PRACTICE OBSERVED

Practice Research

Influence of patient characteristics on test ordering in general practice

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Abstract

Information regarding all consultations was collected in seven general practices for one year. From these data we report on the use of laboratory tests and its association with patient characteristics—including social class, age, sex, and diagnosis—and with which doctor was consulted. Most of the requests were for technically simple tests of low cost. There was a noticeable variation in the use of tests with regard to all patient characteristics. Diagnosis, identity of doctor, age of patient, and social class were each shown by multivariate techniques to be independently related to use of tests. Whereas fewer tests were used per consultation for social classes III-V compared with other social classes, more were used per patient per year for these same groups, reflecting in part the higher consultation rates of social classes III-V. Variation in diagnoses fully accounted for the greater test ordering for women.

Nearly two thirds of all tests were ordered for 10% of all patients who consulted and 7% of all registered patients. The results of our analysis suggest that this concentration is determined primarily by those patient characteristics most indicative of medical need and by which doctor is providing care.

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Introduction

Laboratory testing is an important resource for medical practice. Though comparable figures are not available for the United Kingdom, it accounts for about a quarter of the cost of ambulatory care in the United States.[1] Little attention, however, has been given to the relations between the use of laboratory resources and the clinical and demographic characteristics of patients for whom the tests are ordered. The results of studies of the variation in test ordering among doctors have shown that consideration of who the doctor is, independent of the characteristics of patients he or she sees, is important.[2–4]

The characteristics of patients, particularly in light of their persistent associations with morbidity and mortality,[5] would seem to be as important for understanding the distribution of laboratory and health care resources. The results of several studies have shown that social classes III-V are referred more frequently per individual for specialty evaluation and together with women and elderly people make greater use of general practitioner services.[6–15] Whether these observations hold true for the use of laboratory testing is unknown.

We undertook the following study to examine the use of laboratory resources and its relations to the clinical and demographic characteristics of patients in a population of 50 000 registered patients served by 22 general practitioners.

Methods

Twenty two general practitioners and their trainees in Greater London recorded data on every consultation in 1980. The consultations in which a National Health Service patient was seen either by a principal or by a trainee were analysed; this included 87% of all consultations recorded during 1980. The consultations that were excluded were: (*a*) visits by private patients; (*b*) visits to locum doctors; (*c*) visits to one principal who had incomplete laboratory reporting.

At each surgery consultation the doctor used a printed form on which was entered a confidential patient identification number; the age, sex, and social class of each patient seen; and the number and type of laboratory or referral requests that had been made. Typical combinations of tests—for example, electrolytes, liver enzymes—were entered as single requests. The only tests done on the practice premises were urine dipsticks, which were not recorded. The International Classification of Diseases (9th revision) was used to record patient diagnosis. Social class was defined according to the Registrar General's categories: I, II, III manual and non-manual together, IV, and V. Women who worked more than 20 hours a week were classified by their own occupations. Social classes I and II were combined for analysis and a category "social class not recorded" was added. For approximately 11% of the consultations no social class was entered. We therefore repeated regression analyses using only a group of doctors with near complete (> 97%) recording of data on social class; the results were essentially unchanged, as reported below.

For this paper diagnoses were grouped, with some modifications, according to chapter headings from the International Classification of Diseases. Organ specific symptoms from chapter XVI (Symptoms, signs and ill defined conditions: 781, 782, 785-789) were incorporated into the pertinent preceding chapter. Chapters XI (Complications of pregnancy, childbirth, and the puerperium), XIV-XVI (Congenital anomalies, certain conditions originating in the perinatal period) were combined; together they constituted less than 10% of all consultations. A separate category was formed to include all visits of healthy and pregnant patients whose attendance was routine and not prompted by a specific complaint (Health maintenance: V01-V39, V66-V82).

