PRACTICE OBSERVED

Practice Research

Family doctors: their choice of practice strategy

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Abstract

The economic decisions taken by family doctors in one family practitioner area in the north of England were examined. There was evidence of a differential response to professional and economic incentives by a group of "high investing" practices. On five indicators of improvement in practice 32% of the practices accounted for 71% of the positive scores. Nearly all the high investing practices were in affluent areas; they were on average larger and had younger partners than the other practices. The high investing practices also faced more financial problems. There was evidence that older doctors with long lists of patients had a different strategy of income maximisation. Innovation in primary care is not determined by attitude alone but also by objective factors such as age, location, and size of the practice.

Introduction

Family doctors are the recipients of much good advice on how to run their practices. The pressures on them to improve and change their services are increasing. There are new pressures from family practitioner committees directly and personally from regular visits to surgeries, and there will also be pressure as the planning role of the family practitioner committees develops. New professional standards are being set by the Royal College of General Practitioners' quality initiative,[1,2] and the government's recent green paper on primary care suggests a good practice allowance, which would mean that family doctors would have to provide evidence of the standard of service that they were achieving.[3]

There is a great deal of published material laying down what the family doctor should be doing.[4-6] Most of the recommendations seem to imply that family doctors can generate a development margin above their personal income and the basic running costs of the practice, which would be available for improvement of services. This indicates an optimistic view of the economic potential for general practice.

The aim of this study was to examine how family doctors have come to terms with the pressures of making economic decisions. The system of rules laid down by the review body gives one set of incentives,[7] but their impact on particular practices might be modified and affected by many factors, such as changes in the local population and the degree of competition from other practices. The study aimed at looking at things from the family doctor's point of view by collecting evidence on the strategies that practices follow in adjusting to their local environment.

Practices make decisions about their "production function"—that is, the mix of capital and labour that they will employ. They also make decisions about the quantity of output in terms of medical services that they are aiming at. All of these decisions have certain results for the doctors' income, for the degree of risk that they face in the future, and for the distribution of time between work and leisure. Doctors have to take decisions that may commit them well into the future on the size of the partnership, the location of the practice, and the amount of capital in buildings and equipment. Other decisions might be reviewed regularly on the pattern of staffing, the pattern of surgeries, and the types of services on offer, such as special clinics or services to particular groups of patients.

In addition to these decisions on practice strategy which are made consciously and rationally, commitments are also made as part of the clinical work, the policy being planned afterwards. There are outcomes rather than plans as far as the practice is concerned. These include the consultation rate, the pattern of prescribing, and the pattern of referral. Previous work on what determines these

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outcomes suggests that they are mainly related to subjective factors in differing clinical judgment.[8-11] They do not seem to be related to objective factors such as the doctor's age or size of the practice.

Methods

The research was carried out in a family practitioner committee area in the north of England in one medium sized town and its environs, on either side of the Pennines. It has a central core, working class estates, some suburban housing developments, and many small villages. It is self contained and at some distance from other towns or cities. The total population of the study area was 228 475.

There were 37 practices in the study area with 106 family doctors. Eight of these were singlehanded practitioners who were excluded from the study. Thus 29 partnerships remained of which 25 agreed to take part in the study. Table I gives partnership sizes and participation rates.

TABLE I—*Participation rate of practices in the study area*

No of partners	No of practices	No of participating practices	% Participation
1	8*		
2	10	8	80
3	7	6	86
4	7	6	86
5	3	3	100
6	0	0	
7	2	2	100
Total	37	25	

*Excluded from study

The research was carried out in two stages. The researchers visited the practice to interview one of the senior partners. During this interview a questionnaire was completed covering size of partnership, history of the practice, services provided, and the gross and net income of the practice as a whole. A separate questionnaire was left for each partner to complete and return by post. The response rate was 86% for the practice questionnaire and 55% for the individual questionnaires.

The study aimed at testing three hypotheses: (*a*) There would be a differential response to professional and economic incentives. (*b*) The response would be affected by the type of local population and by changes in the local population. More innovation would be found in affluent areas, especially if the population was expanding. (*c*) The practices that had made the greatest attempt to develop and improve their services would face the greatest financial pressure.

The study area was divided between the older industrial areas on the east, and the central core and more prosperous suburban area. Table II gives the social characteristics of the sections of the district.

TABLE II—*Some social characteristics of the family practitioner committee study area at the 1981 census. (Figures are a percentage of the permanently registered population)*

Characteristic	East	Central/west	Family practitioner committee area
One parent families	2·00	1·43	1·78
Unskilled labour	3·05	4·40	3·90
Unemployed	11·10	8·65	8·93
Housing lacking amenities	3·21	2·09	2·35
Overcrowded housing	5·80	6·29	6·08
Ethnic groups	0·28	0·34	0·97

Source: 1981 census.

Results

The data from the 25 practices were organised first by whether the practices had adopted certain innovations that are usually considered signs of professional quality: (*i*) employment of a practice nurse; (*ii*) an improvement of premises achieved through the cost-rent scheme; (*iii*) participation in the vocational training scheme: one or more partners are trainers within the practice. These three practice characteristics are measurable, and there is no doubt of their importance in showing that the partners were willing to incur costs and, in the case of the vocational training scheme, that the practice has been able to meet standards set by others. In addition, practices were ranked by two further criteria which are less easy to measure but where differences may be important if found in conjunction with the other factors.

