OFFICE OF HEALTH ECONOMICS

Surveillance and Early Diagnosis in General Practice

Proceedings of Colloquium

held at

Magdalen College, Oxford

Wednesday, 7th July, 1965

In the Chair: Professor J. N. Morris

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Contents

(Discussion is included between contributions as appropriate.)

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Introduction

FOR the purpose of this meeting 'surveillance' was defined as describing 'procedures aimed at the protection of individuals against chronic non-communicable diseases'.

In preliminary discussions, it was clear that there were two aspects of the subject:

1. widespread, and possibly automated, screening programmes, which could theoretically be linked to the concept of 'high risk' groups with a greater than average likelihood of contracting particular diseases.
2. the extension of clinical medicine, primarily in general practice, to increase the likelihood of particular diseases being detected, whether the patient has consulted the doctor for that disease or not.

These two aspects were not necessarily distinct. The former had so far received more public attention. The latter might possibly be the more promising short-term approach to achieve the objective defined above.

The programme for the colloquium was drawn up to cover both aspects of the subject. It has been assumed that most participants were to some extent familiar with the stage which early diagnosis and screening, for example in diabetes and glaucoma, had reached in this country. To supplement this, Professor Jungner and Dr Collen were asked to describe briefly their work in Sweden and in the USA.

It was not intended that detailed techniques should be discussed, except in so far as they illustrated general principles. In each session it was hoped that the discussion would throw light on questions such as: Who should have it? Who should do it? Why will they do it? How is it to be organised? What procedures should be used? What are the long-term benefits? What is the cost? Can any list of priorities be given (a) for individual clinical practice and (b) for social policy?

Since the colloquium, the OHE has set up a standing advisory committee, under the chairmanship of Professor R. E. Tunbridge, to consider how some of the ideas suggested during the meeting could be translated into policy and action in the future.

Some principles of early diagnosis and detection

DR J. M. G. WILSON

IN a previous discussion on the contents of today's programme, it appeared to me that we were taking on something very difficult, in tackling not only surveillance and early diagnosis, but in addition considering it in the context of general practice. On the one hand, it seemed to me we have a certain amount of early diagnosis going on, and on the other, plenty of general practice, but, to all intents and purposes not the two operating together. But I was then really thinking in terms of a particular form of early diagnosis by screening. Here we have this term 'surveillance'. Really then, I thought, we should be discussing good general practice because surveillance must include activities like ante- and post-natal examination, infant welfare, and perhaps examination of the elderly.

Even allowing that a certain amount of this kind of surveillance goes on in general practice, I do not think we should forget that some forms—maternity and child welfare—were taken up long ago by the public health authorities because the need was not being otherwise met. The run-of-the-mill general practice has perhaps not altered so much since those days. This seems a difficulty; that in today's discussions we shall be talking a good deal about a rather new kind of medical practice by early detection, in the context of an organisation for providing general medical services which has survived largely unchanged from an earlier era. Thus it seems that at least as much discussion should centre round the future organisation of the provision of general medical services as round the subject of surveillance and early diagnosis itself.

The present dilemma has been clearly demonstrated to me by the varying attitude of general practitioners to cervical cytology which, as you know, has been accepted by the health service as a personal preventive medical measure. Some general practitioners regard this as 'preventive medicine', and not within their terms of reference. Others, whether they are able to carry it out in practice or not, believe that cervical cytology is just the type of work for general practitioners and that, if they do not adopt an increasingly preventive attitude to their work, general practice as we know it will probably perish. The question of inducement by payment obviously enters into the argument and this whole matter is, of course, under discussion at present.

Fortunately, others among you here are more qualified than I to discuss this matter of general practice organisation and I am looking forward to hearing more about this later today. My own terms of reference are to discuss the general principles of surveillance. I would like to include early detection of disease by screening and other methods in my terms because, by itself, I think surveillance might be interpreted as passive watchfulness only, whereas early detection implies quite an active process.

I want to divide up what I have to say about early detection and screening in the following way: First, I would like to say a few words about the historical development of surveillance and early detection because I think this throws light on professional attitudes to this form of care. Secondly, screening has grown up mainly in the public health field and I want next to discuss a number of principles which might be used as guides in the practice of public health screening. Following that, I shall briefly look at these principles in the context of surveillance in general practice in order to see whether these public health principles apply there and, if not, what the difference is and what difficulties may be removed and what added. Next, I shall say a few words about economics. Finally, I hope to look at the questions given in the briefing paper with the object of bringing early detection and general practice, the horns of my original dilemma, together—if that is the right metaphor.

Table 1

HISTORICAL DEVELOPMENT OF SCREENING

SCREENING ERA	*EXAMPLES OF CONDITIONS SOUGHT*
Early	Malaria Nematodes Leprosy Trachoma
Middle	Pulmonary tuberculosis Venereal diseases
Late	Diabetes Ischaemic heart disease Iron-deficiency anaemia

Table 1 shows a sort of historical development. It is an attempt at relating the type of conditions of importance, for which screening of the population has been carried out, to different periods. Tropical and subtropical communicable diseases largely comprise the first period. The middle era is that chiefly of the chronic communicable diseases in temperate countries, while the late period represents the rise of the non-communicable chronic diseases. This is, of course, an over-simplification, but I think it demonstrates a broad progression of aims. Victor Heiser, who also had wide experience of tropical disease control, gives a vivid account of an early form of disease surveillance in the United States. As a member of the Marine Hospital Service, the antecedent of the U S Public Health Service, at the end of the last century, it was his duty to screen immigrants at the port of Boston. Anyone liable to become a burden on the country had to be picked out and was not allowed to enter. Conditions like deafness, valvular heart disease, hernia, tuberculosis, trachoma, and favus had to be spotted at what amounted to a march past in file. The sights were set so as not to miss existing disease, and shortage of medical manpower precluded further examination. Personal hardship for the rejected immigrant must have been very great but the object was to protect the public health and the public purse and individual suffering had to be accepted.

The natural successor to this type of screening was its continuation for screening the chronic communicable diseases of the non-indigenous population, much of which had escaped the net and had entered the country

with the immigrants. In this way, screening as a public health measure in the USA is an old-established procedure and, as communicable disease has gradually diminished in importance, attention has naturally turned to the increasingly prevalent chronic non-communicable diseases. Because of this non-stop progression these diseases are apt to be considered on all fours with the communicable diseases. But I think it is important to remember that case-finding for the communicable diseases is aimed primarily at protecting the community, not the individual, that this is the real justification for the cost. Thus, large-scale and expensive malarial control for quite poor countries is economically viable; while the early detection of a non-communicable disease in even well-to-do countries may remain a luxury.

With this early growth of screening in the United States, a large amount of experience of chronic disease programmes of various kinds accumulated, mainly carried out by public health authorities. The Commission on Chronic Illness reviewed chronic disease screening in 1956. Table 2 gives a list of conditions for which it considered screening tests were then applicable. However, it is interesting to note that the Commission places some qualifications on its general approval of screening. If I may quote from the report: 'The successful operation of programmes for making screening tests available to large groups of the population cannot be accomplished until a number of problems are solved. Administrative research is needed to seek solutions to such questions as the appropriate relationship of mass screening programmes to the practice of medicine, the creation of a demand for services after screening which cannot be fulfilled with existing resources, and a standard of reasonable cost for screening.' Though this was written nearly ten years ago, I do not think these problems have been solved for any condition except, perhaps, mass radiography for tuberculosis in certain populations at certain times.

Table 2

CONDITIONS FOR WHICH THE COMMISSION ON CHRONIC ILLNESS* CONSIDERED SCREENING TESTS ARE NOW APPLICABLE

1. Pulmonary tuberculosis.
2. Visual defects, including chronic glaucoma.
3. Hearing defects.
4. Syphilis.
5. Diabetes mellitus.
6. Cancer of skin, mouth, rectum, breast and cervix.
7. Hypertensive disease.
8. Ischaemic heart disease.

*_Chronic Illness in the United States_, Vol. 1, _Prevention of Chronic Illness_ (1957); Commission on Chronic Illness, Harvard University Press, Cambridge, Mass.

Essentially the aim of clinical medicine is simple: to make a proper diagnosis and give useful treatment which, in the case of chronic illness, the patient will keep to. Theoretically, the same should be true for pre-symptomatic disease but in practice there are difficulties, especially when screening is carried out by public health authorities on large, unselected populations. It should, however, be possible to evolve certain criteria or principles which could act as guides to successful public health screening. The ten points in Table 3 are an attempt to list some of the requirements which I would think important and I would like to spend a little time in considering them.

The first is that the disease must constitute an important problem. Clearly, the importance concerns both the individual and the community and, in trying to decide about priorities, there will need to be some weighting according to, firstly, the degree of prevalence and, secondly, the severity and prognosis of the condition if early treatment is not instituted. I suppose, as an example, the attempted control of obesity might be placed at one end of the scale as having a high prevalence with relatively good prognosis, whilst phenyl ketonuria would fall at the other end, with a low prevalence but very grave prognosis if left untreated.

Table 3

SUGGESTED REQUIREMENTS FOR SATISFACTORY CASE-FINDING

1. Important problem.
2. Accepted treatment.
3. Facilities for diagnosis and treatment.
4. Recognisable latent or early symptom stage.
5. Suitable test or examination.
6. Test acceptable to population.
7. Natural history adequately understood.
8. Agreed policy on treatment.
9. Cost related to other medical care expenditure.
10. Continuing process.

Secondly, the disease must have an accepted treatment. I had been going to say treatment of accepted value, but I think that if there is an accepted treatment, whether known to be effective or not, there is then an ethical obligation to make as early a diagnosis as possible. After all, there are not all that number of conditions for which there is a proved treatment of value. For example, for both diabetes and chronic glaucoma one can have doubts about the effect of medical treatment on the long-term prognosis, yet we must generally agree that the established condition should be treated.

In considering an accepted treatment there is also, I think, an economic factor. As an example, the accepted treatment for carcinoma of the lung is pneumonectomy. However, from current surveys it seems probable that, as at present carried out, routine X-ray of the chest for lung cancer at any greater interval than six monthly would be of little value. More frequent examination would not only be uneconomic but would also pose problems of persuading people to attend and possible harm from radiation exposure. Incidentally, in this particular example it seems likely that selective X-raying of persons of middle age, males in particular, with persisting cough will get round some of the objections.

Third, facilities for diagnosis and treatment must obviously be available. In a country like this, with a health service, this means that once a policy of early diagnosis is accepted, these facilities need to be provided everywhere. It is therefore very important to know in advance what the commitment is likely to be. For the detection of chronic glaucoma, for example, the investigation of persons with positive screening tests by tonometery from general population screening would quite swamp the country's ophthalmological facilities and prevent them from doing other work. One can argue from this that there is need for a better test for glaucoma and for ways of assisting the ophthalmologist in his work.

Fourth, there must be a recognisable latent or early symptom stage. Clearly, for useful detection there must

be a reasonable period in the natural history of the development of a condition during which symptoms are either not present or at least not pronounced. For example, though there are evidently changes in the serum globulins in early rheumatoid arthritis, these do not as yet clearly point to a pre-symptomatic stage of the disease and there seems little point, therefore, in trying to case-find by this method, though of course surveys will continue to add to our knowledge.

Fifth, suitable tests or examinations must be possible. This is, of course, one of the most important elements of screening. A good screening test should be quick and simple to perform, reproducible, sufficiently accurate, not cost too much, and be acceptable to the population. Without a good test not only can an unacceptable proportion of persons with the condition being looked for be missed but also, as I have just said of glaucoma, a very large number of persons without the disease may need investigating at length, thus using up a disproportionate amount of resources. I think it is also important to bear in mind the corollary that, despite a poor performance in terms of specificity and sensitivity, a test may appear deceptively good on paper because statistically it correlates well with the disease being sought. Electrocardiography or cholesterol level, for example, correlate well at a group level and indicate a high risk of disease, but are fallible tests for ischaemic heart disease in the individual.

We shall be hearing about the problems of glycosuria testing for diabetes. This method has the drawback of both giving many false positive tests needing diagnostic examination and at the same time of missing quite a high proportion of diabetics, particularly among the elderly. Blood sugar examination is, of course, more reliable but is more difficult and expensive to carry out, at least in general practice. The Dextrostix test, if validated and not too costly, may prove to be an acceptable compromise by providing a convenient technique of sufficient accuracy.

A really simple, quick and inexpensive method for haemoglobin, if this could be devised, would also be very useful. This problem is, I know, being tackled. I think there is probably scope for greater efforts to devise simple techniques which could be used for screening, though this raises an interesting point which will be discussed today, the impact of automation. In the environment of general practice particularly, one can ask: 'Is it better to have really simple rapid tests which can be performed either in the consulting room or home? Or, is it better to provide sampling tubes for specimens and access to automated tests of a high degree of accuracy?' I think much perhaps depends on the way general practice develops, as well as automation, and it will be interesting to hear this discussed.

Sixth, the test must be acceptable to the population, as I have already mentioned. There may be no way of knowing about this before screening a population is attempted. For example, the probable prophylactic value of cervical cytology is by now well known to the more educated women in western countries and indeed there is strong pressure from their organisations for providing services. But we have good reason to think that the less well-educated women do not come forward for examination and their staying away could easily stultify an otherwise good programme. The answer to this particular problem probably lies partly in health education and partly in changing the technique. The Davis cytopipette, though most likely not so reliable as is scraping the cervix, is evidently used, according to Davis, by women who will not be examined by other means.

Seventh, the natural history of the disease must be adequately understood. So far I have avoided definitions as being unnecessary for the present purposes, as well as rather dull; but now I should like to distinguish between two kinds of screening activity. These are, on the one hand, population or epidemiological surveys and, on the other, what I think is best called 'case-finding'. The objectives are different and I believe it is important to remember this. The principal aim of population or epidemiological surveys is not to bring patients to treatment but to elucidate the prevalence, incidence, and natural history of the condition under study. Study of the natural history implies a study of the origins or precursors of a declared disease, and in this way we now have some knowledge of the distribution of variables in populations as a whole, such as blood pressure, blood sugar and intra-ocular tension, and not just their distribution in that part of a population which has consulted doctors. In this way the natural history of the development of a variable over time (blood sugar, for instance) can be followed and the effect of, and therefore the need for, early treatment can be determined without the obligation of treating all cases. This course of action is justified because there is real lack of knowledge about the effect of treatment. Population surveys will, of course, find patients with declared disease, by screening, but this is a by-product and not a primary aim of the survey.

