The use of investigations in a general practice

A prospective longitudinal study

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Diagnosis by intuition is a rapid method of reaching a wrong conclusion

John Chalmers Da Costa,
Selected papers and speeches 1931.

THE use of a variety of investigations, encouraged by open access to hospital facilities, offers the general practitioner increased expertise in the evaluation of illness in his patients.

This paper presents an analysis of prospective observations of investigations requested by a partnership of two doctors during a period of one year. No attempt has been made to differentiate between the partners.

In the area of the practice—Shaw, in South-east Lancashire—there is unrestricted access for hospital pathological investigation, and also for radiological investigation, with the exception of some contrast-media examinations. The medical and technical staff of both departments maintain a high level of interest in the work undertaken for the general practitioner. Many tests are also performed at the surgery.

The objects of the study were to determine the nature and place of investigations performed; the rate of abnormal tests and some of the characteristics of the patients who were investigated. Data concerning women during pregnancy have been excluded. Access to independent electrocardiography was not available.

Method

1. *Recording investigations*

During the period 1 January to 31 December 1969 two special registers were maintained of investigations requested.

The first register recorded, for each investigation request, the information indicated in Table 1. With the exception of a full blood count, the records were of single items of investigation. When a request contained more than one item—for example, serum cholesterol and serum protein bound iodine—each item was separately recorded.

TABLE 1

1. Name of patient
2. Age of patient
3. Sex of patient
4. Social status of patient
5. Date of the test
6. Nature of the test
7. Site of test—surgery or hospital
8. Result of the test

The first seven items of the table were recorded at the time the request was made, and item 8 when the result of the test was known.

The second register recorded, in alphabetical order, the names of the patients for whom an investigation had been requested. During the year of observation further tests for the same patient were recorded on the second register so that the number of tests for individual patients during a year could be measured.

When a specimen became 'spoilt' all entries were deleted. At the end of the year of observation there were six deletions.

2. *Recording demographic, morbidity and surveillance data.*

An age-sex register (Pinsent, 1968) for all patients of the partnership was maintained. An analysis of the distribution of this register was made on 1 January, 1 April, 1 October, and 1 December. A mean value was calculated. This analysis is made easier by means of a technique already described (Lloyd, 1970)

'E' book recording of morbidity (Royal College of General Practitioners, 1963) was also continued during the period of the study. Some of the information obtained from this is used in comparative analysis.

The surveillance of patients who have chronic illnesses such as diabetes, or anaemia, calls for repeated investigations. A special recording system was used by the partnership to permit the recall of such patients. The system allows forward planning of further investigations at intervals of up to one year so that the result of the required test is available for the next surveillance consultation.

3. *Hospital services*

Laboratory tests were performed at Oldham and District General Hospital, the patients attending daily between 09.00 and 10.00 hours. Samples for analysis were obtained by the laboratory staff. When patients were unable to travel to the hospital, specimens were obtained by the doctor or nursing sister and delivered to the laboratory. Patients attending the x-ray department were expected between 15.00 and 16.00 hours. On four occasions x-rays were taken by a consultant radiologist in the patient's home.

In order to help the patient and the hospital the request card for investigation was enclosed in an envelope bearing the name of the department and the time the patient was expected to attend. This procedure has since been adopted by the hospital, and printed envelopes have been issued to all practitioners using these hospital services in Oldham.

4. *Surgery facilities*

Tests of urine were performed using 'Urolabstix' testing strips usually by the receptionist and doubtful results checked by the nursing sister or the doctor.

The partnership owned a 'Vitallograph' machine. One of the two receptionists employed was trained to standardise and to use this instrument. When doubt arose tests were repeated by the doctor.

Results

1. *The partnership population*

The age-sex register provided demographic measurement of all the patients registered with the partnership. A comparison of the sex and age distribution of the patients with projected national estimates has been possible. The result of this analysis is shown in Table 2.

There is no significant difference in the sex distribution. Male patients are statistically significantly older and the number of female patients is significantly greater in the middle-age group, though the differences are not great.