(*iv*) Possession of diagnostic equipment in the practice. Information was collected on various types of equipment that were on the premises and also about doctors' views on equipment that was not in the practice which would be of use to them. Possession of an electrocardiograph seemed to be the key dividing line. In the 17 practices that did not have one general practitioners from 11 (65%) of these practices expressed a desire to own one. Of the 37 doctors who did not have access to one at their premises, 17 (46%) specifically mentioned in an open ended question that they wished to own one. (*v*) The development of service innovations defined in terms of special emphasis in prevention and treatment that required the doctor to contact patients: these included hypertension clinics, flu vaccination programme, follow up clinics for patients with diabetes, and employment of counsellors.

To select high investment practices the criteria was whether they had at least two of the three clearly measurable characteristics (*i*, *ii*, *iii*). Taking all five characteristics the eight high investing practices accounted for 27 positive scores against 11 for the 17 other practices. For characteristics *i-iii* the scores were 18 against 6. Five of the eight practices employed nurses compared with two of the other 17 practices. Seven of the eight practices had taken part in the cost-rent scheme compared with two of the other 17. Six of the eight were training practices compared with two of the other 17. Five of the eight had high levels of equipment compared with three of the 17. Four of the eight had made innovations in services, and these were found in only two of the other practices.

These indicators define a group of high investing practices. The data on net income, list size, and the age of partners showed that there were further significant differences within the group of 17 practices. As table III shows, certain practices had higher average list sizes at the time of the study and in the past: had higher average net income, and had lower costs per patient. For the group of six low investor practices practice costs were 25% of gross income compared with 35% for the high investor practices. These six practices were also distinguished by the relatively high age and long service of the doctors working in them. Our visits suggested that this model of general practice was declining, with poor premises and short consultations but the ability to care for extremely large numbers of patients. These low investing doctors also tended to have their main premises in health centres, which may help to explain why their costs are so much lower (table IV).

Our classification leaves a middle group of intermediate practices that are neither investing heavily nor achieving high incomes. These partnerships

TABLE III—*List size, income, and age of partners by practice category*

	High investors	Intermediates	Low investors
List size per partner:			
Now	2 123	2 103	2 683
5 years ago	2 201	2 322	2 680
10 years ago	2 386	2 532	2 928
No of responding practices	8	11	6
Income (£):			
Average gross income per partner	36 250	30 300	30 500
Average net income per partner	23 400	21 800	25 000
Ratio net:gross income	0·648	0·673	0·749
Cost per patient (gross-net/No of patients) (£)	4·88	5·00	3·25
No of responding practices	8	9	5
Average age and time in present practice:			
Average age per doctor (years)	39·5	43·3	51·4
Average time in present practice (years)	8·9	10·1	15·6
No of responding doctors	23	20	9

TABLE IV—*Capital value of premises and practices operating from a health centre by practice category*

	High investors	Intermediates	Low investors
No (%) with main premises in a health centre	2 (25;	5 (45·5;	3 (50;
No of responding practices	8	11	6
Mean capital value of premises (£)	115 000	31 500	33 300
No of responding practices	7	6	3

were small and often struggling in areas of static or declining population. They include several doctors from ethnic minorities.

The high investors represent the approved group who have changed their practice decisions in response to incentives to employ staff, improve premises, and take part in training schemes. What were some of the characteristics of doctors in these practices that might explain why they had adopted these strategies? We looked at the characteristics of the partnership internally, the characteristics of its external environment, and the background and attitudes of the partners. The importance of the decisions made by the high investing practices is shown by their willingness to invest large sums in their own premises, the mean capital value of the high investing practice being £115 000 compared with £32 000 for the other practices (table IV).

The high investing practices were larger: the mean number of partners in the eight practices was 4·1 compared with 3·2 in the other 17 practices. These practices were more likely to have female partners: five compared with four in the remaining 17 practices. They were located away from the declining industrial eastern section of the area: only one of the eight practices was in the east, where eight of the 17 remaining practices were located. Thus the high investing practices were more likely to be in areas of new housing and of expanding population. Partners in the high investing practices were significantly younger: average age 39·5 years against 47·4 years in the other practices. The personal background of doctors in the high investing practices suggested that they were more likely to be influenced by professional incentives to change and improve their practice. For example, 56·5% of doctors in these practices were members of the Royal College of General Practitioners compared with 10% of doctors in other practices (table V). They were also less likely to have paid employment outside general practice and seemed to have a different view of their own role, being more likely to see themselves as having special interests within general practice.