Case-finding, on the other hand, seems a suitable term for screening when the objective is to detect patients with illness and bring them to treatment. It is essentially a service matter.

The need for maintaining this distinction is not always clear, since the distinction itself tends to become blurred unless we look at the matter historically. One is perhaps apt to assume that, because it is possible to carry out successful case-finding by screening for a condition like pulmonary tuberculosis, the same should hold for other chronic diseases such as diabetes or chronic glaucoma. In making this assumption we are liable to forget that much of the survey work has been carried out in the past on pulmonary tuberculosis and that the natural history of the early stages of the disease has gradually become established over the course of many years of study. Perhaps the most important questions that need answering before case-finding is undertaken are, firstly, what early changes should be regarded for practical purposes as pathological and what may be considered physiological variation. Secondly, are early pathological changes progressive? Thirdly, is there an effective treatment which can be shown either to halt or reverse the early pathological changes? It is worth noting that even for some established clinical conditions, like the progress of the complications of diabetes and chronic glaucoma, we do not really know the value of treatment, the reason being that controlled trials were not carried out at the time of the introduction of the treatment. It seems to me, therefore, more than ever important that the opportunity to test the effectiveness of treatment for pre-symptomatic conditions should not be missed while it is ethically justifiable. There is nothing, I think, to be said in favour of treating early changes on the chance that it may do

some good. Apart from the expense much treatment is unpleasant and may need to be advocated for the rest of the patient's life, so that a considerable injury may be done by instituting unnecessary treatment.

Eighth, there must be an agreed policy on treatment. The measurement of a variable in a population sample, such as blood pressure, blood sugar, or intra-ocular tension, we now know (thanks a great deal to the work of some of you here today) fails to detect a dividing line between diseased and normal; although, of course, there may well be other factors which contribute to the diagnosis in those persons selected as abnormal. In a population survey it will probably be decided that those at the extreme ends of the distribution should be regarded as diseased and in need of investigation. But between these people and the clearly normal population there is a large group of 'borderline' cases, those with possible early disease, in whom a trial of treatment may be instituted. There are, in fact, many more 'borderlines' than diseased and to select this group by case-finding would inundate diagnostic resources, besides being at best of indeterminate value to the individuals. At worst, I myself feel it would be harmful for a patient with, say, a moderately raised blood pressure to be alerted to this through case-finding. It seems the right thing, therefore, in case-finding to apply the results of surveys somewhat arbitrarily to determine a high cut-off point for the screening test, so that only those almost certain to need treatment are screened as positive. Thus, by screening at a blood sugar level of 180 or 200 mgm. per cent two hours after taking glucose, for example, the 'borderlines' would be excluded from case-finding. This means as well, of course, accepting that many true diabetics would be missed because of the low degree of sensitivity of the test.

Ninth, I do not, at the moment, want to say much about the cost related to other medical care expenditure, except that from the information available the cost of screening appears to have been high and the benefits low. Regarded as case-finding, therefore, it is likely that better value in medical care could have been had in other ways. However, these schemes have been largely experimental and a large part of the cost must be put down to that account. When automation has advanced further, the cost of many tests may be lowered, thus making screening a better buy.

Finally, as for screening programmes being a continuing process, much screening in the past, for example for glaucoma, has been in the form of 'drives' or 'weeks'. There have certainly been good reasons for this and an important one is the difficulty in keeping up public interest in continuing schemes. However, continuing schemes are needed to cover complete populations and to establish the work as an accepted regular part of preventive medicine. I think probably the more soundly established the basis for a particular form of screening, the more readily is the need for a continuing process accepted.

My conclusion, therefore, is that, before useful screening can be carried out, we should study and understand the natural history of the conditions sought, one by one, and use only well-evaluated tests. With that in mind, what can we usefully look for at the present time? I have tried applying the criteria which I have just listed to various conditions. The list in Table 4 is not very different from that of the Commission on Chronic Illness, though I include certain conditions detectable by rapid physical examination, since I think these can be included under the definition of surveillance or screening. I have also added asymptomatic bacteriuria which, I think it would be agreed, is well worth looking for in pregnancy.

Table 4

CONDITIONS WHICH MAY JUSTIFY CASE-FINDING IN VARIOUS AGE GROUPS

Category in Order of Satisfying Criteria	INFANCY		OLD AGE
I	Phenyl ketonuria Cong. dislocation hip Amblyopia Deafness	Anaemia Cancer uterus Pulmonary tuberculosis Urinary tract cancer	Hernia Cataract Senile macular degeneration
II	Venereal disease Diabetes (strict criteria) Bacteriuria (asymptomatic) Ischaemic heart disease (strict criteria) High blood pressure (strict criteria) Overweight		

You can also see that I have used the term 'strict criteria' for diabetes, ischaemic heart disease and high blood pressure. This, to some extent, begs the question about a full understanding of the natural history of the condition but I would think enough is now known to justify looking for these declared conditions in populations, by means of screening. You will see that I have placed them in a second and less confirmed category than the other conditions. I have also, in this table, made a rough division by age. I might have mentioned earlier the importance, economically and in other ways, of a reasonable yield from screening. This can, I think, only be attained by selective screening, examining particularly high risk categories of persons. Age, sex, and pregnancy are obvious ways of dividing people into special risk categories. For instance, at ante-natal examination, besides the complications of pregnancy, which include pre-eclamptic toxaemia, there is also a reasonable risk of cervical and breast cancer, anaemia, pulmonary tuberculosis, diabetes, and asymptomatic bacteriuria. All these conditions could be looked for at the same time with economy and convenience. In this way, one can have the advantages of multiple screening, but the difficulty may often be that one is not always able to combine a number of tests and remain selective at the same time.

In discussing these principles, I have, as I hope I have made clear, been talking in terms of public health screening. I want now to return to the idea of surveillance in general practice and to see what difference, if any, it makes to screen people in general practice rather than as a public health measure. I think the main difference is concerned with communication between the doctor and the person screened without the intervention of another agency. The points about a full prior understanding of the natural history of the condition to be screened and our agreed policy on treatment are under these circumstances perhaps not of such fundamental importance. Obviously, the more the natural history is understood, the better; but if a general practitioner were surveying his practice for diabetes, for example, the borderline

patient would not present such a problem in management. The finding can be recorded in the patient's notes and used as diagnostic information when the occasion arises. Another practical point is that, whoever arranges and carries out screening examinations in the first place, it is the general practitioner who is responsible for the management and treatment of the patient. If he is in direct charge of the examination, it is a good deal easier for him to keep in touch and arrange for the diagnosis and treatment of his positively screened patients. It would be interesting to hear the views of the colloquium on this.

One further advantage of the general practice environment is the one of getting people to attend for examination. In cervical cytological examination, for example, this is, I am sure, going to be one of the big obstacles to the success of the scheme. If examinations could be carried out in the environment of general practice, with suitable help, it might be possible largely to overcome this difficulty.

However, there are great present difficulties about surveillance in general practice and I hope this is a matter which will be fully discussed today. Firstly, knowledge of how to manage patients with early disease is needed and for this a different education for general practice must be provided. I will not say more about this as Professor Scott is here and we can discuss, later, education for general practice. All I would say now is that, from my own experience of clinical medicine, clinical know-how is at present too much confined to the hospital environment for general practice screening and the management of early disease to be successful.

Secondly, records. I spoke of selective screening and I would think this was essential. But to do this it is necessary to have a proper age and sex register of patients in general practice. These are becoming more common but only among particularly keen general practitioners. However, given the other needs, this ought not to be an excessively large problem.

Thirdly, time and place. I cannot imagine that large numbers of general practitioners would feel they had time or the proper facilities for routine surveillance of their patients. Certainly, there are some keen ones who are able to carry out cervical cytological examinations, but generally, at present, this is developing as a service where smears are taken at local health authority or other clinics. The results are sent to the general practitioner, who takes the further action necessary. However, any kind of general surveillance would be quite impracticable under present conditions. The only way in which this could be done would be with ancillary help and probably in purpos-built premises. Since this is at present the exception rather than the rule, I cannot see regular surveillance as a routine service of the National Health Service becoming possible in general practice until a lot of the changes that are being discussed now become realities.

To sum up, it seems that it is right in principle to screen in general practice but that we cannot expect to see this becoming a reality unless there are pretty sweeping changes in the education for general practice, the general practitioner's records, ancillary help, and premises. The health centre with general practitioners and local authority workers working side by side, good records and laboratory facilities, would, I think, provide the ideal situation. Recording and linking of data can more easily be arranged when there is a degree of centralisation of this kind, and local health authorities are acquiring computers some of whose time could be used on data processing of records and arranging for recall examinations. The collection of specimens in a uniform way for automated laboratory techniques would also be made easier by this form of general practice organisation.

I have delayed until now putting the question: What are the benefits of early detection? Clearly, there are benefits in some forms of screening—early pulmonary tuberculosis, an early cervical cancer, an anaemic person, for example—but what I mean more is the benefit compared with providing other forms of medical care, a matter I just touched on earlier. I think the question we must ask is: Do we do better spending resources on early detection than on other public health facilities, say, more health education, providing aids for the handicapped, or more health visitors, assuming as one must that the total financial resources for health are limited? I think we can only say at present that we do not know. I hope we may hear views on this. My own feeling is that much depends on the 'hardness' of the evidence in favour of early detection for particular conditions and that is one reason why I am in favour of considering the merits of different conditions separately and not lumped together as multiple screening. I think we have got to admit that much of the evidence is pretty 'soft' and does not therefore command a high priority. If asked, I would call anaemia 'hard', cytology for uterine cancer 'fairly hard', and glaucoma detection 'pretty soft'.

Once we can show the real value of a measure to the community, it becomes easier, theoretically, to allocate funds for that purpose. In practice, it takes time for the usefulness of a measure to become established and, in general, it acquires financial support gradually. Basically, the treasury question must be: what is the quality of your wares?

Table 5

THE OHE QUESTIONS ON SURVEILLANCE AND EARLY DIAGNOSIS

Q.	A.
1. Who should have it?	Selective.
2. Who should do it?	Family doctor, MOH, Industry.
3. Why will they do it?	Only when real benefit can be shown (a) for the individual (b) for the economy.
4. How is it to be organised?	See 2 above; with ancillary help, good records and automation.
5. What procedures should be used?	Depends on surveys of natural history of particular conditions.
6. What are the long-term benefits?	Aim is to prevent spread of disease, diminish ill-health and prolong expectation of life.
7. What is the cost?	Probable increase for increased benefits.
8. Priorities for: (a) individual? (b) social policy?	Depend on proved efficacy of methods and prevailing facilities for medical care.

For these reasons, I think we need to plan our early detection as a series of campaigns each aimed at establishing the natural history of a particular condition with special reference to its prevalence, incidence, origins and

the effectiveness of early treatment. We have, in this country for example, directed surveys of anaemia, diabetes and glaucoma, about all of which we shall hear more today.

In order to speed up the acceptance stage, following the establishment of worth, the U S Public Health Service has an admirable institution which I strongly believe we should copy. This is the demonstration programme, supported financially by a Public Health Service matching grant, for a limited period, the object of which is to get the results of research into an acceptable service form with the minimum delay. A major problem is, I think, how to show whether case-finding pays off.

Finally, in Table 5, I have attempted to answer the questions given in our briefing paper, in the light of what I have been saying.

To sum up in a few words, I would say that we are not ready yet on medical grounds to screen for more than a few conditions; that the justification for the cost of early detection must depend on the demonstrable benefits; and that the present organisation of general practice as regards orientation of doctors, professional time available, records, premises, and laboratory facilities, is all against surveillance and early detection in that environment. As I said at the start, quite as much needs to be discussed on this last question as on surveillance itself.

A multiphasic screening programme

DR M. F. COLLEN

THE Kaiser Permanente organisation provides a rather comprehensive pre-paid programme of medical care through the West Coast of the United States of America. It is centred primarily in four major areas including the San Francisco Bay area, with which I am associated. We presently provide care to about 600,000 subscribers, or approximately 15 per cent of the Oakland/San Francisco Bay population. There is another large group at Los Angeles, a third group in the Portland area, and a fourth group in Hawaii. Altogether the Kaiser Permanente organisation takes care of over 1,000,000 subscribers. It is organised primarily as three legally separate entities. The Kaiser Foundation Health Plan is the intermediary insurance plan which contracts with subscribers to provide medical and hospital services. In turn it contracts with the two other legal entities: the Kaiser Foundation Hospitals, which is our financial organisation which arranges for the building of the centres and operates hospitals; and the third group, the partnership of physicians which provides the medical services within the hospitals and the offices. As a physician, therefore, I am associated with the Permanente Medical Group which is the group of doctors in San Francisco area who provide these medical services. Our basic principles, since we started in 1942, comprise pre-payment, integrated facilities, preventive medicine, voluntary subscription and a comprehensive programme of medical care. Although general practice is oriented primarily to therapeutic medicine I believe the time is approaching when preventive medicine for the individual patient will become an important part of general practice. Dr Wilson has alluded to some of this. Hopefully, health surveillance and preventive medicine directed to early abnormalities may prevent or postpone the need for therapy of chronic diseases. This will be realised, we believe, because of the introduction of new technology and instrumentation into medical science.