It has not been possible to compare the distribution of the partnership patients by

TABLE 2

DISTRIBUTION OF POPULATION OF ENGLAND AND WALES* COMPARED WITH DISTRIBUTION OF PARTNERSHIP LIST BY AGE GROUP AND SEX

Age Group	*Male*		*Female*	
	E & W	*Partnership*	*E & W*	*Partnership*
0–14				
No.	6·8M	385	6·5M	425
%	*25·1*	*21·3*	*22·8*	*23·2*
15–29				
No.	6·0M	364	5·8M	390
%	*22·1*	*20·2*	*20·3*	*21·3*
30–44				
No.	5·1M	268	4·9M	394
%	*18·8*	*14·8*	*17·2*	*21·4*
45–59				
No.	5·0M	315	5·3M	335
%	*18·5*	*17·5*	*18·6*	*18·2*
60+				
No.	4·2M	472	6·0M	291
%	*15·5*	*26·2*	*21·1*	*15·9*
Total	27·1M	1804	28·5M	1835
	100%	*100%*	*100%*	*100%*
	$\chi^2=148$ d.o.f.=4 p=0·001		$\chi^2=20$ d.o.f.=4 p=0·001	

*Social Trends No. 1. Central Statistical Office, 1970

marital and social status with larger populations because of differing standards of classification. These measurements for all partnership patients provides comparable information with those who were investigated.

2. *Total investigations performed*

During the period of observation, 1,756 investigations were requested for 1,109 patients. Six specimens were lost or otherwise unsuitable for analysis. There were completed records available of 1,750 tests for 1,104 patients—(481 tests per 1,000 patients per annum). Of this total:

719 tests were performed at the surgery (196 per 1,000 patients per annum), 763 tests were performed at the hospital laboratory (209 per 1,000 patients per annum), and 268 tests were performed at the hospital x-ray department (74 per 1,000 patients per annum).

There were 283 requests per 1,000 registered patients for laboratory and x-ray examinations, compared with 406 described by Barker (1967).

The rate of requests for x-ray—74 per 1,000 registered patients—compares with 29·5 per 1,000 patients found by Evans (1969), and 151 by Barker (1967). There seems to be a wide variation between practitioners.

Table 3 shows the number of tests per patient requested during the year of observation. For the majority of patients only one test was requested. There is no significant difference between the distribution for males and females.

TABLE 3

NUMBER OF TESTS PER PATIENT

Number of tests during one year	*Number of males*	*Number of females*	*Total patients*
1	305	421	726
2	104	132	236
3	25	47	72
4	10	22	32
5	9	11	20
6	5	13	18
Total	458	646	1104

Male v female: $\chi^2=4{\cdot}2$ d.o.f.$=5$ $p>0{\cdot}5$

Multiple investigations were sometimes requested at the same time. For other patients investigations were cumulative during longer periods. It has not been possible to determine the number of patients or tests in each of these two groups.

With the exception of urine and stool examinations, bacteriological tests are conspicuously absent. This is explained by the encouragement of referral to hospital outpatients for the diagnosis and management of focal infection and the displacement of the vaginal swab by the cervical smear for the diagnosis of vaginitis caused by *Monilia* and *Trichomonas vaginalis*.

Abnormal tests—criteria

At the time of the study, the handbook for general practitioners—*Using the Laboratory*, had not appeared. The laboratory at Oldham provided each practitioner with the range of normal for each test which was acceptable to both the hospital pathologists and other medical staff. These criteria were used for this study with the exceptions indicated in Table 4. It is conceded that the limits imposed on the normal may be subject to discussion but the same standards have been applied to all patients with a few concessions in old age.

X-rays of the chest and of bone and joints present diagnostic problems. The diagnosis of radiological chronic bronchitis and of osteoarthrosis may be difficult to make with accuracy. For this reason the rate of abnormal tests for x-rays of chest and bone are shown both inclusive and exclusive of reported chronic bronchitis and osteoarthrosis respectively. The diagnosis of osteoporosis presents even greater problems and reports of this condition have been ignored.