TABLE V—*Professional characteristics of the doctors in each practice category*

Professional characteristics	High investors n = 23	Intermediates n = 20	Low investors n = 9
No of postgraduate qualifications per doctor	1·43	0·80	1·00
No (%) with membership of Royal College of General Practitioners	13 (56·5)	2 (10·	1 (11·1)
No (%) with membership of BMA	22 (95·7)	13 (65·	7 (77·8)
No (%) having regular extra practice work or posts	12 (52·2)	13 (65·	6 (66·7)
No (%) regarding themselves as mainly a generalist aiming to cover all aspects of general practice	8 (34·8)	13 (65)	7 (77·8)
No (%) having special interests within general practice	13 (56·5)	4 (25·	1 (11·1)
No (%) both generalists and specialists	2 (8·7)	2 (10·	1 (11·1)

Opinions on practice strategy and on appropriate incentives in general practice also differed. The high investors felt under more pressure and at times less able to cope (table VI). They expected more changes in services in the future, were more likely to want to reduce house visits, attached less importance to a large list of patients, and wanted to see fees for service extended. Thus the practice decision seems to have helped to bring about a different set of attitudes on how the work should be carried out and paid for. They seemed, however, to expect more stability in income and list size in the future than they had experienced in the recent past. Table VII compares their expectations with their recent experience. They seemed to think that a plateau had been reached and that fewer changes were to be expected in the future than had occurred in the past. Such prognostications have to be set against the information available in practices about the structure of income and of costs, which was not very complete, but most of the senior partners in the high investing practices were concerned about recent changes in their costs. Two of the eight practices had decided to raise their income from fee for service. The high investing practices with growing lists of patients were having the fewest problems.

TABLE VI—*Responses of doctors in the three practice categories to statements about general practice: percentages in parentheses*

Agreeing that	High investors	Intermediates	Low investors
The principle of fee for items of service should be extended to other areas	13 (56·5)	7 (35)	3 (33·3)
It is very important to have a large list (of patients in order to maintain a reasonably high income	5 (21·7	4 (25	4 (44·4)
I would hope to bring about major change and improvements in services over the next three years	14 (60·9	10 (50	5 (55·5)
I can cope with these normal working hours in most weeks	12 (52·2)	12 (60	6 (66·7)
I am sometimes under pressure to complete all that needs doing in a week	10 (43·5	8 (40	3 (33·3
I am ready to make home visits and am prepared to see more time devoted to home visits in the future	2 (8·7)	2 (10)	2 (22·2)
I am keen to reduce the number of home visits and to replace them with other forms of service such as telephone consultations	4 (17·4	1 (5·	0

TABLE VII—*Experience and expectations: list size, partnership size, and workload (numbers and percentages of doctors in high investing practices)*

	Recent past experience	Expectations in three years' time
List size:		
Larger	11 (47·4)	2 (8·7
Smaller	7 (31·6)	9 (39·1)
Same	5 (21·1)	12 (52·2)
No of partners:		
More	3 (25·0)	6 (26·1)
Fewer	3 (12·5)	
Same	15 (62·5)	17 (73·9)
Pressure of work:		
More	12 (52)	9 (39·1)
Less	11 (48)	2 (8·7)
Same	—	12 (52·2)

Thus a high investment strategy was related to the size of the practice, the location, and the professional background and views of the doctors. The low investing group had long experience, long lists of patients, and the ability to maximise net income. In the middle the practices were much more varied. One or two were moving towards the high investor group and were considering taking part in the cost-rent scheme. But many of the others were struggling for survival in the face of declining list size, relatively low incomes, and little professional contact.

Discussion

General practice is often referred to as an entity and general practitioners as a homogeneous group. Many attempts have been made, with both exhortation and incentive, to persuade this group of general practitioners to act in certain ways and not in others. The evidence from our study suggests that innovation will be very strongly related to certain characteristics of the partnerships and the partners. The two initial hypotheses were clearly supported. There was a differential response to professional and economic incentives. About 32% of the practices (36·3% of the doctors and 48% of the population in the area) had made related and consistent decisions on staffing, premises, and practice organisation that are usually taken as indirect evidence of concern with quality. The response was greater in practices in areas of expanding or middle class population. Innovation was typically found in large practices in areas that were more socially attractive.

On the third hypothesis, that the high investors would experience the greatest financial difficulties, the evidence was also generally favourable. Their costs were higher, and their practice strategy had not given them a higher level of net income than other practices: those high investing practices with declining list size were facing serious problems. The others seemed to be more stable. Some of the investments had been made only recently, and given this and the poor quality of the financial information available in the practices, the longer term consequences were much less clear. It was clear, however, that their decisions had entailed a higher degree of risk of capital debt than the other practices had.

The recent government green paper on primary care suggested a range of incentives to bring about change in primary care. Any new

measures would be added to the continuing professional incentives and established financial incentives such as the cost-rent scheme, which is likely to continue. The evidence suggests that certain key variables such as age, size of partnership, and the environment of the partnership may influence the response to incentives in a systematic way. In broad terms younger doctors in larger partnerships are much more likely to innovate. The forces operating locally may bring about much greater differentiation within general practice. The evidence points in two directions: firstly, to new policies to help practice viability in areas of declining population and not just in the inner cities; secondly, for encouraging the formation of larger partnerships and for incentives to early retirement. If the aim is innovation and development in primary care the economic determinants of innovation in terms of age, location, and practice size become highly relevant.

The existence of a development margin in general practice cannot be taken for granted: in fact a declining average list of patients will create even further pressure on it over the next few years. In some cases strong professional aspirations may overcome the economic obstacles: but this too cannot be taken for granted. Practice strategy is affected by economic forces and constraints operating locally.