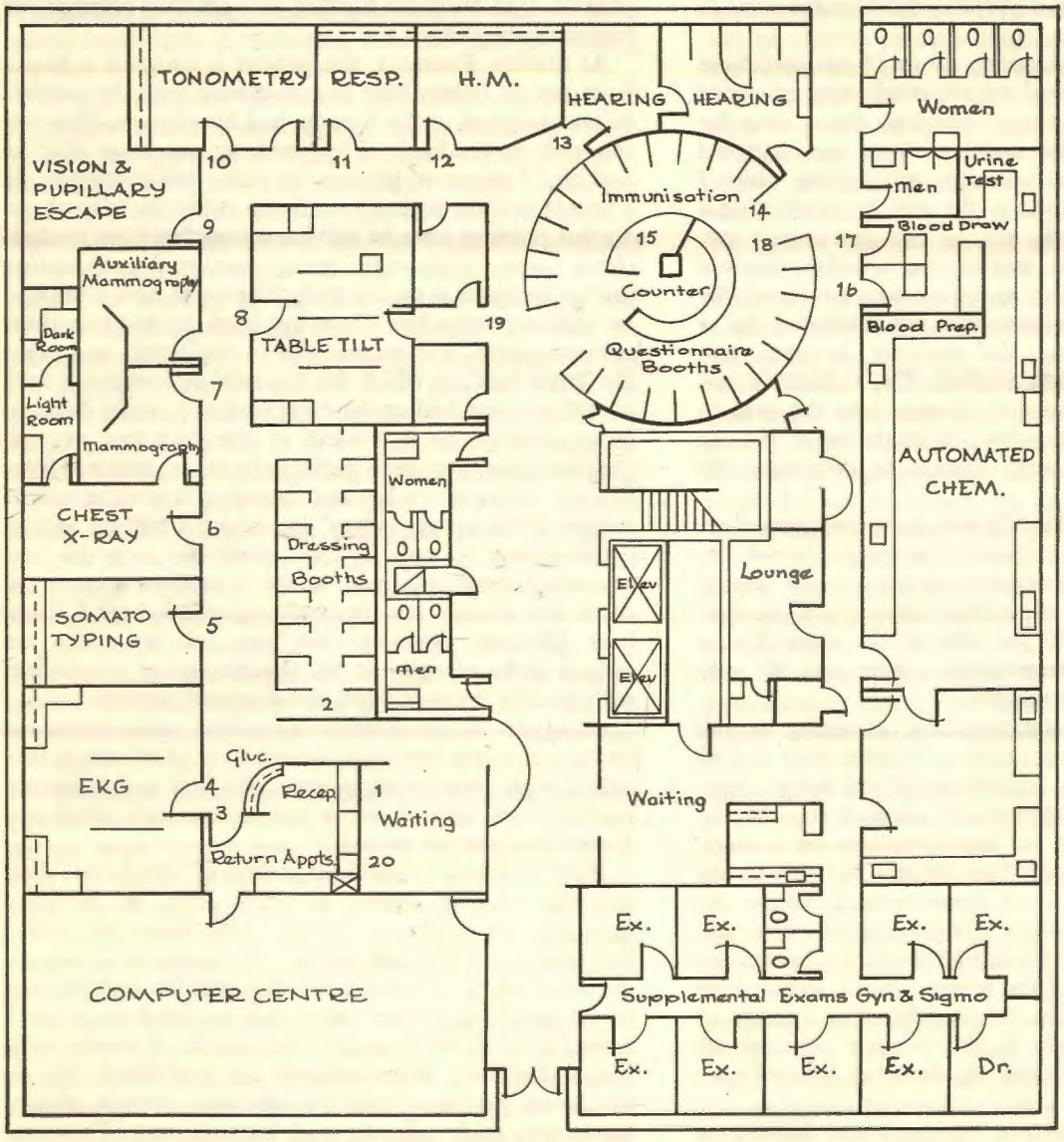
I shall describe to you today how this has come about in our medical care programme. Our approach to providing health surveillance to patients has been through the use of periodic health examinations. The research aspects which I will describe have been supported in part by a Community Health Service project grant, from the Chronic Disease Division of the U S Public Health Service. Traditionally, in annual health evaluation, the physician conducts a historical review and physical examination, he then arranges for the patient a series of routine laboratory, electro-cardiographic and radiological examinations; subsequently the patient returns for report and follow-up procedures. In our programme, the patient first obtains a battery of tests and procedures conducted in an automated laboratory. The physician subsequently

reviews the multi-test laboratory report, conducts the physical examination and then proceeds in a traditional manner to diagnose, treat and arrange follow-up procedures. This method has been utilised by the Permanente programme since 1951.

The so-called multi-test laboratories, which I will describe, are presently operating in our Oakland and San Francisco Medical Centres where the automated electronic and computer equipment is utilised as an integral part of the routine periodic health examinations. Presently we are examining 4000 patients each month.

I will describe very briefly how we conduct the examination and how we process our patients at the present time.

Table 6



PERMANENTE MULTIPHASIC SCREENING CENTRE

Table 6 is a floor plan of the specially designed and constructed facilities for our automated laboratory in Oakland. The patient proceeds from Station One to Station Twenty and it takes approximately 2 hours for the patient to complete the examination. He receives electrocardiography, chest X-rays, audiometry, etc. The health questionnaire is on pre-punched IBM cards. Laboratory tests, including eight blood chemistries, are recorded. Before the patient leaves this area additional indicated procedures are arranged in accordance with programmed computer 'advice rules', and when all the test reports are received, the computer prints out a summary report for the physician.

At the first station, patients are registered at a rate of approximately one every 3 minutes. The laboratory operates from 1 p.m. to 8 p.m. daily. Here, the patient receives a clip-board which contains a medical questionnaire form and a deck of IBM cards which are prepunched for computer input with his medical record number. Upon these cards will be recorded his test results as he goes from station to station.

At Station Two, the patient goes into a dressing booth and puts on a paper gown.

At Station Three, six electro-cardiogram readings are simultaneously recorded by a direct optical recording oscillograph. We operate two tables since we work in multiples of 2½ to 3 minutes a test. With two of these tables connected with the instrument, we have 5 to 6 minutes per patient. The electro-cardiograms are subsequently read by a cardiologist who records his interpretation on a mark sensed card. This is a card on which he records with a high carbon content lead pencil. The marks can then be directly fed through a card-input reader into

the computer. We are finding under the age of 40 around 90 per cent of the electro-cardiograms recorded show no significant abnormalities, whereas over age 70 only about half of them are being so reported.

We do the electro-cardiogram before we give the patient glucose at Station Four, of course, otherwise we would get artefacts by S T - T changes which appear rapidly. The patient is given 75 grams of glucose in 8 oz. cold carbonated water which is conveniently dispensed from a reconditioned, second-hand vending machine. The provision of the cold carbonated solution has decreased the incidence of nausea and vomiting to only a fraction of 1 per cent. The time of glucose ingestion is recorded by the nurse on the back of the card by a stamp machine. It also allocates to each patient a number from one to twenty-four, whose purpose will become clear at Station Fourteen.

We are finding approximately 10 or 15 per cent have elevated serum glucose and we are conducting extensive analyses to try to define more precisely the criteria for the diagnosis of diabetes mellitus. Since we instituted our computer analyses a year ago, any figures which I will give you are preliminary. We will be conducting a one year analysis this fall.

At Station Five, we record the weight, skinfold thickness, and punch body measurements automatically into cards. Body measurements are recorded by a potentiometer measuring the distance between two probes touching the body surface. The technician can record fourteen measurements directly into the card in 2 minutes without writing down a single value. We are correlating body types with disease to determine the value of this procedure.

At Station Six a standard 70 mm chest roentgenogram is obtained which is then subsequently read by the radiologist who records his interpretation on a mark sensed punch card. Similar to the electro-cardiogram, we find under age 40 around 90 per cent of the chest X-rays show no significant abnormalities; over age 70 only one-third show no abnormalities.

At Station Seven, mammography, screening of the breast for cancer, is performed on women over age 40 who receive two views, a cephalocaudal and lateral view, of each breast. The mammograms are then read by the radiologist who records his interpretations on a mark sensed card. Approximately two-thirds of the women are over 40 so that two out of three women receive the examination for breast cancer. We are presently detecting approximately one out of every 1000 women, proven by biopsy, to have cancer of the breast. Approximately half of those are not palpable. We are detecting cancers of the breast in around one in 2000 women over age 40 which otherwise would not be detected by ordinary physical examination.

The patient then returns to his booth and dresses. At Station Nine we record pulse and blood pressure. We are also evaluating the usefulness of a tilted table test in which we tilt the table to 80 degrees and record pulse and blood pressure at 1 minute and 2 minutes. We are awaiting the arrival of automated blood pressure equipment in order to make this test more useful and more precise. We find the technicians can record quite accurately the initial supine pulse and blood pressure but the fatigue factor begins to introduce considerable error in the 1 and 2 minute values. We find approximately 8 per cent of all our adults examined have a clinical diagnosis of hypertension. This is our third most common clinical diagnosis in our periodic examination.

Visual acuity is tested by reading a wall chart. For the pupillary escape test we use the flashlight. Results are recorded on a mark sensed card. About 5 to 10 per cent of the patients are referred for refraction. At Station Ten ocular tension is recorded with a Schiötz tonometer by a nurse and the reading is recorded on a mark sensed card. Approximately 1 per cent glaucoma are found. At Station Eleven, vital capacity is measured with a respirometer and the highest of three measures is recorded on a mark sensed card. At Station Thirteen, the hearing is tested with the automated audiometer and the graph readings are transferred to a mark sensed card. Only patients with treatable hearing loss are then referred for further audiometry.

At Station Fourteen, the patient is assigned a booth from one to twenty-four in accordance with the number he was assigned at the time he had his glucose. This was stamped on the back of his card, so one hour after he had his 75 grams of glucose the nurse will know exactly where to find the patient to call him out to the laboratory. At this point in time he will have completed his medical check form questionnaire going from station to station and so he leaves it on the desk. The nurse now gives him an ordinary letter-box which has been divided into three compartments. The patient sits in the booth and takes the 'letter-box', in which the top section contains a deck of 200 pre-punched cards, each having a single dichotomous question on it. Instead of checking 'yes' or 'no', the patient answers each question by taking the card from the top section of the box and dropping it into the middle section if the answer is 'yes' and into the bottom section if the answer is 'no'. This automatically sorts the 'yes' responses for direct input to the computer because the cards are already pre-punched with the question numbers. Medical questions have been selected which are judged to be of value in the discrimination of patients with specific diseases from non-diseased persons.

As a part of the preventive medical programme, the patient may here receive a booster dose of tetanus toxoid with a high pressure jet injector. We find approximately one-third of our adults in our community need and receive this tetanus toxoid.

When the hour since the ingestion of the glucose dose has elapsed, the patient is called from his assigned questionnaire booth and is sent to the laboratory where the blood samples are drawn. We perform a haemoglobin, a white cell count, V D R L test for syphilis, and blood grouping. These values are recorded on a mark sensed card. From a single 2 ml sample of serum, eight blood chemistry determinations are performed. We do the serum glucose, creatinine, albumen, protein, cholesterol, uric acid, calcium, and transaminase. These are simultaneously performed in 12 minutes by this multichannel technique and automatic analysis with the results directly punched into cards. The serum is put into a sampler which splits it into eight channels; 12 minutes later these are read on the colorimeter, and automatically punched into cards, which are then dispatched by pneumatic tube to the computer room.

Urine specimens are also collected and tests are performed for bacteriuria, pH, blood, glucose and protein. The results are marked on the cards by the technician.

The patient returns to the questionnaire booth and when he has completed all his questions, he then proceeds to the next station where a photograph is taken of the left retina with the Zeiss-camera. His eye pupil is now dilated since he had a drop of Neosynephrine put in his left eye when he had his tension measured. This is an example of a routine photograph read by the ophthalmologist who records the results on a mark sensed card.

Now the patient has completed the stations and returns to Station Twenty with his questionnaire box and his cards and clip-board. These are passed through the window into the computer room, on the other side. The patient turns in the first questionnaire box and receives a second box of 200 psychological questions.

The majority of the data generated in this laboratory is recorded in pre-punched or mark sensed cards so as to admit immediate introduction into the data processing system.

In the computer room the girl takes out the 'yes' responses from the middle box, she takes the patient's header card that has the medical number recorded on it, puts them through a 519 reproducer which runs them through and ends up with a single card with the medical record number and each of the 'yes' responses punched on it all ready for input into the computer. While the patient is waiting at the last station answering the psychological questionnaire the computer processes the punched cards from anthropology, chemistry, etc. In the central Oakland facility, these punched cards are entered into the I B M 1440 system. In the San Francisco facility, which is some 14 or 15 miles away, through the I B M 1050 tele-processing system, the information is all transmitted through the processor into the random access memory discs. The computer goes through a process in which all the information is recorded after the patient's medical record number as the cards come through in random on this disc.

The computer indicates if the results of certain tests have fallen outside certain limits, and if further tests or special advice is needed. For example as the patient's blood sugar reading comes in, if the blood sugar is over 170 mgm per cent, or over a certain limit for that age of the patient, it prints out a number to transmit by telephone line, which instructs the receptionist to send the patient back for a 2 hour check. If the haemoglobin is over or under certain pre-set limits which physicians have determined, it prints out a series of numbers which the receptionist refers to her list. She then gives the patient requisitions for additional blood tests or whatever has been so programmed.

As an off-line procedure, that is after the patient has left, the computer stores on the random access discs the remaining information, that is the mark sensed interpretations, from the electro-cardiogram, retinal photograph, the pre-punched questionnaire form and so on. When all the information has been received and stored, the computer prints out a summary report. This lists the information, the chemistry determinations, laboratory tests, prints the normals for our population by age and sex and lists the questions to which the patient has answered 'yes'. After several examinations, in addition, we will print a second normal which will be the patient's own normal mean and standard deviation for the individual. We can then determine individual trends. Also as a result of the programme, in time, we will insert the provisional diagnosis which will be generated from the computer.

The physician reviews this summary report at the time of the patient's first office visit. He directs further history-taking towards elaborating upon the questions to which the patient answered 'yes' and the report from the multi-test laboratory. He completes the physical examination and proceeds to arrange whatever medical care is necessary for his patient in the normal manner. He records his final diagnosis upon a special form which can be optically read for a direct computer in-put. This form permits 300 diagnoses to be recorded. We therefore have an automatic programme inventory every year of these diagnoses with the symptoms and test results. Thereby we can improve the accuracy of our diagnoses. This is the application of Professor Neyman's method in which we will be able to provide diagnoses and have a pre-determined knowledge of accuracy built into the programme.