Distribution of all tests by age of the patient

Figure 1 shows the distribution in ten-year age groups of the ages of the patients for all tests and abnormal tests compared with the distribution of the partnership population and total morbidity (excluding immunisation and contraceptive advice).

There is a significantly greater number of investigations performed on patients of middle age ($p<0{\cdot}001$) which is not associated with an increase in morbidity. Abnormal tests are shown to be more frequent in older patients ($p<0{\cdot}001$).

Total morbidity is highest in children under ten, though there are fewer total and abnormal investigations in this age group. This may reflect both the nature of illness in infants and a reluctance to take blood samples.

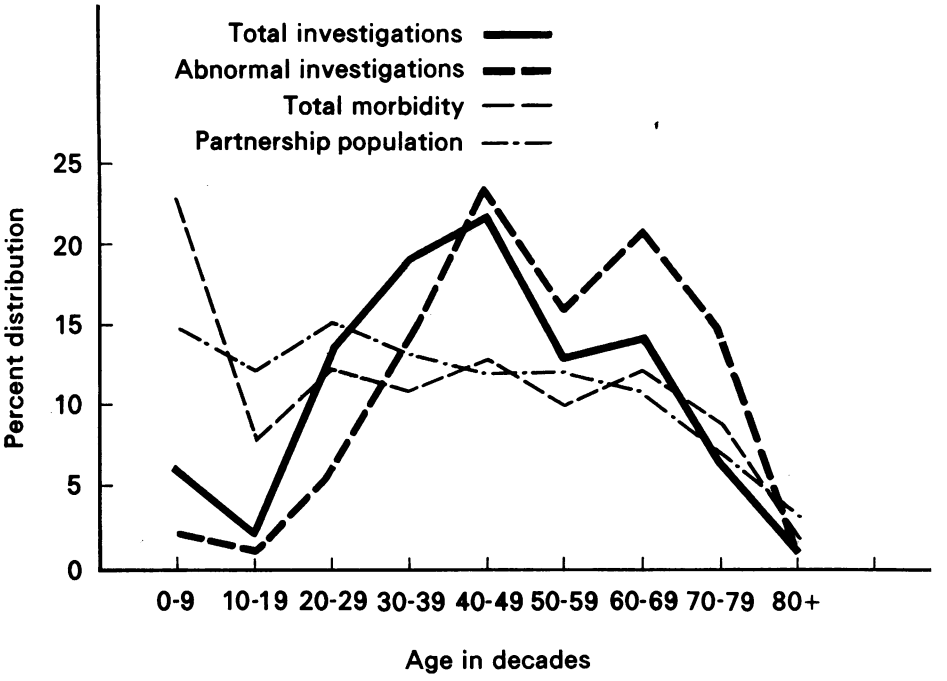

Figure 1.

TABLE 4

LIMITS OF NORMALITY

Test		*Criteria*
Haematology	Hb.	Less than 11·0 grams/100ml over 14·5 grams/100ml.
	ESR	Over 15 mm per hour up to age 50. Over 30 mm per hour over age 50.
	Full blood count	Any component abnormality.
Biochemistry	Blood urea	Up to 40 mg/100 ml up to age 50. Up to 50 mg/100 ml over age 50.
	All other tests	Limits indicated by the hospital laboratory.
Urine—Surgery		Presence of sugar, protein, acetone, or blood as indicated by 'Urolabstix' test.
Urine—Laboratory		Limits indicated by hospital laboratory.
Cervical smear		Presence of malignant cells or dyskaryotic cells. Presence of trichomonads or monilia.
X-rays		Radiologist's report (with conditions explained in text)
Vitallograph (Chronic bronchitis)		FEU, VI/FVC=less than 70%

Distribution of investigations by sex

An analysis of the distribution of the number of tests according to the sex of the patient is shown in Table 5. There is a significantly greater number of investigations of females which is not explained by the inclusion of cervical cytology. The proportion of total