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Randomised controlled trial of computer assisted management of hypertension in primary care

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Abstract

The hypothesis that general practitioners would obtain better outcomes for patients with hypertension using a computer than doctors not using a computer was tested. Sixty family physicians were randomised to two treatment strategies. "Test" physicians completed a data collection form after each visit from a patient with hypertension and mailed the forms to the test centre for processing. Computer feedback on management was mailed to the doctors. This encouraged doctors to apply the "stepped care" protocol, supplied charts of diastolic blood pressures *v* time, and ranked patients' diastolic blood pressures by percentile. Letters were mailed to patients to remind them of appointments. "Control" doctors filled out the same data collection forms as test physicians, but neither doctors nor patients received computer feedback.

Physicians who used the computer saw more patients per practice than control doctors (test 50 patients, control 40). For all patients the length of follow up was significantly longer in test practices (test 199 days, control 167), and a smaller percentage dropped out of active treatment in test practices (test 37·5%, control 42·1%).

For patients with "moderate" hypertension of a baseline diastolic pressure of >104 mm Hg the mean score of the last recorded pressure was below the goal of 90 mm Hg in test practices (88·5 mm Hg), but it failed to reach this goal in control practices (93·3 mm Hg). A greater average reduction of diastolic pressure was achieved in test practices (test 21·7 mm Hg, control 16·7 mm Hg). Though patients with "moderate" hypertension were better controlled in test practices than in control practices, the patients in test practices visited their doctors less often (test 13·3 visits per patient-year, control 17·4 visits).

Among patients with newly detected hypertension test practices achieved a greater reduction in diastolic pressure than control practices (test 15·1 mm Hg *v* control 11·3 mm Hg) and more sustained control of hypertension (test 323 days per patient-year with a diastolic pressure of 90 mm Hg or less *v* control 259 days).

Introduction

Computer technology has been used in many health care activities. Much previous work in computer assisted management of hypertension has been carried out without control groups, making quantitative evaluation of those interventions impossible. Apart from one experiment that showed improved follow up of patients with hypertension using computer generated reminder letters of appointments,[1] the results of clinical trials have shown no association between management of hypertension using a computer and better patient outcomes.[2]

Previous studies took place in university teaching centres, and none was representative of the community based, primary care

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environment where high blood pressure is usually treated. To investigate the impact of treating hypertension using a computer in general practice, a multicentre, randomised controlled clinical trial was carried out. The Community Hypertension Management Project tested the hypothesis that family doctors using a central computer facility to help to follow up and treat patients with high blood pressure would achieve better results among their patient populations than doctors who did not use such a system.

Methods

Sixty family doctors in the Toronto region were recruited and given published material about treating hypertension, based on the principles of "stepped care" made popular by the Hypertension Detection and Follow-up Program[12] and which were then advocated by the Ontario Council of Health task force on hypertension.[13]

After stratification for the number of partners working together and for predominating ethnicity of the practice doctors were allocated using a shuffled deck of cards (half marked "test," half "control") to two treatment strategies.

TEST GROUP

Physicians who were allocated to the test group filled out data collection forms after each visit from a patient with hypertension, which gave the patient's name and address; date of visit; systolic and diastolic blood pressures; drugs, dosage, and frequency of administration; and the approximate date of the next scheduled visit to the surgery. Doctors mailed these forms to the test centre in stamped addressed envelopes.

Data were checked and ambiguities resolved by telephoning doctors' offices. Data were entered into a Sperry-Univac V-77 timesharing minicomputer. The computer generated feedback for physicians and patients, using software written in FORTRAN.

Reminder letters of appointments were issued and mailed to patients. When no information was returned to the test centre within two weeks of a scheduled appointment a telephone call was made to the doctor's office to determine whether or not the patient had missed an appointment. If so, a letter was generated requesting the patient to make an appointment with the doctor.

For each encounter form fed into the computer a feedback sheet for the doctor was produced. It contained three pieces of information: (i) a cumulative chart of the patient's diastolic blood pressure *v* time; (ii) intrapractice and interpractice percentile rankings based on diastolic blood pressure, which the doctor could use to identify problem patients; and (iii) commentary on the treatment that the doctor had prescribed, based on the "stepped care" protocol.

The computer did not prescribe treatment initially: the computer gave a critique of the doctor's decisions after the doctor had expressed them.[14] The system often agreed with what the doctor had done. Only when the prescribed treatment deviated from "stepped care" was a general suggestion for change made for the doctor's consideration. Changes were suggested about one time out of three, but no statistics were kept.

The treatment protocol was conservative by current standards.[13] It called for all patients with a baseline diastolic pressure of >104 mm Hg to be treated with drugs. Patients with blood pressures of <105 mm Hg were not treated routinely unless there was evidence of target organ damage or a history of stroke or transient ischaemic attack.

CONTROL GROUP

Physicians in the "control" group filled out the same data collection forms as test doctors, controlling for the "attention getting" placebo effect that might be expected when a doctor participates in medical research and knows that his or her performance in managing a specific disease is being monitored. It also ensured identical data recording methods in test and control practices, hence identical patient recruitment procedures in the two arms of the study.

Though required to return the data collection forms to the test centre regularly, neither the doctors in the control group nor their patients received feedback generated by computer.

All practices started the experiment on the same day. All practices were telephoned roughly every two months to ask whether they were having trouble filling out forms or whether they needed supplies, to remind doctors in both test and control groups that completing the data collection forms was important, and to reassure them that their continuing contributions were both noted and appreciated. After 16 months (a time determined by the availability of human and computer resources) the experiment was terminated suddenly, with no warning to participating doctors.