In summary, for the purposes of health surveillance and early diagnosis, it is our experience that periodic health examinations can be provided for large numbers of people at a reasonable cost by the utilisation of an automated multi-test laboratory, such as I have described. We believe this has several advantages, namely, firstly, an automated multi-test laboratory which can provide 50,000 or 100,000 or more examinations can be implemented within 24 months. Secondly, extensive re-education of the practising physicians is not necessary.Thirdly, there results improved economy by providing at least four times as many tests for the same cost and at a greater speed. Excluding costs for the physician's examinations in our programme, with the twenty stations which I have described, we are able to provide about 30,000 examinations a year at a cost of approximately 25 to 30 dollars or, I would say, around £10 in your money per examination. That includes capital costs and depreciating equipment over 5 years. For 100,000 examinations, we think it would probably halve the unit cost. Fourthly, the result is improved efficiency for physicians by providing them at the first office visit with a large amount of information about their patients. As a result, it is our experience that a significant percentage of patients can be completely taken care of by the physicians in a single 15 minute office visit. The size of this percentage will depend, of course, on the age and health of the population to be tested. Fifthly, improved quality results by using automated equipment. Sixthly, there is improved efficiency of service to patients which can be provided through close integration of many test procedures. Finally, there at last develops the possibility of earlier detection of a wider range and greater number of unsuspected diseases among apparently healthy people; that is the concept of surveillance. In addition detection and diagnosis becomes possible by providing the physician with comprehensive profiles of the individual patient's psychological state.

Chemical health screening

PROFESSOR G. JUNGNER

I WOULD like to give some comments on the pilot study on chemical health screening which we have done in Sweden. It is based on principles that may not be new but are done in a rather special way. Much of the background is described in the two appendices, which I shall refer to when making my remarks. The first is called *Chemical Health Screening*. It is a little old and was written in 1962 but it will give the basic ideas behind our programme—that was automation to get a battery of chemical tests that could be of use to a general practitioner. That was the basic idea from the beginning. We felt that blood samples had some advantages if, with a proper selection of tests, they could be taken almost anywhere. It is easy to get such a sample. It can be taken and processed in a central laboratory at a comparatively low cost. We felt it was something for the future. I must admit the ideas came when I was working in the northern part of Sweden where we have very many difficulties with distances. People there are living very far from any hospital. Generally speaking, the use of blood analyses is suitable for health screening because blood samples can be taken almost anywhere, the technique is simple, and sampling can be arranged on a very large scale. Blood samples also keep well, and can be posted in chilled boxes for a long distance. We have, in fact, favourable experience of blood samples from Africa which were analysed in Stockholm. We feel that blood tests (chemical as well as, for instance, serological) are especially valuable for detection of asymptomatic diseases and metabolic disorders in a pre-clinical stage. One of the main advantages is that blood analyses can be done by automatic procedures with little need of medical personnel, and still there is a very high capacity. We have preferred health screening procedures that can be offered to everyone, and not to selected special groups.

The second appendix describes our pilot study in the Värmland district. In Sweden, as in other countries, the lack of trained medical personnel has hindered progress as far as general health examinations are concerned. The approach in Värmland can be regarded as an extreme way of carrying out multiphasic mass screening in a labour-saving way. The Swedish National Board of Health suggested in 1961 to the Government that a health screening project of 100,000 people should be carried out in association with general mass photofluorography in the county of Värmland. Now the project is completed. However, I can only comment on some results from the earlier stages of the investigation.

The area for health screening was fairly distant from the central administration office, as well as from the laboratories. Many problems dependent on long distances had to be solved, and consistently in a way that did not burden the ordinary health services and, especially, did not overload the hospitals. The following organisation was tried. A mobile field group for the sample-taking, photofluorography, etc. was organised; it moved from place to place, and could deal with 300 samples a day. The medical follow-up of patients with positive findings was done at a medical station. It changed location now and then, and was always in communication with a nearby hospital. The chemical analyses were done at a special laboratory in Stockholm for automation analysis, capable of 600–800 samples in 24 hours. At the National Board of Health, a group of experts was formed with the head office in Stockholm. The field group did not co-operate or work together with a general practitioner in that area. I think this was one of our biggest mistakes. But it was necessary to plan it in such a way because nobody knew how much work this health screening would mean to the general practitioners.

All inhabitants from 25 years of age were offered the chemical health screening. As a rule, health screening started by a self-administered questionnaire which contained only twenty questions, and we knew was too short. At examination by the field group, height and weight were recorded, and also the time of taking the sample and of the last meal. The blood pressure was measured in the sitting position because that was more convenient, although we are well aware that it can be criticised. We have the experience, that it is very important to get the technique of pressure taking correct. We have standardised the sphygmomanometers against the mercury register every day and that has been found absolutely necessary. I think this is more important than having the patient lying down, especially in a semi-mobile unit where we demand that everything be done very quickly, at a rate of one per minute. I should also mention that this almost 'flying' blood pressure measure has actually shown to be fairly correct.

By experience, it was shown that blood pressure should be taken before a blood sample was taken. It is always a question of which procedure upsets the patient most. If the patient is expecting a blood sample to be taken, nobody likes it actually, the blood pressure should be taken before, not afterwards. We have tried both ways and it has been found that that is best. This is a voluntary investigation, of course, and we had a feeling that many persons would not like this new technique. But we were completely mistaken. We had a very high percentage of attendance and almost all agreed to the blood sample being taken. In this first part of the investigation, about 70 per cent of the people to whom it was offered attended for health screening, but later on we got much higher figures. The last figures for this year were 98 per cent and 99 per cent, that means almost everybody who was not actually in hospital or in jail. Obviously a very high percentage of the people is willing to undergo this kind of health screening.

Each individual brought the urine sample to the medical station. You will realise this is not a very safe technique, but for practical reasons we had to do it in such a way. To take fresh urine specimens at this speed is not practical and we had to rely on the patients' being careful enough. We have had fairly good experiences, but we have given quite a lot of information to everybody about ways to collect urine samples as well as possible. The urine specimen was analysed for the presence of

sugar or protein by Clinistix and Albustix, respectively.

A blood sample was taken, and divided into a heparinized tube for determination of haemoglobin and haematocrit, and a tube for preparation of serum. When taking blood samples on a large scale, it is much better to send them in chilled boxes to the laboratory, and this we did. After discussions, the National Board of Health decided that chemical health screening should comprise the following analyses: haemoglobin and haematocrit; serum iron to detect iron-deficiency status; creatinine as a renal function test; two enzyme tests: the transaminases, GOT and GPT, for liver damage, etc.; thymol turbidity, as well as the zinc sulphate test for gamma-globulin content; beta-lipoprotein and cholesterol and, finally, protein-bound hexoses and sialic acid to detect non-specific inflammatory states. The tests were selected in such a way that they partly overlapped, giving a higher significance. Table A in the appendix shows some examples of earlier unknown diseases when about 3200 patients had undergone follow-up examination. I would like to make a few additional comments.

Anaemias constitute the largest group, 472 cases, mostly women. More than 80 per cent of them were iron-deficiency anaemias. Low serum iron in men is frequently found in blood donors, and after partial gastrectomy. *Hypercholesterolaemia* is known to have a comparatively high incidence in Värmland. Cholesterol and beta-lipoprotein values are fairly well correlated. Raised values of these lipids are noted at an earlier age than the rise in blood pressure. Persons who have reached a high age have lower blood pressure, and also a comparatively low serum content of cholesterol and beta-lipoprotein. It may be astonishing that *hypertension* had a fairly low incidence in comparison with the results of other health investigations. This is due to the fact that most patients, especially women, are aware of their hypertension, and are therefore not listed here.

The incidence of *diabetes mellitus*, 148 cases, represents about 0·4 per cent. This is a figure to be expected in Sweden. However, a qualitative test on urine is not conclusive, and many 'false positives' are found. Certainly some cases of diabetes remain undetected. Of the earlier unknown thyroid diseases, eight cases consisted of *myxoedema*. Pronounced hyperthyroidism is not likely to be found in health screening, and twenty-nine cases were *nodal, non-toxic goitres*. The figures for liver damage are low, definitely lower than we have found in other parts of Sweden. This might be explained by the fact that the incidence of epidemic hepatitis has been very low in Värmland during this period. The *malignancies* obviously offer special problems, since no specific chemical tests are available for cancer. The non-specific, inflammatory changes that sometimes appear in serum can detect some cases, and others may be suspected from a low haemoglobin level, pathological liver tests, changed serum protein pattern, etc. In seven cases, in addition to the nine listed, the follow-up examination disclosed a malignant neoplasm. However, the diagnosis proved to be known, which is the reason why these cases are not counted here. Naturally, the many other patients who, according to the questionnaire, had been treated for cancer were also omitted.

We know of some twenty additional cases that were not detected by the health screening, but were reported later through the cancer registry of the National Board of Health. Many of these patients had no or insignificant findings at the time of health screening. In a few cases with suspect laboratory values, not even the doctor's physical examination gave grounds for a more thorough investigation that might have disclosed the cancer. In the asymptomatic stage, with no history of symptoms, and no complaints at all, the diagnostic possibilities of diagnosing malignancy are very limited. Any means of detecting cancer at an early stage are then important.

During the investigation, we have given increasing attention to the possibilities of detecting *paraproteinaemia* or *myeloma*. Altogether, we have found some fifty cases, but in the first 30,000 screened only twelve cases were found. The remaining diagnoses were extremely varying, and very few cases had the same diagnosis.

The Table B in the appendix shows how different methods have contributed to a clinical diagnosis. The material is classified by sex, as well as by unknown and known diagnoses. Blood chemistry, which here includes haemoglobin determination, detects pathological changes in many cases, and is much the most important investigation as far as the number of diagnoses is concerned. The percentage of pathological findings varies in an interesting way, geographically and seasonally, but also with the incidence of severe colds or other epidemic diseases which produce chemical changes in the blood, at least temporarily.

The difficulty is to judge whether or not a change is important. In this study, only patients with definite, previously unknown findings were recommended to see a doctor. The borderline cases were often neglected, in the hope of a better and more reliable decision at the next health screening. The borderline problems also depend on the choice of screening methods. Although our selection comprises fairly sensitive tests, it is certainly not the final answer to the question of which methods should be used for multiple screening.

As a whole, marked chemical changes were detected in about 14 per cent of some 60,000 samples. If moderate changes are included, the figure rises to 58 per cent. After disregarding already known or expected results, and together with the other screening procedures (except photofluorography which is evaluated separately), it is found that, on the averages, *every tenth person* is recommended to have a clinical examination.

Thanks to automation blood analysis can be done in a large scale, and a more extensive use for health screening can be anticipated. Some examples are given to show how a battery of tests can be included in health screening programmes. Blood analysis can be used in a simple *basic programme* with or without use of disease-detecting procedures. Because sample-taking is a rapid procedure blood analysis is possible also, when little time is allowed for each step in the health screening.

Finally I would like to comment on the two charts attached to the appendices (page 51). They are by no means anything very special. They are intended to suggest how a blood sample can be connected together with other principles, in the way you have heard today. I think in these two charts, you can see how there are two viewpoints. One is how much time it is possible to spend on this. That seems to be very important for Swedish people; they do not like to be away for hours. They would like to go for health screening that takes some 15 to 25 minutes at most and leave the place after that. It is very

important. Maybe the Swedish people will change, I do not know. Anyhow, that is the trend in Sweden, to make a basic programme together with a blood sample analysis, so that it forms a broad, non-specific programme to which disease detecting, specific procedures can gradually be added.

DISCUSSION

Dr J. Fry: I should like to say how fascinating these two aspects have been; the one Dr Wilson mentioned and then we saw exactly what is possible when you put your mind to it in America and Sweden. I would like to take up one or two points which Dr Wilson made. The first point is that in facing reality I think we have got to think in terms of the future—and the future for this must be ultimately related to the education of the medical student, and the education of the GP at present, and also relating this to the hospitals and public health services.

The GP himself considered in isolation cannot possibly cope with any of this. This has got to be a team approach. Dr Wilson raised the question as to how much is possible in present terms. I think our whole approach to all this must be an experimental and research approach. I think we learned from Dr Collen that this is at present experimental. We have got to get our priorities straight, as Dr Wilson said, and decide which things to go for. I still feel that the GP is not so overworked at present that he could not, with proper organisation certainly, make an attempt at cervical smears, at the detection of anaemia, and testing urines and so on. It is the 'so on' that we have got to decide: how much more he wants to do.

The other point is whether we are thinking of just getting the GPs to go on with it because this is the right thing, or are we thinking in terms of any incentives to help this? At present they are paid for notifying the immunisations. Should we, in fact, adopt some such scheme for preventive examinations where they complete some forms and send them in? I do not think the record-keeping ought to be left just to the GP. I think this is where co-operation with the local health authorities is really important. I think the main thing is that this must be a plea that we are not ready yet to embark on this. I think there is a stage in between to get our ideas straight first of all on the priorities in terms of available manpower, costs, and the importance of various diseases, and also to try to get our ideas straight on the organisation of this. We should not consider the GP in isolation, and the health department in isolation. We have got to bring the hospitals in, too, because ultimately it is going to be the specialists who are going to be involved in sorting these conditions out.

Dr J. P. Horder: On John Fry's question of who should do the test, I would like to produce a little piece of recent and practical experience which might also illustrate an aspect of what Dr Wilson was saying. In our group practice in London, we have recently made an attempt to get all married women between 25 and 65 to have cervical cytology. We were invited to do this by the Medical Research Council together with other practices. This put the practical problem to us: should we attempt to do these cervical examinations ourselves or ask the MRC to get them done by their staff in our premises? We thought very carefully about this. I think we just could have done it ourselves, although it would have meant an immense extra effort. In fact, we chose to ask the MRC to do it. It has been achieved in six months and the arrangement has worked out rather well. I feel myself if it is to be done in general practice surroundings it is probably the better way to do it.

Dr R. Smith: I would like to take up the points John Fry made earlier and refer to the three papers as a group, because I think it is becoming increasingly accepted that mass screening is not only justifying itself on economic grounds but also on pure social grounds, and on general medical grounds. The problem we have got to face in this country is how in fact we are going to be prepared when the various decisions have been arrived at during the next few years of applying these principles. We know the problems that confront general practice. It is undoubtedly true that these screening processes must be mounted. In a health service which is nominally a unified one, we have to look at the problem of who is going to take the initiative about this. Who is going to start thinking now about how these sort of schemes are going to be carried out in the fairly near future if we are to fulfil our responsibilities in applying modern useful medical techniques in practice? It is a point I would like to put to Max Wilson and others here who have the ear in high places. What is being done now to look at this whole problem so that we are going to have some chance within our lifetime of seeing these schemes operating in this country?