TABLE 5

COMPARATIVE DISTRIBUTION BY SEX

		Male	*Female*	*z I test***
Partnership list	Number	1804	1835	
	%	*49·6*	*50·4*	
Total morbidity	Number	1851	2205	n=4056
	%	*45·6*	*54·4*	z=5·1
				p<0·002
Total investigations	Number	703	1047	n=1750
	%	*40·0*	*60·0*	z=7·8
				p<0·002
Abnormal investigations	Number	308	362	n=670
	%	*46·0*	*54·0*	z=3·1
				p<0·002
All tests except cervical smears	Number	703	961	n=1664
	%	*42·0*	*58·0*	z=6·0
				p<0·002
Haematology and biochemistry	Number	173	452	n=625
	%	*28·0*	*72·0*	z=3·7
				p<0·002
Haematology and biochemistry except FBC and Hb.	Number	82	180	n=262
	%	*31·0*	*69·0*	z=5·9
				p<0·002
Urine—Surgery	Number	119	169	n=288
	%	*41·0*	*59·0*	z=2·8
				<0·01=p>0·002
Urine—Laboratory	Number	7	38	n=45
	%	*16·0*	*84·0*	z=4·6
				p<0·002
Cervical smear	Number	0	86	
	%		*100·0*	
X-rays	Number	142	126	n=268
	%	*53·0*	*47·0*	z=1·1
				p<0·1
Vitalograph	Number	258	173	n=431
	%	*60·0*	*40·0*	z=4·18
				p<0·002

** The z test of instances (z I test) is an extension of the 50 per cent probability test and is useful for observations in excess of 40 (Russell, 1968).

Significance has been tested using the distribution of the partnership population to be the expected population except for abnormal investigations when the distribution of total investigations is the expected distribution.

investigations of women is greater than the proportion of total morbidity. Anaemia, being more common among women, might be held to be responsible for a greater number of investigations. However, exclusion of full blood counts and haemoglobin tests from the count of haematological and biochemical tests does not provide evidence to support this view.

X-ray tests seem to be equally distributed between the sexes. Vitallograph tests were more frequently performed on males, reflecting a greater incidence of chronic bronchitis in men.

Abnormal investigations were found to be more frequent for women though there is close approximation to the proportion of total morbidity.

Distribution by marital state

The distribution of the investigations performed according to the marital state of the patient for each investigation, is shown in Table 6. Comparison is possible with the

TABLE 6
DISTRIBUTION OF INVESTIGATIONS BY MARITAL STATE

	Single	*Married*	*Widowed*	*Divorced*	*Total*	χ^2 *test*
Partnership population						
Number	1319	2085	222	13	3639	
%	*36·2*	*57·3*	*6·1*	*0·4*	*100*	
Investigation sample (total)						
Number	316	1322	103	9	1750	d.o.f.=3
%	*18·1*	*75·5*	*5·9*	*0·5*	*100*	p<0·001
Haematology & biochemistry						
Number	109	469	44	3	625	d.o.f.=2
%	*17·5*	*75·0*	*7·0*	*0·5*	*100*	p<0·001
X-ray						
Number	47	204	13	4	268	d.o.f.=2
%	*17·6*	*76·0*	*4·9*	*1·5*	*100*	p<0·001
Vitalograph						
Number	82	325	23	1	431	d.o.f.=2
%	*19·0*	*75·4*	*5·4*	*0·2*	*100*	p<0·001
Urine (surgery)						
Number	65	200	22	1	288	d.o.f.=2
%	*22·6*	*69·5*	*7·6*	*0·3*		p<0·001
Urine (lab.)						
Number	3	41	1	0	45	d.o.f.=2
%	*6·6*	*91·1*	*2·2*		*100*	p<0·001
Cervical smear						
Number	4	82	0	0	86	d.o.f.=1
%	*4·7*	*95·3*			*100*	p<0·001
Stools						
Number	6	1	0	0	7	

distribution of the partnership population. There is a significantly greater number of investigations of the married. This is apparent irrespective of the nature of the test except for stool examinations, which were mainly requested for children.