STATISTICAL ANALYSIS

Outcome variables were associated with patients, but doctors were randomised. All patients of any one doctor were automatically allocated to the same arm of the study. Since observations arising from patients allocated as a group inevitably share some variability, "cluster randomisation" has special implications for statistical analysis.[15] Thus we analysed the performance of the practices not the results for individual patients. For each variable one "score" is derived to represent all observations within the same practice. For continuous variables the median observation is chosen as the practice "score." Medians are preferred to means because the median is less susceptible to the influence of outlying observations, hence more representative of the typical value within the practice. For each variable, these scores—one for each practice—are compared between groups. The mean score (mean of the practice medians) is used as a summary statistic for each treatment arm of the study, and Student's *t* test on practice scores determines the significance of a difference. Where a proportion summarises each practice, the proportion is designated as that practice's "score."

However many patients are in the study, all individual observations reduce to a comparative handful of practice scores. Such a loss of degrees of freedom limits the power of even a large, multicentre experiment to detect real differences. A method that probably underestimates the significance of observed differences is preferred as a more honest alternative to overestimating it.

Given the rigour of this analytic method, and in keeping with modern statistical practice that is now departing from ritual obeisance to the arbitrary 5% level of significance that has often been cited in medical papers,[16] precise p values are listed when the chance of making a type I error is less than 10% by a two tailed test.

POPULATIONS ASSESSED

We planned to evaluate four populations: (*a*) Everyone with a baseline diastolic pressure of >90 mm Hg, or who was prescribed an antihypertensive medication at any time regardless of diastolic pressure reading. (*b*) Patients with "moderate" hypertension with a baseline diastolic pressure of >104 mm Hg. These were the patients whom the protocol directed should always be treated with drugs. (*c*) Patients with "mild," uncontrolled hypertension, with a baseline diastolic pressure of >90 mm Hg to <105 mm Hg, constituted a separate group whom the protocol directed should not be treated routinely with drugs unless there was evidence of complications or high risk factors. (*d*) All patients whose high blood pressure was newly detected during the trial. This group was expected to benefit a great deal from intervention since much of the total reduction in diastolic pressure occurs early in treatment.

The number of practices (the units to be evaluated) would remain constant regardless of which subpopulation might be analysed or its ultimate size.

Results

DROP OUTS, ACCEPTABILITY, AND ELIGIBILITY

Five practices dropped out from the test group, and five from the control group. The 10 doctors never sent data to the test centre, typically stating that they were too busy to fill out the forms. An equal number of drop out practices in the test and control groups suggests that the feature shared in common—data collection forms—was the objectionable factor. There is no indication that the use of the computer was unacceptable. Drop out practices were excluded from analysis, since they had provided no data, leaving 25 practices in the test group and 25 in the control group.

According to advanced planning, patients were excluded from analysis for three reasons. Patients who had been followed by their doctors for possible development of high blood pressure but who had never had a diastolic pressure of >90 mm Hg recorded nor had antihypertensive medications prescribed were considered non-hypertensive. Patients were also excluded if they had been seen only once during the trial, because at least two blood pressure readings for each patient were needed to establish a change, or if they had been enrolled in the study for fewer than 30 days since it was thought that this much time was required to give doctors a fair chance of controlling high blood pressure. Exclusions were roughly comparable in both groups (table I).

Sudden termination of the experiment "wasted" data from many patients,

but this was a conscious choice. Physician compliance with filling out patient encounter forms and consulting computer feedback was likely to be consistent only if the intervention was applied universally throughout the duration of the trial. There was too much potential for confusion had doctors been instructed to fill out encounter forms for some hypertensive patients, but not others, as the trial was winding down.

TABLE I—*Patients excluded from analysis*

Reason for exclusion	Test group No	Test group % Of total	Control group No	Control group % Of total
Not hypertensive	65	20·4	51	18·0
Only one office visit	158	49·5	151	53·4
Two visits or more, but in trial < 30 days	96	30·1	81	28·6
Total	319	100	283	100

After 602 patients were excluded 2231 patients remained whose records were used to derive practice scores: 1241 in the 25 test practices and 990 in the 25 control practices.

BASELINE COMPARABILITY

The mean score age for subjects in the test group was 59·8 years and in the control group 57·8 years. No significant differences were found in any of the four populations. Women made up 53·3% of test subjects and 64·2% of control subjects (p<0·06). There was no significant difference in baseline diastolic pressure in any population.

Among practices the mean number of years since the doctor had graduated from medical school was 29 in the test group and 30 in the control group. The numbers of central, urban, and peripheral practices were almost equal in each group. The number of group practices and the ethnic composition of the practices were comparable in both test and control groups since practices had been stratified by these criteria before allocation.

WORKLOAD AND FOLLOW UP

Doctors who used the computerised system saw more patients in each practice than doctors in the control group (50 patients per doctor *v* 40). In Canada it is impossible to determine which patients are being followed up in a general practice and which ones have dropped out of the practice at a specific time.[17] Asking the doctor or office staff is unhelpful. Patients often leave a practice without informing the doctor, and some patients may wait months or years between office visits.