Professor A. L. Cochrane: I want to add a very few words to Max Wilson's paper with which I was in general agreement. However, what I thought he did not stress enough, surely, is the difficulty of evaluating the effect of these processes. As I see it, we have a whole series of very complicated controlled trials to be done. As far as I know, the Bedford people are doing an excellent one on diabetes. We are struggling away with glaucoma. Certainly nothing is being done on a very large scale on blood pressure starting at the lower levels, though there is every indication that this is needed. There is still a lot, I fear, to be done on anaemia before we even do that. I do think we ought to consider seriously who should do these trials and how many of them there should be for each disease. I am all against relying on the results of one controlled trial.

The other point I want to make is impressed on me by our glaucoma prevention trial. Some of this treatment is going to be thoroughly unpleasant. Max Wilson talked about acceptance of tests. We must look ahead and remember that preventive therapy must be acceptable, too. I have been talking to these people; ophthamologists, of course, put drops in their eyes three times a day. The reality of the suggestion that they are going to have drops in their eyes three times a day for the rest of their lives is simply beyond imagination. Putting myself in their place, I certainly would not tolerate this idea. The same sort of problem will certainly arise when we look into the problem of taking anti-hypertensive drugs for blood pressure and probably diabetes as well. The side effects, the social unpleasantness of having to do something three times or twice a day will possibly prevent these beautiful schemes of ours from ever being put into action. We will probably have to improve the acceptability of our therapies as well as the acceptability of the tests.

Dr H. Keen: The point I want to make is really only a rider on the one Professor Cochrane has already made. I

think a very real and important point is the question of acceptability and human relations in this business. One of the things that impressed me has been the enormous importance of forming some sort of relationship with the people we are surveying, in order that they believe in our *bona fides* and they feel that somewhere in the deal there is some real human feeling. My fear may be quite unfounded, but it is that with increasing mechanisation one is getting increasing de-humanisation. The last thing of all any of us want to see is synthetic human relations. Five minutes spent at the end of it would make everybody feel better. I wonder how Dr Collen is coping with this and whether he feels it is necessary to achieve the co-operation with the people he is looking after. If he wants to see them every two years or so, does he think he is going to achieve this co-operation on a fairly mechanistic basis?

Dr M. F. Collen: That is a very good question. Actually, it is my opinion that our scheme improves the humanistic approach because it is our experience that the patient accepts the laboratory as a laboratory. In fact, they like the laboratory approach. They like it so much it worries us because, first, it is voluntary and we have a waiting period of six to eight weeks for this. They come back time after time and they are so impressed by all these gadgets that very often when I ask them to undress they say they have had a multiphasic and what do they have to undress for. The procedure is very acceptable to the patients. They like it, they bring in the family including the teenagers—the whole family comes through. There is no problem about acceptability by the patients. The important point is, by getting routine procedures off the doctor, we leave him more time, and this is the humanistic approach, to do the unique things a physician only can do, to evaluate, advise, counsel, and educate. Perhaps then we will be able to improve these situations where only 25 to 50 per cent of the patients are following their instructions. We want to separate the testing part from the treatment part, which needs to be personal, because there you got into a unique situation, everyone is different and everyone's problem is different. That is where you need the unique position when the testing part has been done.

Dr K. Schwarz: When I think of surveillance, I usually think of small-pox. We can learn quite a lot from infectious diseases. We have to try simple methods in making pre-symptomatic diagnoses. I will show you one example, in Table 7. We tried to see if we could find out whether we could control an outbreak of mumps in an enclosed community. They were handicapped children. We introduced our measures round about the 4 February. The incubation period, of course, for mumps is quite long. What we found was, taking numerous factors into account, (it was all very carefully done under controlled conditions) between the 4 and the 18 February there was no infection contracted by anyone else. The important thing, of course, was we were working on critical levels of infectivity.

You may wonder about the case on the 5 March. It occurred because we stopped taking measures before the case on the 18 February occurred. The moment we stopped our measures this person picked up the infection. The measure was a simple one—an example of surveillance to identify the people infected. We took basal temperatures; the moment people got temperatures higher than 99° we segregated them. That brought the infectivity to below critical level. The same things were done in an influenza outbreak (Table 8). In one closed community we had 100 per cent outbreak, in other words everybody developed flu. In a similar situation in an open community, but controlled open community, again amongst children, we introduced basal temperatures and found that the infection rate just dropped. Basal temperatures are terribly easy. We took the temperature morning and evening and when it rose segregated the people on the premises amongst the suspected cases. The results are shown in Table 8. The first point I want to make is that it has to be a simple thing that nurses and anyone else are prepared to do. The second point, of course, is that the children, or whoever it is, must also be prepared to allow this to be done to them. These, of course, are basic principles in any method of surveillance.

Table 7

MUMPS—DISTRIBUTION OF CASES

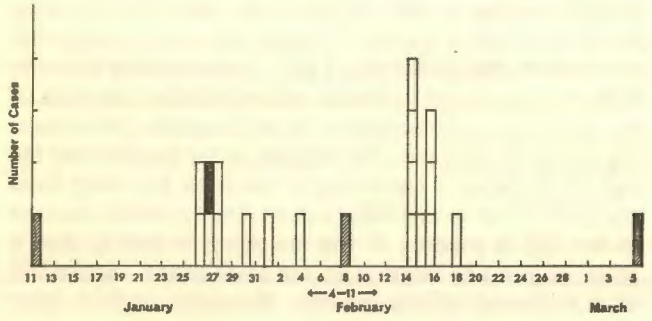
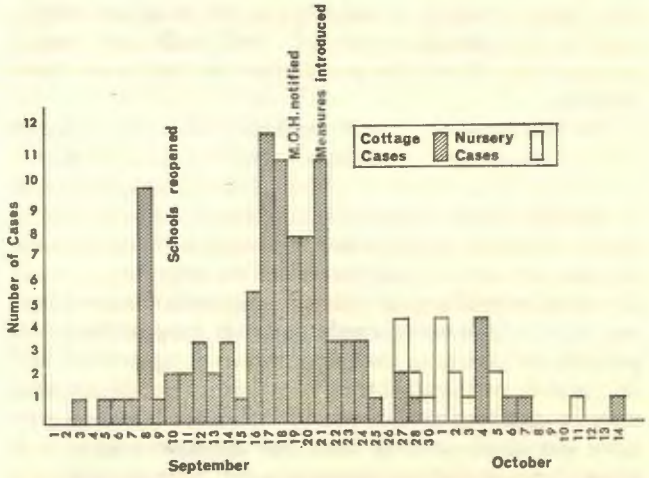


Table 8

INFLUENZA OUTBREAK 1957:—DEVELOPMENTS OF CASES IN A LIVERPOOL CONTROLLED OPEN COMMUNITY (CHILDRENS' HOME)



This brings me to another aspect of the subject. These were specified groups. In many of our screening tests we have to work out 'high risk' groups. Take the T B mass X-ray campaigns such as the big one I was involved in at Liverpool. You know the sort of results one gets. If we concentrate on, say, contact tracing, the results are about ten times better than routine screening. Finally, you know the audiometry tests that are carried out at schools about age seven. Those of you from Scotland will know

that recently a physicist did an investigation and found that the people doing the test were not even testing the machines; they were using their own hearing, and the observer error was fantastic.

I want to draw attention to the fact that we have to be prepared all the time to alter even what we consider to be reasonably proved. Take phenyl ketonuria: in one area they tested over 120,000 children. Half a dozen were found—in round figures—to have an abnormality, the laboratory checked and they were found to have some abnormality but did not require treatment.

Thus, there are three points I want to make. We need to have something simple acceptable not only to the people who do the tests but to the people who are the recipients. Secondly, we must be prepared to look for 'high risk' groups which save us a lot of worry, time, effort, and money. Thirdly, if we have a test which we like, we have to re-evaluate it from time to time to make quite certain that we need not modify it because, although superficially they may appear to be good tests, they are probably not as good as we hope they are.

Dr E. D. Acheson: One point I wanted to make concerned a matter that has been consistently raised in the discussion. This is how one ascertains in a given population who are the patients particularly vulnerable in respect of a given condition. Obviously, one of the most important and simple ways of doing this is to take into account the age and sex of patients in the populations. We have heard about the age–sex registers that exist in various practices. What I would like to ask people here is whether information about age and sex is sufficient and whether one also wants to know things like parity of women, socio-economic group, possibly age of marriage, and certain things about family history of diabetes for example, and whether women have up to the present time had babies of such and such weight, and things of this sort. Most of these things are recorded and the question arises, I think, whether we should be planning possibly on a pilot scale to make use of Executive Council records in order to provide in an area of the country for practitioners and local authority people information about the population in terms of these variables.

The second point is that I would like to underline again what other people have said, speaking now from the standpoint of the position of how different it is when one is presented with a person who feels ill and one has to advise treatment and a person who feels well and who one is trying to advise treatment for. One only has to recall the experience of the out-patient treatment of tuberculosis and it is widely recognised that it is easy to persuade patients to continue their therapy as long as they feel ill. As soon as they feel well, it is extremely difficult. One may be confronted with patients who feel well but who have got some positive test. For example microscopic haematuria is one we frequently get from screening at Harwell, where everyone gets urine examinations for microscopic haematuria at intervals. It is exceedingly expensive to investigate this. It involves a lot of highly complex procedures, sometimes including an aortogram. In my experience, there is very little at the end of this one can offer the patient in any way.

Professor C. A. Clarke: It seems to me rather important that the results of the reports should be confidential. Adverse medical information, particularly in a small community, easily leaks out, and if someone were up for a job this might prejudice their chances.

Dr C. M. Fletcher: May I ask a question of Dr Collen? What plans are being laid to establish the value of what you are doing? Is there any possibility of comparing future morbidity and mortality in your screened population with that in any unscreened population? What fatalities are resulting from the investigation of minor abnormalities by major cathetorisation procedures and so on?

Dr M. F. Collen: We have extensive research built into the programme and also planned. We have completed at this time our so-called demonstration model and actually at the 1 September we enter a second phase, which we call primarily preventive health service research programme. We do a type of epidemiological research programme, going on one already in process, to answer the specific question you raise.

You ask what is the value of an annual periodic health examination in its effectiveness in postponing or preventing disease and disability. We have a control study in which we have 4000 or 5000 study patients whom we call in once a year for such an examination and we completely supervise their care. Then, we have another population pool of 40,000 that we bring in periodically to evaluate them. They seek their own level of care. Both groups are randomly selected, and every other year we will be able to compare their morbidity, fatality, utilisation cost, and so on. Differences between the groups after seven or ten years should give a measure of the success of our programme and answer your question.

Also we are initiating various 'spin-off studies', as we call them, which are epidemiological studies, to answer the questions Dr Wilson raised. What are the most effective methods of treating early pre-symptomatic disease? In other words, we already have a diabetes study in that when we detect early symptomatic diabetes we spin these patients off, in fact the computer fulfills that, and they are separated into controlled groups.

We are initiating studies on bacteriuria. Again, the computer compares patients' findings with certain criteria. If they have over 1000 bacteria per ml. they are referred to another group where they are split in half, and half of them are treated to keep the urines clear and the other half have observance treatment symptomatically to see, again, whether it makes a difference in treatment and so forth. We have in our plans various other studies we hope to spin off. It is only a question of how much research we can have for these things.

Dr R. F. L. Logan: If we are going to talk about costing—and so far it has been costing financially not economically—then it is only one aspect that we have been talking about so far, instead of the social costing of the strategy of the whole of the health control. Now, this is really talking to Max Wilson here, where he did bring in the question of quality of wares and almost suggested cost benefit, but he did this, I felt, in relationship either to GP or drugs or public health, whereas in fact the bulk of the health bill is for hospitals. In the hospitals, the increasing sector of that, even for surgery, is for people over the age of 65. What I am trying to do is to get away from whether it is so many dollars or so many pounds, because in fact this is peanuts. If you are going to cost it, then it must be given in relation to the total health service bill of a thousand million pounds. However, in fact, your

denominator is probably quite different from dollars or pounds; it is an age expectancy. Therefore, my feelings here are to kick this ball right out of the round of financial or economic costing. If we are going to talk about costing then we should use several denominations, such as, for example, handicap in terms of years of invalidity over a life-span. I think the sums then would come out very differently.

Diabetes detection

DR H. KEEN

I WANT to follow the general pattern that this conference seems to be taking; that is to be philosophical to start with and medical to finish with. I want to apply these two approaches to the problem of diabetes and diabetes detection. The fact that there is such a thing as diabetes detection and that we are here discussing it, must I think, imply that we start from some sort of proposition which I have tried to formulate along these lines: 'The earlier we can diagnose or detect a condition the better chance we have of intervening in order to postpone or prevent its worsening.' This is a simple proposition, but I think it contains a number of statements and assumptions which we ought to examine with some care before we proceed.

First of all, the condition itself. If we are to diagnose a condition early we ought to have a fairly well-defined notion of what we mean by it. Diabetes in the past offered us very few difficulties in this respect. The acute form, which was characterised by a profusion of symptoms and signs, was almost self-diagnosing. If one takes a look at the average diabetic clinic, one will see diabetics of this variety, presenting with quite clear-cut signs and symptoms, but they constitute a distinct minority of the total patients. In a detection survey they constitute a very tiny fraction of the new diabetics found. So that we are bereft of the solace of clinical symptoms and signs on which to make our diagnosis. Without extending the argument at this point, I think probably we will all agree the lowest common denominator for the diagnosis of diabetes is a raised level of the blood sugar. Even so there must be reservations because the conditions under which blood sugar is measured are obviously relevant to the assessment we make of it.

This search for a diagnostic level is made difficult by the fact that when one screens a population for blood sugar, one finds a continuous distribution of values. The majority of values fall around the population mean, as one would expect, but there is no clear cut-off point above which one can confidently make a diagnosis and below which one can confidently exclude it. Table 9 is a frequency distribution histogram of the blood sugar values measured two hours after 50 grams of glucose in a random sample of the population of Bedford that the Department of Experimental Medicine, Guy's Hospital, examined in 1962. A commonly accepted figure dividing the normal from the abnormal is 120 mgm/100 ml. In this comparatively small sample of approximately 600 people there is little justification for drawing a line there.