The number of investigations of the widowed—103 out of 1750—can be compared with the distribution of this class in the partnership population. Such comparison shows that there is no tendency for increased investigation of the widowed ($p>0{\cdot}1$).

Distribution by social group

Comparison is made with the distribution of the partnership population.

The distribution of the social group of the patient for each investigation is shown in Table 7.

TABLE 7

DISTRIBUTION BY SOCIAL GROUP—ALL TESTS

		I	II	III	IV	V	*Total*	χ^2 *Test*
Partnership population (total)	Number	129	434	1836	656	584	3639	
	%	*3·5*	*11·9*	*50·5*	*18·0*	*16·0*	*99·9*	
Investigated sample (total)	Number	46	217	874	346	267	1750	d.o.f.=4
	%	*2·6*	*12·4*	*49·9*	*19·8*	*15·3*	*100·0*	p=0·1
Cervical smear	Number	1	23	46	3	13	86	d.o.f.=2
	%	*1·2*	*26·7*	*53·5*	*3·5*	*15·1*	*100·0*	p<0·001

There is only a marginally significant difference between the distribution by social group of the patient for the total tests.

The only highly significant difference is found among women on whom a cervical smear was taken. For this test there were fewer patients in social groups I, IV and V, and a compensating greater number in social group II.

Chi-square-evaluation of the distribution of laboratory tests, x-ray tests, and surgery tests other than cervical smear, showed that there was no significant difference at the ten-per-cent level between these tests and the partnership population.

Evaluation of abnormal tests by social group was found to show no significant difference (chi-square-test) between the tests and the partnership population.

Rate of abnormal tests

An analysis of the tests carried out is shown in Table 8 with the number and percentage of abnormal tests. There is a wide variation in the percentage of abnormal tests.

Urine sent to the laboratory was more often abnormal than urine tested at the surgery.

The rate of abnormal cervical smears corresponds with previous personal experience (Lloyd, 1967). One smear showed malignant cells. Five smears showed trichomonads and three monilia. Two smears showed the presence of both trichomonads and monilia.

Chronic bronchitis, frequently associated with byssinosis, is a common clinical condition in Shaw. There was a tendency to restrict the use of the vitallograph to situations where chronic bronchitis was suspected clinically. This explains the high rate of abnormal graphs.

The overall rate of abnormal tests, and the variation in individual tests, confirms the experience of others (Davidson, 1965; Collinson, 1968; Irwin, 1971; and Barker, 1967).

TABLE 8

NUMBER AND PROPORTION OF ABNORMAL TESTS

	Number	*Number abnormal*	*Per cent abnormal*
Haematology and Biochemistry	625	186	*29·8*
X-ray			
Chest	183	91 (Inc. C.B.)	*49·7*
		22 (Ex. C.B.)	*12·0*
Bone and joints	66	29 (Inc. O.A.)	*44·0*
		13 (Ex. O.A.)	*19·7*
Abdomen	15	4	*26·6*
Cholecystogram	4	2	*50·0*
Total x-ray	268	126 (Inc. C.B. and O.A.)	*47·0*
Urine			
Surgery	288	41	*14·2*
Laboratory	45	23	*51·0*
Stools	7	1	*14·3*
Vitallograph	431	284	*66·0*
Cervical smear	86	9	*10·5*
Total	1750	670 (Inc. C.B. and O.A.)	*38·3*

C.B.=Chronic bronchitis. O.A.=Osteoarthrosis

There were 26 individual types of haematological and biochemical tests, haemoglobin, blood sugar, and W.R. Superficial observation of the number of each test compared with the number abnormal, suggested an inverse correlation. The application of Spearman's test of rank correlation does not support this, the sum of the squares of rank difference being 3235 for 26 tests ($p>0{\cdot}10$).