Therefore, a substitute variable must be used. The elapsed time in days between the first and the last recorded patient visits is an indirect indicator of length of follow up, which would tend to be shortened for a patient who dropped out of the practice early. This measurement excludes patients whose follow up appointments were scheduled for dates after the conclusion of the experiment, but it cannot be assumed that all scheduled appointments would have been kept. Table II shows that for all patients the mean score "length of follow up" estimated in this way was longer in the test group than in the control group. Similarly, for newly detected cases follow up was longer in the test group. In the other two populations raw differences also suggest longer follow up in the test group, but they are not significant.

Assuming that any patient who had not been seen for three months or more at the conclusion of the trial was a "drop out" from regularly monitored treatment, 37·5% of patients in the test group dropped out compared with 42·1% in the control group (p<0·03). Patients in all four populations were seen less often per patient-year in practices using the computer than in the control practices (table II). The difference is slightly significant for "moderate" hypertensive patients.

TABLE II—*Follow up of patients with hypertension*

	Length of follow up from first to last visit (days): Test group	Control group	No of office visits per patient-year (visits): Test group	Control group
	All hypertensive patients			
Mean score	199·3	167·0	10·8	12·4
95% confidence limits	173·0-225·6	148·8-193·2	9·2-12·4	9·8-15·0
P	<0·09		NS	
	Moderate hypertension			
Mean score	168·0	152·7	13·3	17·4
95% confidence limits	141·0-195·0	121·1-184·3	11·0-15·6	13·9-20·9
P	NS		<0·09	
	Mild hypertension			
Mean score	190·9	169·3	11·6	12·7
95% confidence limits	163·6-218·1	137·7-200·9	11·2-12·0	12·1-13·3
P	NS		NS	
	Newly detected			
Mean score	162·0	132·1	13·1	14·7
95% confidence limits	137·5-186·5	108·0-156·2	11·5-14·7	11·7-17·7
P	<0·1		NS	

DECISION TO TREAT

Crude differences in the proportion of patients treated with drugs in the two groups favour the test intervention in the populations of moderate, mild, and new hypertensive patients (table III). Although it would be a desirable conclusion to attribute these differences to the test intervention, none of them is significant.

TABLE III—*Change in diastolic pressure*

	% Of patients treated: Test group	Control group	Change in diastolic pressure from baseline to last visit (mm Hg): Test group	Control group
	All hypertensive patients			
Mean score	95·4	95·7	−4·9	−4·1
95% confidence limits	87·1-100*	87·7-100	−6·6-−3·2	−6·1-−2·1
P	NS		NS	
	Moderate hypertension			
Mean score	95·1	84·5	−21·7	−16·7
95% confidence limits	86·6-100	70·3-98·7	−25·1-−18·3	−19·9-−13·5
P	NS		<0·06	
	Mild hypertension			
Mean score	91·4	90·2	−9·8	−8·5
95% confidence limits	80·4-100	78·5-100	−11·9-−7·7	−10·8-−6·2
P	NS		NS	
	Newly detected			
Mean score	79·4	76·1	−15·1	−11·3
95% confidence limits	63·5-95·3	59·4-92·8	−18·2-−12·0	−14·2-−8·4
P	NS		NS	

* Upper limits of confidence intervals truncated at 100%.

CONTROL OF BLOOD PRESSURE

In the category of moderate hypertension the mean score last recorded diastolic pressure was below the goal of 90 mm Hg in test practices, but it failed to achieve that in control practices. The difference was clinically small with respect to an individual patient but potentially important with respect to the population (88·5 mm Hg test, 93·3 control, p <0·1). Removing patients who never received drug therapy from analysis barely affects the result.

As shown in table III, for moderate hypertensive patients there was a large and significant difference in the mean score reduction in diastolic pressure from baseline to last recorded pressure favouring the test group. Similarly for "newly detected" cases test practices experienced a greater reduction than control practices. The difference also favours test practices in the other two subpopulations but is not significant.

For combined patients of test and control groups sex, age, mean diastolic pressure, and practice were regressed by a linear stepwise procedure against observed change in diastolic pressure. The most important factor influencing the change in diastolic pressure was the practice to which a patient belonged, which supports the "practice scores" method of analysis (sum of squares = 17 874, p<0·0001). As expected in a protocol that called for the most vigorous treatment of the most severe hypertension, another important predictor of change in diastolic pressure was the mean pressure (SS = 4100, p <0·0001). (It would be inappropriate to examine baseline diastolic pressure as a predictor since change and baseline diastolic pressures are not independent variables: using the mean pressure gets around that problem.[18]) A patient's age was the third most important factor, though its total contribution was comparatively small (SS = 1810, p <0·0002). Sex was neither important nor significant (SS = 219, p <0·09), which is reassuring in view of baseline differences in the sex composition of the two groups.