Table 10 shows, for men and women separately, 'fasting', 'one-hour' and 'two-hour' distributions of blood sugar levels in the random sample. You will see the spread of blood sugar values is greatest at one hour

Table 9

FREQUENCY DISTRIBUTION HISTOGRAM OF CAPILLARY BLOOD SUGAR LEVELS 2 HOURS AFTER 50 g. GLUCOSE ORALLY (2 hr BS) IN AN AGE/SEX STRATIFIED RANDOM SAMPLE OF THE BEDFORD POPULATION

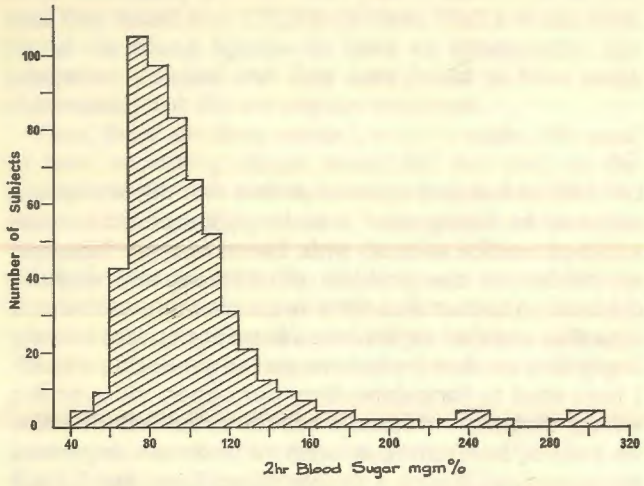
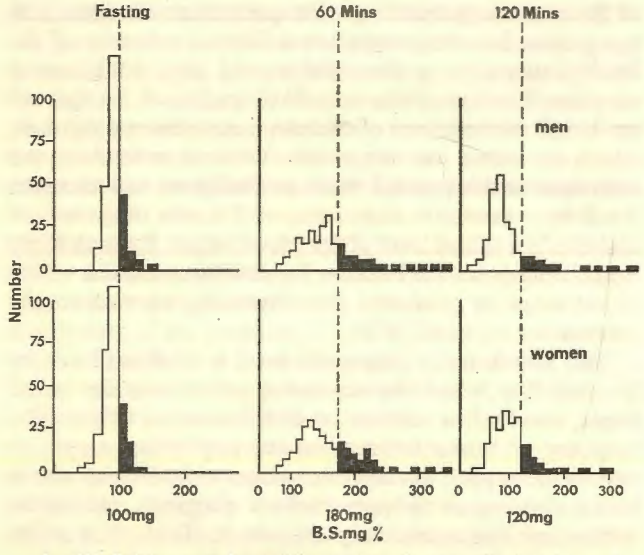


Table 10

FREQUENCY DISTRIBUTION HISTOGRAMS OF BLOOD SUGAR VALUES, FASTING, THEN 60 MINUTES AND 120 MINUTES AFTER 50 g. GLUCOSE BY MOUTH IN THE RANDOM POPULATION SAMPLE. THE DOTTED VERTICAL LINES REPRESENT COMMONLY ACCEPTED UPPER LIMITS OF NORMALITY, COLUMNS EXCEEDING THESE BEING SHOWN IN BLACK

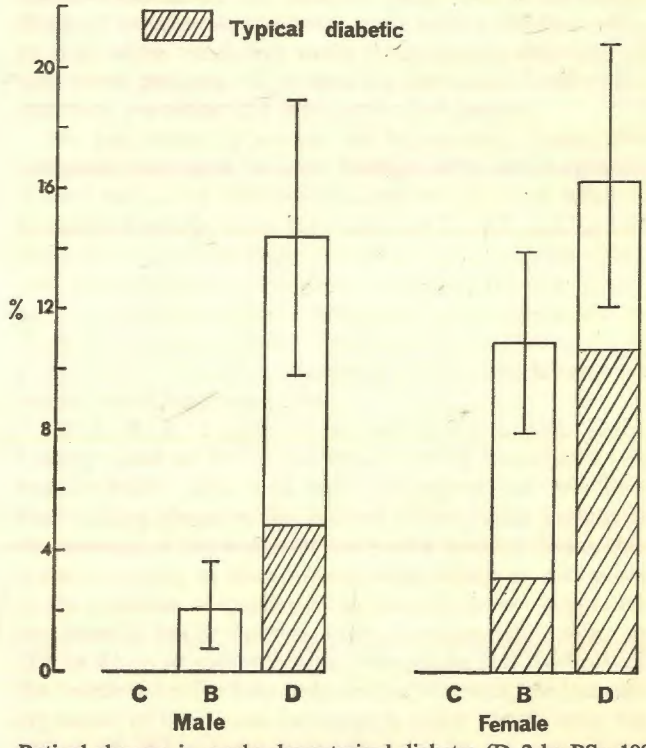


and still fairly considerable at two hours. In looking for a method of detecting abnormal blood sugar levels the fasting blood sugar is rather insensitive and one of these later time points would seem to be more reasonable. The timing of the sample (or the use of the whole curve), however, does not really help to solve the two linked problems. First of all, exactly where to draw our diagnostic line and, secondly, how to make an assessment of the significance of levels above the line, most of which are minimally so. The setting of the level is a matter of some considerable logistic importance because we found in the Bedford random sample that, taking a two hour blood sugar of 120 mg/100 ml as the diagnostic level, something like 10 per cent to 15 per cent of the population fell into the abnormal group, most into what one might call a borderline group. In a town the size of Bedford, therefore, one would expect 4000 to 5000 people to fall into the abnormal diagnostic category. With diabetes and probably with some of the other subjects we are going to discuss today, the diagnostic problem is not a serious one for the people found to be way out on the distribution curve. Here there is no argument and, for better or for worse, one feels justified in making a positive diagnosis and consigning these people to the ordinary processes of treatment. The problem arises with the large number of people of intermediate or borderline blood sugar values.

We felt that people in this borderline group posed two main problems. First, did they differ in terms of their physical health from people with normal blood sugar levels, or from people with grossly raised blood sugar levels? Were they in fact in any sense, even at microscopic level, a sick population? Secondly, would treatment in any way affect the likelihood of the development of the complications of diabetes in these people? So we set up in 1962 what we chose to call a 'Borderline Clinic', where we enrolled about 250 people who fell into a two-hour blood sugar category which we defined as having a lower limit of 120 mgm./100 ml. and an upper limit of 200 mgm./100 ml. There may be some argument about these limits, but we had to make a decision and this was the decision we made. I would like to show some tables which compare various characteristics of people in this borderline group with those in an age and sex-matched normal group (of

Table 11

DIABETIC RETINAL CHANGES



Retinal changes in newly characterised diabetes (D–2 hr BS > 199 mg. per cent), borderline diabetes: (B–2 hr BS 120–199 mg. per cent) and control normals: (C–2 hr BS < 120 mg. per cent) found in the Bedford survey. Total height of column represents possibly diabetic retinal changes while the shaded portion represents those showing typical diabetic retinopathy (exudates and 'microaneurysms').

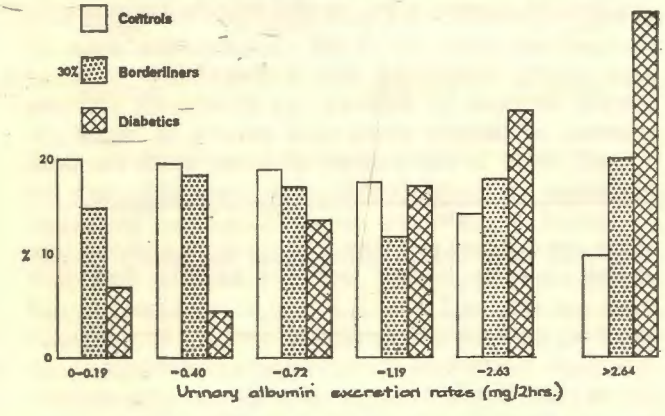
people proved to have two-hour blood sugar levels of less than 120 mgm./100 ml.) and also comparing them with those people with two-hour blood sugars of 200 mgm./100 ml. upwards.

Table 11 shows the frequency of changes in the retina in these three groups. The total height of the column relates to the total amount of pathology as defined by us and consists almost entirely of white exudates and red dots. The central line indicates the standard error of the percentage. You will see there appears to be a gradient as one goes from the control through the borderline to the diabetic group. I have more faith in the shaded parts of the columns. Those represent people showing typical diabetic changes with combinations of red dots (microaneurysms) and exudates.

Table 12 shows the degree of albuminuria in the three groups measured at these low, near-normal levels by an immunological method. Normal controls are best represented in the groups where the concentration of albumin is lowest. By contrast, the diabetics (with blood sugar of over 200 mgm./100 ml.) are increasingly represented as the concentration rises. The borderliners are, in the middle columns, about equally represented right the way through. It looks as if borderliners occupy an intermediate position in relation to protein excretion in the urine between normals on the one hand and diabetics (as defined) on the other.

Table 12

URINARY ALBUMIN EXCRETION



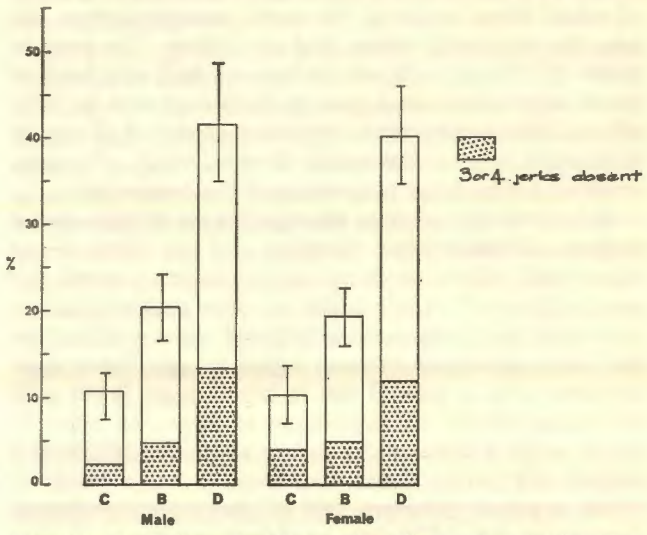
Percentage representation of diabetics, borderline diabetics and control normals (for definition see previous legend) in successive equal sixths (hexiles) by number of all individuals ranked in order of excretion rate. Albumin was assayed by a radioimmunochemical method.

Table 13 shows the number of leg reflexes absent in ordinary clinical testing among the three groups. The total height of the column represents those with any jerks missing. The dotted part represents those with three or four jerks missing. Again there appears to be a gradation of abnormality through the groups.

Table 14 shows cardiovascular symptoms and electrocardiographic changes in the three groups, again the control, borderline, and diabetic. The figures for symptoms are based on application of a standard questionnaire for the presence of arterial disease (devised by Dr G. A. Rose and approved by the World Health Organisation) to a high proportion of the three blood sugar groups. The ECG was taken under standard conditions about two hours after ingestion of 50 grams of glucose. Again there is a gradient through the groups both in symptoms and in ECG changes. (Detailed analysis subsequently published:—*The Lancet*, **ii**, 505–508, 1965.)

Table 13

ABSENT TENDON REFLEXES IN LEGS



Absent tendon reflexes (patellar and achilles tendon) in the three groups previously defined. Total height of column represents percentage with any absent reflexes; the dotted portion represents those with three or four of the possible four reflexes absent.

Table 14

PREVALENCE OF CARDIOVASCULAR SYMPTOMS AND ELECTROCARDIOGRAPHIC ABNORMALITIES (THE FORMER ASSESSED WITH A STANDARD QUESTIONARY AND THE LATTER WITH THE MINNESOTA CODE) IN THE THREE GROUPS ORIGINALLY DEFINED. DIFFERENCES IN AGE AND SEX COMPOSITIONS AMONG THE GROUPS HAVE BEEN ALLOWED FOR BY TAKING THE MEAN OF AGE/SEX SPECIFIC PREVALENCE RATES

	CV Symptoms	E.C.G.
C	8·1 ± 2·0%	33 ± 3·5%
B	11·7 ± 2·2	40 ± 3·5
D	19·2 ± 3·8	59 ± 4·8

C—Controls B—Borderline D—Diabetics

So it looks as if at least in the factors I have shown you, the person with a borderline elevation of blood sugar occupies an intermediate position in terms of pathology between the normal and the grossly diabetic. This finding reassures us in the controlled trial of treatment we are running with them; that in doing so, we are not engaging ourselves purely in an exercise in blood sugar aesthetics. Half of the borderline group are on oral sulphonylureas; the others receive placebos. Half of each of these two groups are recommended a carbohydrate restricted diet and the other half given largely ineffective recommendations. What is quite clear is that, in order to assess the full significance of raised blood sugar levels and the

influence of treatment, time must pass and careful and precise observations must repeatedly be made. The chief things we are watching in the borderline clinic are as follows:—The blood sugar may rapidly rise with the appearance of clinically eloquent diabetes. In three, this has already happened in the course of the three years we have been following them and in many more, there have been lesser rises. We are looking for a deleterious effect of raised blood sugar on the cardiovascular system, the eye, the peripheral nerves and the kidney. We want to know if there is a threshold below which the level of blood sugar does not appear to be linked with harmful effects. Perhaps the most important aspect of the study is its relation to cardiovascular disease, which, of course, involves a very large proportion of the community.

Before we can estimate the significance of these minor degrees of blood sugar elevation and the effect of our therapeutic efforts on them, we still have to watch this group through for quite a time yet. One problem that we have with our group is that the blood sugar qualification for entry is defined without regard to age. Since there appears to be a general rise in blood sugar levels with increasing age in the population at large, the question really arises whether older people should be 'allowed' a degree of hyperglycaemia. One suspects that a two-hour blood sugar of 130 mgm./100 ml. has more significance in a young man of 20 than an elderly woman of 70. One can make almost the analogous query as far as blood pressure is concerned. Should old people be allowed to run higher levels or should these be regarded as pathological?