Discussion

During the past four years there has been a consistent increase of about one per cent in the use made by general practitioners of investigation services in the Manchester Regional Hospital Board Area (M.R.H.B., Annual reports). In 1970, about ten per cent of the total use of pathological and radiological services provided by the Manchester Regional Hospital Board was by general practitioners.

Cervical cytology is the most popular investigation performed in general practice. In Manchester 26 per cent of cervical smears are taken by general practitioners. It is claimed that in East Lincolnshire over 50 per cent of smears come from general practice (Wookey, 1971). In England and Wales the proportion is 23 per cent (Wakefield, 1971).

Throughout the country there is mounting evidence that the general practitioner

makes responsible use of services provided (Yentis, 1970; Evans, 1968; Davidson, 1965 and Forbes, 1966)

A barium enema is frequently associated with a sigmoidoscopy and an intravenous pyelography with a cystoscopy. These two investigations can therefore be accepted to be the responsibility of the hospital specialist. With these two exceptions there can no longer be reason to deny unrestricted access to radiological and pathological investigation for general practitioners. Having accepted that the general practitioner does and should make use of such services, we can begin to find out how he does so.

Hull showed in 1969 that there is a relationship between the extent of clinical examination and the frequency of investigation. The general practitioner is more likely to request an investigation in association with a full clinical examination than on the evidence of the history alone.

There is continued interest in the place of general practice as a medium for screening procedures (Morgan, 1968; Taylor, 1970, and Symonds, 1970). The possibilities of the use of the technicon analyser to support screening activity in general practice have been broached (Irwin, 1971).

The results of this study suggest that, for one partnership there is a tendency to investigate women more frequently than men, and that this is not related to pregnancy, cervical cytology, or possible anaemia. There is also the finding that the middle aged are more fequently investigated, whilst the older patients have a higher proportion of abnormal tests (Figure 1).

The association between investigation and morbidity, both in the middle aged and the elderly, may be related to the quality of illness in these patients, though this does not explain the low rate of abnormal tests in the 20-40 year age group.

It is likely that the motivation of the practitioner who asks for an investigation needs to be examined. How often and under what circumstances does the general practitioner require supportive reassurance for himself and his patient?

Does the general practitioner always require that investigation of the elderly should confirm a likely diagnosis? What part does the investigation play in the further management of the patient?

These are questions which seem to arise from this study, and are only partly answered.

Further study, particularly of motivation, will be needed to provide answers.

Four motives for initiating an investigation in general practice are suggested:

1. *Supporting a diagnosis*

This is probably the most common motive, particularly in children and the elderly. The objective is to use the investigation to support a clinical diagnosis and to help to define the nature of treatment. For example, the result of a glucose tolerance test may assist the use of an oral hypoglycaemic agent.

2. *Refuting a diagnosis*

In the middle-aged group of patients, clinical demonstration alone may not be sufficient reassurance for the patient. The investigation becomes an instrument of reassurance and positively refutes an imagined diagnosis. The high incidence of normal tests in the middle-age group encountered in this study probably reflects this.

3. *Surveillance*

Routine surveillance investigations can be identified for a number of chronic illnesses. Effective surveillance calls for the organisation of an adequate method of recall of the

patients concerned. There seems no satisfactory reason to prevent the general practitioner from undertaking this responsibility in place of his colleagues at the hospital.

4. *Screening*

This term should be restricted to mean the determined investigation of population groups who have 'at risk' characteristics of a particular disease. There is a need for clear identification of the population and the illness, and for an organised programme. The opportunities for such screening in general practice are at present few.

These four suggested motives could form the basis of a further study of investigative procedures in general practice.

Summary

A prospective observation of 1,750 investigations performed in a year on a partnership population of 3,639 is presented. An analysis according to some of the characteristics of the patients is made and related, in part, to morbidity.

For the partnership described, women and the middle aged are most frequently investigated. Over half of all investigations were for patients aged under 50 years, whilst over half of abnormal tests were for patients aged over 50. Suggestions are made as to the possible significance of the findings and an indication is presented of the nature of further enquiry.

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