Table IV shows that there was no significant difference in the percentage of patients who achieved the goal of a diastolic pressure of 90 mm Hg in any

TABLE IV—*Blood pressure control*

	% Of patients with diastolic pressure 90 mm Hg or less on last visit: Test group	Control group	No of days with diastolic pressure 90 mm Hg or less per patient-year: Test group	Control group
	All hypertensive patients			
Mean score	88·9	87·5	215·6	202·6
95% confidence limits	76·5-100	74·5-100	175·1-256·1	160·8-244·4
P	NS		NS	
	Moderate hypertension			
Mean score	86·0	76·2	191·7	175·7
95% confidence limits	72·4-99·6	59·5-92·9	136·6-246·8	119·1-232·3
P	NS		NS	
	Mild hypertension			
Mean score	87·9	88·3	251·0	274·0
95% confidence limits	75·1-100	75·7-100	205·7-296·3	229·5-318·5
P	NS		NS	
	Newly detected			
Mean score	92·4	91·5	323·2	258·5
95% confidence limits	82·0-100	80·6-100	299·7-346·7	212·8-304·2
P	NS		<0·03	

population. Ascribing each recorded diastolic pressure, however, to all patient-days of observation since the previous recorded blood pressure among newly detected cases test patients had 64·7 more days per patient-year with a diastolic pressure ≤90 mm Hg than control patients—a 25% improvement.

Discussion

The Community Hypertension Management Project was concerned with the net results of treating hypertension, not with the process of treatment. It was impossible to force doctors to adhere to the protocol. If some doctors failed to fill out encounter forms, or ignored feedback generated by the computer, then their poor compliance would have diluted measured differences between interventions. Periodic telephone contact encouraged the use of encounter forms in both test and control practices, but it is possible that computer generated feedback had a positive influence on doctors using the forms in the test group, where more patients per practice were ultimately enrolled than in the control group. If this happened it might lead to further underestimation of differences between the two groups: patients not enrolled by their doctors would probably be seen less often and thus have relatively poorer blood pressure control.

Multiple interventions were used in the test groups. Whether letters, graphs, percentile rankings, or suggestions for treatment helped to improve patient outcomes cannot be answered by the design of this experiment. An intermediate endpoint (diastolic blood pressure) was used as a well accepted, but surrogate, representative for the eventual endpoints of morbidity and mortality.

The "stepped care" protocol adopted for the Community Hypertension Management Project was conservative compared with current standards.[19,20] New recommendations have recently been published by the Canadian Hypertension Society.[21,22] Canadian doctors are now advised that all patients with a diastolic pressure of >100 mm Hg should be treated, the minimum level for treatment having been lowered by 5 mm Hg from the 1977 guidelines used in this trial.[13]

This computer system may have caused doctors to refrain from treating some patients with mild to moderate hypertension, encouraging them to concentrate on patients with higher baseline diastolic pressures. It is potentially important that, although doctors in the test group treated more patients in each practice than doctors in the control group, a similar proportion of patients had a baseline diastolic pressure of >104 mm Hg in both groups (12·2% test *v* 12·3% control, NS). Computer assisted management may have helped each doctor to treat more patients who needed treatment according to the criteria of the day, but since practice size (the denominator) is impossible to determine accurately no firm conclusion can be reached.

Because the post was used there was considerable delay between when a patient visited a doctor and when computer generated feedback on that appointment was delivered to the doctor. Ideally, a computer system would be used interactively by doctors when a hypertensive patient is examined, but this was not practicable for financial and logistical reasons, and the system used in the trial had less potential perhaps for effecting improvements in patient outcomes.

Patient compliance was not measured. Methods such as pill counts were discarded as unworkable. The enthusiasm of busy family doctors for this additional chore would surely have flagged after a short time: thus any data provided would have been unreliable.

Some hypertensive patients whose blood pressure is adequately controlled may visit their doctors less than once a year. A substantial proportion of patients with undetected hypertension present for screening less than once a year, and if they do appear for another reason the doctor may neglect to measure blood pressure. The number of patients with high blood pressure who are either followed up or detected in one practice during 16 months inevitably falls short of the total practice population of patients with hypertension. If recruitment into a study depended on a patient presenting to a doctor and having the blood pressure recorded on an encounter form some potential subjects would be missed.

We conclude that the results of this trial suggest that computer assisted management of hypertension effected several improvements in outcomes in patients compared with control by record-keeping in community based general practices: (*a*) Better follow up was achieved for all patients in the test group compared with the control group. This confirms an earlier report by Barnett *et al*, who found computer generated letters to remind patients of appointments useful in improving follow up among hypertensive patients.[8] (*b*) Among the patients who entered the study with moderate levels of baseline hypertension, better control (relative to the goal of 90 mm Hg) was achieved in test patients, though the difference was small. For these patients reduction in diastolic blood pressure was greater in test than in control practices. These improvements in the test group were achieved with fewer office visits per patient-year than in control practices. (*c*) Among cases newly detected during this study reduction in diastolic pressure was greater in test than control patients and more sustained control was achieved in test patients.

The same computer intervention is not recommended generally for three reasons. Firstly, although the probability that observed differences may have arisen by chance alone is no greater than 10% in any conclusion we have drawn, it is not negligible. Secondly, the best computer technology available when this work was carried out has been superseded by smaller, cheaper, more powerful, personal computer hardware. Thirdly, developments in software are occurring in artificial intelligence and expert systems. The HT-ATTENDING software for hypertension management uses such an approach, though its effect on patients has not been evaluated experimentally.[6,7]

Since this suboptimal intervention showed evidence of efficacy when analysed by the uncommonly harsh "practice scores" statistical technique then a more complex computer system could produce even more convincing results in a larger experiment with more practices participating. The growing use of microcomputer systems by primary care doctors for accounting and other purposes presents opportunities for future work, removing the constraint of using a remote, central computer in another location and allowing the doctor access when a patient is being examined. An interactive hypertension "expert system" for use on microcomputers in the doctor's office and supplied by the Ontario Medical Association is being evaluated.