It is quite fair to apply these queries to people with borderline elevations of blood sugar; to treat or not to treat. I feel, too, we should apply the same sort of critical approach to the treatment of established diabetes. Of course, nobody would argue with the propriety of giving insulin to the ketosis-prone young diabetic as a life-saving measure, or of correcting the immediate metabolic aberration of those with the higher blood sugars. However, the question of whether bringing down the blood sugar with treatment really influences the further course of the disease in the others, I think it is still completely open. We have set up a clinical trial to prove this in our borderliners, but, before embarking on wholesale surveys, one would like the added reassurance that after detecting people with raised blood sugar, one could promise them some benefit from treatment.

An important practical point which arises from surveys for diabetes and which is rarely considered is just what happens to people after diagnosis. Table 15 relates to 103 of the 117 patients who were found at the Bedford survey to have grossly raised levels of blood sugar, those above 200 mgm./100 ml., and it shows the number of times they have been seen, either as out-patients (OP) or by their general practitioner (GP) in the eighteen months following the survey. You will see nine of them saw nobody at all, twenty-three had been seen only once or twice, and seventeen three times. It looks as if about half of these people received inadequate attention for what is really quite a considerable degree of carbohydrate intolerance. We also checked on the treatment they were receiving at that time. Twenty-one were receiving no treatment at all, three were on insulin, twenty-seven diet alone, twenty oral antidiabetics alone, and thirty-two oral antidiabetics and diet. Again, quite a large proportion were receiving no effective treatment. (Those on 'diet alone' means they were given dietary recommendations; we cannot guarantee the recommendations were followed.) These are absolutely and unquestionably diabetics with two-hour blood sugars over 200 mgm./100 ml. It is clear that one has to set up apparatus for making sure that effective measures are taken following diagnosis.

Table 15

REVIEW OF 117 DIABETICS (2 hr BS 200 mg. per cent) FOUND IN 1962 BEDFORD SURVEY 18 MONTHS LATER (INFORMATION ON 103)

(a) ATTENDANCES FOR DIABETES SINCE SURVEY (G.P. + O.P.)

No. of attendances	No. of 'patients'
Nil	9
1 or 2	23
3	17
4	18
5+	36

(b) TREATMENT BEING TAKEN AT REVIEW

Form of Treatment	No. of 'patients'
DIET ALONE	27
ORAL ANTIDIABETIC	20
DIET + ORALS	32
INSULIN	3
NIL	21

I think it worth spending a few minutes discussing the methods we used in the survey and some thoughts about modifications which might be worth trying. I think our method in Bedford—a Blitzkrieg method, if you like—is an inappropriate one for most diagnostic surveys. It puts an enormous strain on all the local facilities, some of them slightly unforeseen, and it overwhelms the local hospital services. In Bedford, we created an absolute epidemic of diabetes which took months to 'digest'. It is much better to run a survey at a rate which the local machinery and local facilities can cope with, and for diabetes at any rate, one can estimate this. The rate at which one will turn up diabetics depends to a large extent on the screening method one uses and the diagnostic levels one sets. In Table 16, I have shown three possible screening methods which might be used, the sort of yields that might be expected from them and an estimate of the cost of each. The first is the most commonly used method, the postprandial urine test. It is simply a Clinistix estimation for the presence of glucose in the urine passed an hour or two after a meal. With 1000 people from a typical population to start with, you could reckon to find of the order of fifty glycosurics. Of those, about ten will be found to have borderline diabetes and four will have quite marked degrees of hyperglycaemia. The rest will have 'normal' blood sugars. If the urine tests cost about £25 and fifty glucose tolerance tests cost about £25, the final cost is £3 10s. for each diabetic found and £12 10s. for each 'severe' diabetic. If one introduces a glucose load before testing the urine, as in the second method, the incidence of glycosuria will rise tremendously, to 20 per cent—30 per cent. Instead of 50 glucose tolerance tests, you will have to do 250 tests. Of these, about sixty will be found to have borderline elevations of blood sugar and twenty marked elevations. Now the cost has fallen, largely because of the increased yield of diabetics, to £2 5s. per diabetic and £8 15s. per severe diabetic; but five or six times as many diabetics have been found. The

third method involves a double screening test in which the blood sugar is estimated by Dextrostix only if the urine is positive two hours after a carbohydrate load. These are both simple measures which can be carried out in the doctor's surgery. The patient could take glucose at home (or perhaps the equivalent load of sucrose or carbohydrate food of some sort), and attend for testing about two hours later. If the urine is positive, one proceeds to a Dextrostix test, and if this reads above a certain sugar level, to the glucose tolerance test. At least two-thirds of glycosurics will prove to have acceptable blood sugar levels. One would expect to find about the same number of diabetics as by the second method but at the expense of many fewer glucose tolerance tests so that the total cost per diabetic would be about £1 10s. and severe diabetics £5 15s. These, I emphasise are estimates, but I do not think they vary wildly from reality.

Table 16

COMPARISON OF SCREENING METHODS, YIELDS AND COSTS PER 1000 SCREENED. (ESTIMATED)

1.	Postprandial Urine test with Clinistix (£25)	50 Glucose Tolerance Tests (£25)	14 diabetics (£3 10s. per diabetic)	10 'mild' 4 'severe' (£12 10s. per severe diabetic)
2.	Glucose Load Urine test with Clinistix (£25 + £25)	250 Glucose Tolerance Tests (£125)	80 diabetics (£2 5s. per diabetic)	60 'mild' 20 'severe' (£8 15s. per severe diabetic)
3.	Glucose Load Urine (Clinistix), Dextrostix positives (£25+£25+ £15)	100 Glucose Tolerance Tests (£50)	80 diabetics (£1 9s. per diabetic)	60 'mild' 20 'severe' (£5 15s. per severe diabetic)

The question of who should organise and perform the screening procedure merits some consideration. The family doctor has the required contact with the population but, on the whole, lacks the organisation and documenting capacity which is so important in keeping a survey of this sort in order. By contrast, Local Health Authorities have the documentary and secretarial facilities but few personal contacts with the population. It seems to me that, limiting the argument at any rate to diabetes screening, this sort of project is one which should bring these two branches of the health service together. Perhaps as the utility of such screening procedures becomes more evident, this will be the natural evolution of these bodies, although, no doubt, some will object to it.

Finally, who should be tested in a diagnostic survey for diabetes? I think everybody agrees women who have borne very heavy babies or who have had a large number of babies, people with diabetics in the family, the overweight, and the elderly are those in whom diabetes is most likely to be found. The question of the degree of priority which one will assign such people obviously depends upon the logistics of running the survey. Assuming universal screening, a general practitioner with a list of 3000, could perhaps work at the rate of thirty tests per week, and so get through everyone in the practice in about two years, turning up in the process about ten people with raised blood sugars each month, of whom two or three will have blood sugars grossly raised. This will bring up the question of optimum treatment and, in particular, the question of diabetic clinics, although it is not within the general remit of this meeting. Their load is obviously going to increase as case-finding practices grow. The next meeting of the Medical and Scientific Section of the British Diabetic Association is going to discuss the general organisation of the diabetic clinic and its role in these changing times.

In summary, then, the philosophy of pre-symptomatic diagnosis of diabetes has been explored, and the validity of many of the underlying assumptions has been found rather hazy; a great deal of work needs to be done on several precise points. Current methods of population screening have been touched upon and modified methods of procedure suggested, with estimates as to their costs and yields. The organisation and execution of these procedures, I think, makes co-ordination of public and personal health services highly desirable and the new problems for the hospital services that will be created should be thought about now. Case selection has been referred to briefly.

DISCUSSION

Mr E. M. Little: Could I suggest to Dr Keen a danger—of which he is perhaps aware—of calculating costs in this kind of situation. There is a risk of his figure of £5 15s. per case detected being quoted in Parliament and elsewhere, in any circumstances, as the cost of detecting a diabetic. In fact, the cost per case detected depends entirely on the frequency of screening. This figure is for a previously unscreened population, and is relevant to that only. Assuming with diabetes that you will have to do repeat screenings, it is the frequency of those which will determine the pick-up rate and that, in turn, determines the cost per case detected.

Dr H. Keen: Obviously one would hope to skim off the cream, as it were, in the first cycle, so one would expect the next time round to be cheaper. This of course presupposes that one is using an efficient screening procedure and it is of interest to note in this regard after the survey in Bedford, there appears to have been no fall in the number of cases of diabetes referred to the local clinic.

Dr D. L. Crombie: I have heard some of this before and found it fascinating to have it brought together in this way. I thought it might be interesting to compare some of the ways Dr Keen has done this in Bedford and the way we did it in Birmingham on a roughly similar size population. In particular, since we are just now in the middle of a five-year follow-up which knocks in many of the nails we thought needed knocking in at the beginning. First of all, we had a problem whether we should use individual blood sugar levels or what should we do. We plumped for the full glucose tolerance test. We are quite sure now that the increased specificity from taking into account several sugar levels allows you to make classifications which are more meaningful than classifications based on any one level at any one time. This is obvious clinical medicine. We may make a definite clinical diagnosis from some symptom–sign pattern, where the individual signs or symptoms each have a low probability of being caused by any particular disease but where the complex as a whole has a high probability of being related to one particular disease. With a pattern of

three or four observations it is often possible to make a very specific diagnosis. Patients undergo many biochemical tests because we have still not developed systems for looking at patterns of biochemical tests or patterns of relations between biochemical tests and signs and symptoms which would give us, I think, this enormously enhanced specificity and allow us to make screening tests much more meaningful.

We found for instance in diabetes that we could clarify the family history situation which is left blurred if you use a single blood sugar level. If you use glucose tolerance test patterns, you can distinguish family history trends very clearly, the trend with age of onset, for instance, whereas if you look at it against single blood sugar levels none of the correlations reach statistical levels.

Against that background, I would like to give you some figures of the five-year follow-up. Like Dr Keen, we are worried about what can be called the borderline group. Of these we found that a third after five years had reverted to absolutely normal tolerance. We have not repeated the glucose tolerance test for them all yet, but the ones done so far are fairly randomly distributed. We are still in this position of not being quite sure of what this biochemical abnormality means. I, too, think there is a gradient that exists relating the levels of sugar or the abnormality of tolerance and the degree to which this is associated with pathological changes in various parts of the body. Which is the cart and which is the horse, or whether there are two carts and another horse, we cannot answer. From a five-year follow-up, we do not think we are going to be able to sort out the time relationships of the other thing we are looking at, such as cardiovascular degenerative changes in these people. We are using 20,000 patients who are a random sample of the population, as a control. We are looking at the rate of all morbidity that occurs and in particular are interested in any related to the cardiovascular system or anything that could be called degenerative. We are hoping to get some patterns of relationship but certainly in five years they are not yet evident.

Dr J. J. A. Reid: In diabetes one clear indication for treatment is the presence of symptoms and this does not, of course, apply to all other diseases for which one can screen populations. I wonder if one were to engage in further public education about what diabetes is, and what its symptoms are, what proportion of florid diabetics would be picked up.

There is another point I would like to make relating to diabetes. We have been dealing particularly with secondary prevention, and I hope that we will not lose sight of the scope for primary prevention, as it need not take much money to try to teach the public about the dangers of obesity. At the same time we must look at tertiary prevention or, in other words, effective treatment, for there is a danger of diabetic screening in this country and elsewhere being regarded as an end in itself. Unless one sets up adequate after-care services—and this was hinted at by Dr Keen—the whole thing is a waste of time. There is an awful lot of poor control amongst diabetics attending clinics, where the cause lies in social, rather than biochemical matters, and this calls for a link between hospitals, general practitioners, and public health departments. I hope that primary and tertiary prevention will be borne in mind by anyone adopting a screening programme for diabetes mellitus.

Professor A. L. Cochrane: I would like to raise the problem of cases found in surveys and referred to general practitioners, who are not treated at all. We have been coping with this for many years in the Rhondda. I would like some advice on how you can do this thing effectively and tactfully. It is a terrible problem. I am sure the Bedford people were better at it than I am. The quantity is really quite large, not only for diabetes but for all diseases.

The second problem is fixing levels which are clinically significant. It comes up in every disease. I, in theory, like to get agreement from general practitioners in the area and physicians with whom I am going to co-operate. If you waited for that agreement, you would never do any experiment at all, so I fix the level and then 'sell' it. It is what one has to do, I am afraid, which is an awful reflection on our profession that we do have extraordinarily differing ideas of these limits of blood sugar level, blood pressure and so on. I feel we ought to make up our minds about it a bit better.

Finally, are we quite certain what we are encouraging? We talk of further case-finding procedures, of surveys. But you can argue that we ought to wait till we know what to do in borderline cases before going out of our way to find them.

Dr E. V. Kuenssberg: I would like to take up Professor Cochrane's first point. Many of us in general practice have been conditioned and possibly disillusioned or got into the happy state that any serious disease is being treated by the specialist. I think the specialist tends to take over the follow-up too—and this is one of the things that happens with these screenings that you follow up. Therefore the general practitioner of course thinks it is not really his job. I think it would be a good thing—perhaps this is not the right place to say it—for general practice to define again what it is to do and what its job and scope is. I personally regard its scope as dealing with these follow-ups and so on, if they are technically within my competence to do so. There is no need to hand all these patients over to special clinics and so on, so that you never see them again, which is unfortunately so frequently the case. I think until we reverse this order a bit and give the general practitioners the incentive, we will, I am afraid, not succeed. Professor Cochrane might not succeed unless perhaps he does it on the social level with a good sherry party or dinner or some other way that is known to help.