ANALYSIS OF DATA

We used two tailed *t* tests to make simple comparisons of differences in the use of tests among groups. Linear modelling, using a least squares model, was used to examine the independent effects of patient characteristics on the number of tests ordered per consultation. We used the same linear modelling package (GLIM) to compare test use in the different levels of each independent variable.[16] Because of the large number of cells in the model three modelling analyses were necessary. The variables in the first were: sex, age, diagnosis, and doctor. Age was divided into four groups (< 5, 5-14, 15-39, > 39 years; that reflected test use; diagnoses were grouped as described above. Sex had no independent predictive value, and the second and third models examined men and women separately. They had as variables social class, age, diagnosis, and doctor. The number of tests ordered per patient a year was not used as a dependent variable in linear modelling because diagnosis often varied from consultation to consultation as did, to a lesser extent, the patient's doctor. A χ^2 test for linear trend, adapted for data expressed in patient years, was used to test the difference among social classes in the amount of testing per year.[17]

Accuracy of coding was greater than 97% for test ordering in a 10% sample of forms from consultations. Detailed comparison in one practice of computer outputs with surgery records showed test recording to be more than 97% accurate. Trends related to patient factors were compared with the information available from the second national study of morbidity in general practice and are presented below.[11]

Results

The mean number of patients on the doctors' lists was 2263 and the mean number of consultations per person a year was 2·7.

PATTERNS OF GENERAL TEST ORDERING

Laboratory resources were used for small proportions of both the populations at risk and the group of patients who consulted. Two thirds of all tests requested during the year were ordered for less than 7% of the population at risk and for about 10% of all the patients who consulted. Eighty one per cent of these requests were for single investigations. Haematology accounted for 22%, of all tests, chemical pathology 15%, radiology 20%, bacteriology 29%, and others (including pregnancy tests and cytology) 14%. Eighty eight per cent were "simple" investigations—that is, blood counts, routine chemical pathology tests (such as electrolytes and urea concentrations), pregnancy tests, plain *x* ray examinations, or bacterial cultures.

ORDERING BY AGE AND SEX

The numbers of tests ordered per consultation (mean (SE)) for women and men were 0·13 (0·002) and 0·10 (0·002) respectively; 0·34 and 0·19 tests were ordered per person (registered on list) a year for women and men respectively. Figure 1 and table I show that laboratory use per consultation varied with both age and sex. Children were particularly unlikely to be investigated and some drop in the rate of investigation was also noted in older age groups. The highly significant difference between sexes in tests ordered per consultation was primarily due to differences during the reproductive years. Figure 2 shows a somewhat different pattern for the number of tests ordered per person per year. The peak during the reproductive years remained evident for women and the difference between the sexes was magnified. Services used for men, after climbing slowly in early life, accelerated in middle age, but only in the seventh decade did it approach the level for women.

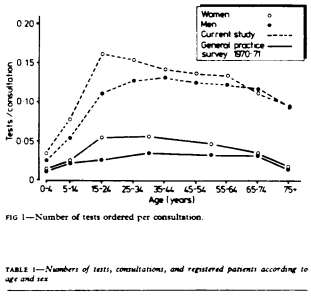

FIG 1—Number of tests ordered per consultation.

TABLE I—*Numbers of tests, consultations, and registered patients according to age and sex*

Age (years)	Women			Men		
	Tests	Consultations	Registered patients	Tests	Consultations	Registered patients
0-4	172	4 850	1 172	150	5 753	1 272
5-14	345	4 398	2 484	266	4 812	2 790
15-24	2153	13 213	4 899	566	4 918	3 362
25-34	2271	14 745	6 417	770	5 985	4 852
35-44	1156	8 095	3 481	581	4 390	3 093
45-54	977	7 193	2 682	513	4 112	2 181
55-64	882	6 625	2 516	572	4 616	1 865
65-74	876	7 727	2 479	461	4 019	1 475
75 and over	662	7 281	2 027	229	2 478	748
Total	9494	73 987	28 157	4108	41 083	21 638

Figures 1 and 2 also show data derived from the national study.[11] In that report only the occurrence of an investigation was recorded, not the number. The distortion thereby introduced into a comparison with our data would be small, however; as noted above for our study, only one test was ordered in over 80% of those consultations in which any investigations were requested. The age and sex related trends in the national study are closely similar to those we report, though the absolute numbers of tests ordered differ.

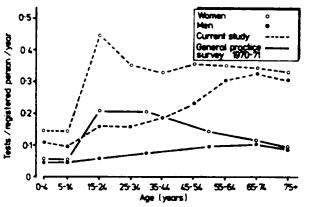

FIG 2—Number of tests ordered per year for each registered person.

ORDERING BY DIAGNOSIS

Table II shows a more than tenfold variation in test use among diagnostic categories. Those diseases most heavily investigated are often not responsible for a large proportion of the overall burden on the laboratory; comparison of blood and genitourinary disorders is one of several interesting examples.