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100 YEARS AGO

At a recent meeting of the Council of Hygiene, in the department of the Seine, France, a question was raised as to the fitness for food of eggs which had been laid for a considerable length of time, and which offered certain peculiarities, such as external and internal spots, and the yolks having a strange colour, and adhering to the shell. Various considerations on the subject had been submitted to M. Chatin, with the request that he would inform the Council whether, in the case of eggs so affected, it would be necessary to prohibit their sale. The reporter stated that eggs which had spots about them were not necessarily damaged, and that they might be used by bakers and confectioners for glazing bread, and some kinds of pastry, whilst the whites could be used by leather-dressers, who employ albumen in the preparation of articles made of leather. He added that eggs which were really damaged, could easily be distinguished on account of the smell. Under these considerations, M. Chatin thought there was no necessity to forbid the sale of them. That a stale egg may, in some cases, be safely eaten, like high game, is quite comprehensible; but game, as well as eggs, cannot be eaten when putrid beyond a certain extent, probably because germs of extreme septic virulence, resisting the gastric juice, have been developed. In the earlier stages of decomposition, both these articles of diet appear to remain innocuous, the game being toothsome to the many, the eggs to the few. (*British Medical Journal* 1886;ii:30.)

A striking and in some respects novel plan for obtaining at least a partial diminution in the amount of impurity which is daily discharged into the river Thames has, according to the *Globe*, been drawn up by Mr. J. O. Phillips, the Secretary of the Gas-Light and Coke Company. The vast works of this undertaking, situated at Beckton, adjoin the present northern outfall, where about two hundred million gallons of sewage are daily discharged into the river. The manufacture of gas at Beckton is carried on on an immense scale, about 1,500,000 tons of coal being annually carbonised in the twelve gas-houses. This coal is brought to Beckton by screw-colliers, each of from 900 to 2,500 tons burthen; and the appliances at the Beckton pier have been brought to such perfection that five of these vessels can be cleared within twelve hours. The proposal of Mr. Phillips is, that the sewage at present discharged into the Thames shall be treated by precipitation and pressure; and that the product, in the form of dry cakes, shall be shipped in the colliers when returning unladen to the North; and shall be conveyed by these to sea, when it can be thrown overboard. Putting aside the consideration of the waste, which, in the present state of our chemical knowledge, is inevitable in such a process as this, it cannot be questioned (says a correspondent) that the scheme has much to recommend it. As a permanent mode of sewage-treatment, it would be objectionable to the highest degree, being, besides, exceedingly costly. As a temporary resource, however, it presents a distinct advance on the present unsatisfactory method. Mr. Phillips states that the Gas-Light and Coke Company would be able to deal with the entire quantity of sewage at Barking; and the cost would, it is said, hardly exceed that at present incurred in the so-called deodorising process. (*British Medical Journal* 1886;i:261.)

It is a fact which is not as thoroughly appreciated by the speaking public as it should be, that the mechanical part of speech-making requires cultivation, if the listeners are not to be converted into innocent victims of the defective articulation, or indistinct voice of the would-be orator. The muscular efforts, which may be quite sufficient for ordinary conversational purposes, are wofully inadequate when applied to the articulation of an address to a crowded meeting, nor will mere exaggeration of those efforts be sufficient to overcome the difficulty; nothing short of a complete rearrangement of the working of the different parts of the vocal apparatus will suffice, and this can only be acquired by patient and deliberate cultivation. We have it on very good authority that the first requisite of a certain dish is to have caught the animal destined to the feast, and to be able to make a speech, an indispensable factor is the possession of sufficient powers of sound-production. It is just as ridiculous for a man to attempt to speak in public without such powers as it is for a vocalist without voice to attempt to sing, and the sooner would-be speakers and vocalists lay this fact to heart, the better will it be for a suffering and not always patient public. So essential is the production of a sufficient volume of sound, that a great many people are enabled to establish a reputation as orators with nothing more than perchance a dose of self-assurance. But even where this gift is not possessed to the extent of compensating for the absence of other minor requisites, enough may be available to do good service if only sufficient attention be paid to careful and distinct articulation, slow but not tedious utterance, and a proper division of the ideas into short sentences duly marked by a pause. It is needless to say that the pauses are but imperfectly replaced by the abortive cough or hawking with which many speakers round their phrases. In the interests of the public it would be well for persons whose laryngeal apparatus is congenitally defective, or has become imperfect from the vicissitudes of life, to communicate their ideas only with the pen. Mediocrity of ideas may, it is true, be covered by a brilliant delivery; but, on the other hand, the most creditable sentiments are rendered nugatory when uttered in a voice which is not audible, or, if audible, unintelligible. Orators cannot always reckon on the indulgence which is usually accorded to post-prandial efforts; the part of the audience whose attention is not taken up in vainly listening to the speaker, seeks some other means of passing the time, and not infrequently interjections more forcible than polite interfere with the periods, and destroy the symmetry of the oration. (*British Medical Journal* 1886;ii:830.)