobins. Explanation for the low rates

remains incomplete. In the present study only 18 percent of follow-up variation can be accounted for by the factors studied, and only two, ie, degree of abnormality and patient sex and race, contributed appreciably. Other possible explanations include inadequacies of recordkeeping with subsequent insufficient information, and factors not under the direct control of the physician, such as low patient compliance and high patient mobility with loss to follow-up.

The finding that characteristics of both patients and their physicians are associated with the follow-up of abnormalities needs further study, because this is certainly a realm in which the physician has considerable control. Armitage et al[8] found that male physicians conducted more extensive medical work-ups on male than on female patients. The present data suggest that white male physicians follow up laboratory abnormalities at higher rates for white males than for other patients. Does this reflect characteristics of white male patients that place them at higher risk medically than white females, black females, or black males? The answer appears to be "no" for the group of patients in this study, where the prevalence of coronary heart disease was only slightly higher for the white males and the prevalence of hypertension, diabetes mellitus, and congestive heart failure was actually lower for white males than for other patients.

The influence of socioeconomic status is suggested by the finding that white males who were of low enough economic status to be covered by Medicaid insurance did not have the high rate of follow-up enjoyed by other white males. However, regression analysis indicated the effect of Medicaid status on follow-up to be negligible statistically.

The male physician may have been influenced by contrasting health behavioral patterns attributed to men and women. Lewis and Lewis[9] presented data indicating that men, in contrast to women, even though "faced with an increased risk of chronic disease and shorter life expectancy . . . are more reluctant to seek care or to adopt behaviors that would diminish these risks." The physicians in the present study may have felt more obligated to follow up abnormalities in males than in females lest male patients not return in response to symptoms as appropriately as female patients.

It is interesting that a similar percentage of the medical problems for which laboratory tests were performed in both men and women was constituted of rather undifferentiated complaints such as malaise, fatigue, and dizziness. Apparently these symptoms captured the physicians' attention more often when voiced by males than by females. This may reflect another label sometimes given to women patients: that of having more frequent complaints than men. The physicians may have assumed the male complaints to be more valid.

Studies are needed to compare the behavior of both men and women physicians with regard to differential management of patients by sex, to distinguish potential bias on the basis of the physician's sex from bias of the medical profession generally. Likewise, studies are needed with physicians and patients of both races. Clinical decision making should incorporate the demographic characteristics of each patient in an attempt to tailor diagnostic and therapeutic interventions to that person's needs, but obviously, any differences in management on this basis should be justifiable scientifically.

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References

1. Huntley RR, Steinhauser R, White KL, et al: The quality of medical care: Techniques and investigation in the outpatient clinic. J Chron Dis 14:630, 1961
2. Lashof J, Turner I: Periodic evaluation of outpatients. Arch Environ Health 8:531, 1964
3. Williamson JW, Alexander M, Miller GE: Continuing education and patient care research: Physician response to screening test results. JAMA 201:938, 1967
4. Schneiderman LJ, DeSalvo L, Baylor S, et al: The "abnormal" screening laboratory result. Arch Intern Med 129:88, 1972
5. Korvin CC, Pearce RH, Stanley J: Admissions screening: Clinical benefits. Ann Intern Med 83:197, 1975
6. Parkerson GR Jr: Determinants of physician recognition and follow-up of abnormal laboratory values. J Fam Pract 7:341, 1978
7. Parkerson GR Jr: Labstand: A computerized system for reporting clinical laboratory data in standard units. J Fam Pract 6:611, 1978
8. Armitage KJ, Schneiderman LJ, Bass RA: Response of physicians to medical complaints in men and women. JAMA 241:2186, 1979
9. Lewis CE, Lewis MA: The potential impact of sexual equality on health. N Engl J Med 297:863, 1977