TABLE II—*Laboratory use according to diagnosis*

	Diagnostic category	Proportion of all consultations (%)	Proportion of all tests (%)	Tests/consultation
1	Infectious disease	4·3	3·2	0·09
2	Neoplasms	0·5	0·2	0·07
3	Endocrine disorders	1·8	2·9	0·20
4	Disease of blood and blood forming organs	0·6	1·7	0·34
5	Mental disorders	7·2	3·0	0·05
6	Nervous system disease	7·1	1·9	0·03
7	Circulatory system disease	7·5	6·1	0·10
8	Respiratory system disease	19·1	13·7	0·09
9	Digestive system disease	7·5	10·1	0·17
10	Genitourinary system disease	6·9	21·8	0·39
11	Skin and subcutaneous tissue disease	7·0	4·0	0·07
12	Musculoskeletal and connective tissue disease	7·9	9·9	0·16
13	Injuries	4·0	2·7	0·08
14	Health maintenance	11·2	8·2	0·09
15	Symptoms, signs, and ill defined conditions; congenital anomalies; certain perinatal conditions	8·0	10·4	0·16

INDEPENDENT EFFECTS OF PATIENT CHARACTERISTICS AND OF DOCTOR CONSULTED

We used linear modelling to investigate the independent relation of each patient characteristic with the number of tests ordered per consultation, while controlling for the effects of the other characteristics. Table III shows that diagnosis accounts for the greatest part of the explainable variation among patients in test use. The identity of the general practitioner and age of the patient also contribute appreciably. Sex does not, the substantial difference between the sexes being fully accounted for by the other patient variables, most notably diagnosis.

To determine whether some doctors referred patients for specialty opinion rather than test them, we compared doctors' test ordering with their rate of referral for specialty opinion. The two were directly associated ($r = 0{\cdot}55$, $p < 0{\cdot}01$), suggesting no such substitution was occurring.

TABLE III—*Variation in test use accounted for by patient characteristics*

	Variable	Proportion of variation due to variable (%)*	p value
1	Diagnostic category	47·6	< 0·001
2	Doctor	8·4	< 0·001
3	Patient age	3·3	< 0·001
4	Patient sex	< 1·0	> 0·05
5a	Social class (women)	< 1·0	> 0·05
5b	Social class (men)	< 1·0	> 0·05

*Explained by models (see Methods).

ORDERING BY SOCIAL CLASS

After controlling for the effects due to patient's age, diagnosis, and doctor, appreciably fewer tests per consultation were ordered for women in classes III, IV, and V and for men in class V than for patients of the same sex in classes I and II combined (table IV). The same trends were found when analysis was limited to the patients of those doctors with near complete (> 97%) recording of social class. The amount of variance explained by social class, however, was less than 1%, for both men and women (table III).

The last column of table IV gives the number of tests ordered per patient per year for each social class. A highly significant trend of increasing test use from social classes I and II to V was found. The reversal of the social class trend seen for tests per consultation indicates that though patients of social classes III-V are less likely to be investigated at any particular consultation, they have more tests ordered for them over a period of time.

TABLE IV—*Test use according to social class*

Social class	Tests per consultation*				Tests per patient a year (all doctors)
	All doctors		Selected doctors†		
	Men	Women	Men	Women	
I & II	0·119	0·143	0·110	0·152	0·256‡
III	0·090	0·122¶	0·094	0·110¶	0·304
IV	0·087	0·117¶	0·086	0·102¶	0·339
V	0·070¶	0·114¶	0·071	0·103¶	0·392
Not recorded	0·124	0·144	—	—	—

*Adjusted for age, diagnosis, and doctor.
†Doctors with complete or near complete (> 97%) social class recording.
‡χ^2, (trend) = 70, $p < 0{\cdot}0001$.
§$0{\cdot}05 < p < 0{\cdot}1$.
¶$p < 0{\cdot}05$.
**$p < 0{\cdot}01$.
} compared to social class I and II of same sex.

Discussion

When tests are ordered in general practice they are most commonly simple, inexpensive, and requested singly. In most consultations no tests were requested at all. This pattern, but not necessarily the actual number of tests, is largely unchanged from that of 20 years ago.[2–4] The effects of the availability of new facilities and technologies seem to be limited to the increase in the relative proportion of requests for routine chemical pathological tests. Hitchens and Lowe, among others, reported in 1966 that requests for chemical pathological investigations constituted about 5% of general practitioners' requests (radiology excluded); in our sample that proportion would be about 18%.[3]

We used multiple regression techniques to examine individually the association of each patient characteristic with test use while the effects of other characteristics were controlled. Only diagnosis, identity of doctor, and the patient's age remained independently important. The pronounced difference in the patterns observed for men and women was fully explained by the differences in their diagnoses; once adjustments were made for the effects due to diagnosis no difference in test use remained.

We also showed an association between test use per consultation and social class. Though these findings were statistically significant, their importance is limited because they accounted for only a small amount of the difference in test use among patients. The pattern of medical care in social classes III-V, however, seems to differ from that in social classes I and II: the former see their doctors more often and have more tests ordered for them over a period of a year, but at any particular consultation fewer tests are ordered. Cummins *et al* noted a similar social class pattern for referrals for specialty consultation: individuals in social classes IV and V had fewer referrals per consultation than those in social classes I and II but more per patient a year.[4] The higher consultation rates of patients in social classes III-V, therefore, seem to result in greater aggregate testing and referring, which may result from greater or different disease burdens in these classes compared with those in social classes I and II. Social class accounted for little of test use variation after adjustment for more medically related patient factors. An alternative explanation would be that doctors alter the content—for example, frequency of follow up consultation, amounts of testing and referring—depending on the non-medical characteristics of the patient.

The degree of concentration of testing among a small proportion of the population at risk and of those who consult was striking: two thirds of the tests were used for less than 10% of either group. Mills and Reilly recently reported that an average of 12% of patients seen in four general practices underwent laboratory testing.[18] To study this further we compared the extent to which various factors predicted the quantity of test use. As expected, the best was diagnosis, but the next strongest association was who the doctor was. This doctor effect not only remained after controlling for several important patient characteristics, but it also contributed more to the variation in test use among consulting patients than any other patient characteristic we studied except diagnosis.

Substantial variation among doctors in their use of laboratory services has been reported in many studies, but none has previously compared the doctor with patient characteristics in regard to the strength of their associations with the quantity of test use.[2–4] Rather than reflecting differences in the mix of patients that doctors see, these variations in test use most likely result from fundamental differences in their styles of medical practice and their reliance on laboratory testing in patient care. These variations do not seem to be due to doctors choosing to refer rather than test patients: those doctors who ordered more tests also referred their patients more often. The relation of such variation in laboratory use to health outcomes is not known. Whether it is acceptable from the perspective of quality or cost of medical care, therefore, is not clear and needs further study.

The national study reporting morbidity statistics from general practice during 1970-1 provided information that enabled the analysis of the associations of laboratory use with patient characteristics.[11] The patterns related to age, sex, and diagnosis observed in that study are closely similar to those we report. The quantity of tests ordered in the national study, however, was roughly half the number that we found. Because of the many differences between the two studies we cannot satisfactorily comment on whether this doubling represents a true temporal trend in test use. Though the national study did not have a random sample of practices, it did have a much broader geographic representation than the study we report, especially of rural practices. The similarities between our findings and those of the national study suggest that our results are likely to describe much of general practice.

Our findings suggest three general observations on the use of laboratory resources in general practice. Firstly, they are used sparingly. Whether readier access to and greater use of such resources would result in better quality of care is an important issue, but one that would require further careful investigation. For screening at least, additional testing in general practice has not been shown to be useful.[19] Secondly, of medical and non-medical characteristics of patients, the use of laboratory resources seems to be primarily related to those indicating medical need. Diagnosis and age, a proxy for disease severity, are related more to test use than are sex or social class. Other non-medical factors, such as a patient's education or ethnicity, might influence test use and deserve to be studied, though they are unlikely to be more important than the ones that we analysed. Thirdly, most laboratory testing is requested for a small proportion of patients. This concentration of resources is primarily determined both by the nature of the patient's illness and by who is taking care of it.

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Diary of Urban Marks: 1880-1949

On my return from the war I intimated to the local medical committee my intention to resign. Their reply to this was to present me with two entree dishes and a soup tureen suitably inscribed at the next meeting. Then I was begged to keep my position as they felt no one else could properly fill it. There was a good deal more sob stuff poured out and at the end I was forced to withdraw the resignation.

Two or three years later, on the resignation of Dr Begg, I became chairman of the panel committee, a position which I was holding in 1925 when I also was elected chairman of the Swansea Branch of the British Medical Association after being the secretary for a number of years.