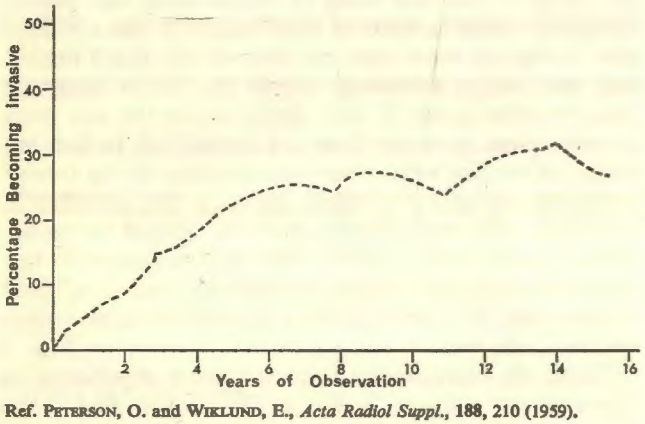
Detecting cancer of the cervix

MR E. M. LITTLE
(Uncorrected transcript)

BEFORE the turn of the century, changes in the cervix now designated as pre-cancerous were in fact recognised. Twenty years after that, techniques whereby the presence of such histological cases could be discovered were first introduced, that is to say cytology. More recently, other techniques have been carried out by chemical and perhaps advanced inspection methods by culdomicroscope. These things have been developed within the last few years, all of them cytological, and are well favoured. This may change at any time but it is the situation at the moment. The last ten years or so have seen the accumulation of evidence between the relationship of such lesions and cancer. They are either forerunners, or frequent forerunners of cancer. Today, we are really concerned about the form of screening programmes, the form in which application of cytological tests might take in our attempts to recognise these pre-cancerous states to prevent invasive cancer of the cervix.

Table 17

THE RATE OF CONVERSION OF CERVICAL PRE-CANCEROUS LESIONS TO INVASIVE CANCER—O. PETERSEN AND E. WIKLUND



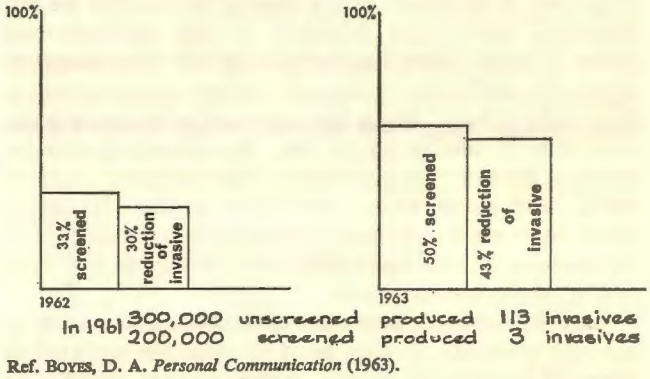
Ref. PETERSON, O. and WIKLUND, E., *Acta Radiol Suppl.*, **188**, 210 (1959).

The classical study was by Peterson, who in the 1930s established a group of a 100 or more women with 'pre-cancerous' lesions in Copenhagen. They were followed up, and within about a year 4 per cent of them developed malignant invasive cancer, within five years perhaps about 20 per cent, ten years about 30 per cent or more. (Table 17.) So from this kind of study then, we can look at the relationship and ask whether there is in fact a case for regarding these lesions as being pre-cancerous. The cases in which they were in fact pre-cancerous in this population were a small group of patients; within a year, perhaps one in twenty-five of them developed invasive cancer as opposed to a normal expectancy in this group of perhaps one in 1000 or 2000 or so. When the group are followed up *ad infinitum* as it were, about one third would apparently develop invasive cancer. Thus the presence of 'pre-cancerous' lesions can be regarded as a prevalent disease, amongst whose sufferers there is a certain incidence of invasive cancer. You can also find out how much invasive cancer is preceded by this kind of disease by doing a little calculation. You need an extra bit of information. If you have prevalence rate of this kind of pre-cancerous lesions, you can multiply by the annual rate at which pre-cancerous lesions become invasive. This gives a figure you can compare with the actual incidence of cancer. This indicates what proportion of cancers come from this prevalent pool of disease, as it were. However there are serious objections to this kind of study based on material collected by biopsy. A small biopsy may miss even advanced lesions, and repeated biopsies may interfere with the natural history. Thus there is a big question mark about the relevance of this information to the material we find in the screening programme.

Therefore, the main approach to the study of this relationship is arbitrarily to remove, as it were, pre-cancer from the whole community and then attempt to assess what happens to the incidence of invasive cancer among this group of women from whom you have removed the pre-cancer. This kind of study has been done most outstandingly perhaps in British Columbia by Boyce and his colleagues whose results are given in Table 18. This is out of date, but it is representative enough.

Table 18

THE EFFECT OF REMOVING CERVICAL PRE-CANCEROUS LESIONS FROM A COMMUNITY ON THE INCIDENCE RATE OF INVASIVE CANCER—PROVISIONAL FIGURES FROM BRITISH COLUMBIA



Ref. BOYES, D. A. *Personal Communication* (1963).

When they had screened about 33 per cent of their women at risk, all women over the age of 20, there was a fall in incidence rates of 30 per cent; when they had screened about 50 per cent there was an apparent fall of about 43 per cent in the incidence of invasive cancer. Perhaps more compelling is the fact that from the 300,000 in the unscreened group there were 113 invasives, and from the 200,000 in the screened group only three invasives appeared in a year. Again, there are still question marks attaching to this kind of study. How comparable are these populations? I think we have got so far no evidence about their comparability. The unscreened are probably lower class, a group perhaps more liable to

Table 19

Author	*Cytological Technique*	*1st Screening Prevalence per 1000 Women*		*2nd Screening Incidence per 1000 Women*			*3rd Screening Incidence per 1000 Women*		
		Dysplasia	*In Situ*	*Dysplasia*	*In Situ*	*Invasive*	*Dysplasia*	*In Situ*	*Invasive*
Nieburgs *et al* 1957	Endocervical Scrape	3·8 (Biopsy)	4·4		2·5	0·4			
Calabresi *et al* 1958	Vaginal Aspiration Endocervical Aspiration		3·2		1·1	0·4			
Dunn 1958	Vaginal Aspiration		3·7		0·8	0·2		0·8	0·4
Stern 1959	Vaginal Aspiration Cervical Scrape	4·9 (mainly smear)	4·0		1·1	0·1			
Dunn *et al* 1959	Cervical Scrape	1·3 (Biopsy)	7·8		2·6	0·2		1·2	0
Miller and Von Haam 1961	Vaginal Aspiration ⅓ Cx Scrape		1·9		0·9	0·2		0·1	0·1
Christopherson *et al* 1962	Endocervical Scrape	3·2 (Biopsy)	3·7	2·1	0·6	0·5	1·5	0·5	0·1
Boyes *et al* 1962	Cervical Scrape		5·8		0·5				

References:

Nieburgs, H. E., Stergus, L., Stephenson, E. M. and Harbin, B. L. (1957). *J. Amer. Med. Ass.* **164**, 1546.

Calabresi, P., Arnold, N. V. and Stovall, W. D. (1958). *J. Amer. Med. Ass.* **168**, 243.

Dunn, J. E. (1958). *Amer. J. Publ. Hlth.*, **48**, 861.

Stern, E. (1959). *Cancer* **12**, 933.

Dunn, J. E., Slate, T. A., Merritt, J., Wand Purvis L. M. (1959). *J. Nat. Cancer Inst.*, **23**, 507.

Miller, E. M. and Von Haam, E. (1961). *Acta Cytol*, **5**, 214.

Christopherson, W. M., Parker, J. E. and Drye, J. C. (1962). *J. Amer. Med. Ass.*, **182**, 179.

Boyes, D. A., Fidler, H. K. and Lock, D. R. (1962). *Brit. Med. J.*, **1**, 203.

lethal cancer because they keep their symptoms for longer. Also, I think so far after screening year by year a number of patients, there is still no observable effect on mortality for cervical cancer. Of course, there would not necessarily be a large observable effect so far because of the interval of recognition of pre-cancerous lesions and the patient in the ordinary course of events in fact is dying from the disease probably some years later. This is the part of the whole of the natural history that we are uncertain about—the duration of the pre-cancerous phase. I think there has been a lot of misconception about this, and that it is of much shorter duration than is commonly alleged. Boyce has estimated what he calls the incidence of carcinoma *in situ*. He arrived at this by taking a group of the population who had given negative results and re-screening them after a year. However, again, there are a great number of objections to describing the number of new cases found in this way as the 'incidence' of carcinoma *in situ*.

There have been a large number of studies, of course, of cervical screening. In fact, most of them are reported in terms of histological lesions. When they are reported in terms of histological lesions you have also got to take account of different kinds of biopsy procedure, in what way they collect tissue, and in what way they process it. There are accounts of finding invasive cells, for example, after inspection of as many as a 1000 slides from one cervix, finding a spot of invasive disease only after intensive examination of that order. That is obviously impracticable as a routine. Another area where there are different possibilities is what sort of tissue examination you are going to subject the patient to. Lastly, of course, there is the degree of competence on the part of whoever is carrying out the examination.

The results of Table 19 are based on histology. It shows the prevalence of pre-cancerous lesions when women are first screened, and the subsequent incidence of both pre-cancerous and cancerous lesions when the women are screened again. The number of invasives occurring after screening is disappointing in some cases. However one of the things to realise about them is that many invasive cancers are very early invasive cancers only recognised by histology. Another thing to realise about this second screening is that in many of these studies it was not done after a year. In some cases the interval was much longer, and that would artificially inflate the return incidence rate. Another point is well worth noting. In any third or subsequent screening there is a further fall. In fact, the misses of the first turn round are picked up in the second screening—or many of them are—and the situation is corrected, as it were, when you do the second screening. Many people with a good deal of experience of this situation are much happier to label the patient as being in the clear, as it were, after a second screening rather than a single test.

Table 20 summarises, from our own experience in Birmingham, roughly the figures for what we find at the first screening, and what we expect to find on repeat annual screening. It emphasises the point I made during the discussion about costs. The figures for repeat screening in all these situations obviously depend on frequency. The more you spread out the interval between testing, the cheaper it will be. On anything based on cost per case, if you screen very frequently the cost per case is going to rise phenomenally per case found.

Table 21 is just a summary of three of the larger studies which have been conducted in which an attempt has been made to screen well women. In fact it is not very accurately represented and is very much in round figures. As you will appreciate, the figures are not really comparable.

Table 20

FIRST SCREENING OF WELL WOMEN

Positive Smears	(Severe Dysplasia 4) (*In situ* 4) (Invasive (Nearly all Cx.) 2)	10 per 1000
Intermediate Smears	(? Mild Dysplasia)	15 per 1000
REPEAT SCREENING OF WELL WOMEN (ANNUAL)		
Positive Smears	(Severe Dysplasia 2) (*In situ* 1) (Invasive Nearly 0)	3 per 1000
Intermediate Smears	(? Mild Dysplasia)	10 per 1000

The patients to whom the test was offered in fact differ. In Memphis, a sort of explosive everything hit the population. There were tents outside the baseball pitches and in you went after the game to have your test. Perhaps our American colleagues will have something to say on it, because I am rather caricaturing it. They used non-medical people as collectors. The technique is a rather cheaper one, perhaps less efficient, but almost universally applicable. Using vaginal aspiration, for all women over 20, the acceptance rate was 40 per cent. In Aberdeen, they went to three general practices and got a list of married women between the ages 25 and 60, I think. They wrote letters. Where there was a failure of acceptance on the basis of the original letter, they followed it up by an enquiry by the social worker. The sample was taken by a rather nice lady doctor, who was unpaid. Using a cervical scrape, one of the more efficient ones, the acceptance rate was about 60 per cent.

Table 21

WELL—WOMAN SCREENING PROGRAMMES

Study	*Approach*	*Collector*	*Technique*	*Patients*	*Acceptance Rate*
Memphis[1]	Press, Radio and Television	Non-Medical Person	Vaginal Aspiration	Aged 20+	40%
Aberdeen[2]	Letter and Social Worker	Lady Doctor	Cervical Scrape	Aged 25–60	60%
Copenhagen[3]	Letter	Patient	Vaginal Irrigation	Aged 30–45	80%

References:
1. Kaiser, R. F., Erickson, C. C., Everett, B. E., Gilliam, A. G., Graves, L. M., Walton, M. and Sprunt, D. H. (1960). *J. Nat. Cancer Inst.*, 25, 863.
2. Baird, Sir D., Macgregor, E. (1963). *B. Med. J.*, 5346, 1631.
3. Davis, H. J. (1962). *Amer. J. Obstet. Gynec.*, 84, 1017.

The Copenhagen study is perhaps the most interesting at the moment. The Davis irrigation technique was used with this type of pipette sent out to the patients. There was very little in the way of preliminary propaganda. There was, I think, one announcement on television and a little press notice. A letter, plus the pipette, was sent to the patients in their own homes and they got about 80 per cent acceptance. Again, of course, a question mark attaches to this. Here we have an age group who are perhaps maximumly conscious of this kind of health risk and are maximumly prepared to do something about it. It is none the less encouraging that cytology is very much under study at the moment. I say apart from any other considerations the economic one might be important. There is no need for any special arrangements for collection of cell samples. The patient does it herself. All these acceptance rates are, of course, in a sense a bit phoney in the initial reaction. The population is being invited to participate, and obviously the basic criteria differ. I am sure the ladies in the middle of Copenhagen are very different in their probable reaction to this sort of thing from the ladies in the backwoods of Aberdeen. All these figures, as I say, are first reactions and the situation in five or ten years with continuing education might be quite different.

Table 22 suggests the possible differences between an ideal programme—such as recommended in British Columbia—and a compromise one which might be more generally applicable. Finally, just a word about the possible role of the general practitioner in this situation. I think myself it entirely depends on what form the screening programme is going to take. Until we have more information, I think he himself should be very cagey about it. If, for example, we had to have a programme such as they have in British Columbia, where it was annual screening for all adult women over age 20, this would mean in a practice of 3000 the general practitioner would have 1000 tests to do in a year. I cannot imagine he would enjoy doing that every year. On the other hand, if you are going to restrict your screening to the higher risk half of the population, if you are going to test them every five years, and if only half the patients you invite do take part, the number falls to perhaps a twentieth of that; so the average general practitioner would have perhaps fifty tests to do a year. That might be acceptable. I think there is little doubt from the patient's own point of view, it is desirable and nicest for her to go to her general practitioner to have this kind of thing done. Whether it is a practical proposition for him I think depends on the form of screening programme not only in respect of cervical cancer, but other tests as well that we have been hearing about today. If there is a whole battery of tests to which the patient is to be subjected, then there is a good deal to be said, perhaps, for the special centre. Perhaps the general practitioners could start it in some way or another.

Table 22

CERVICAL CANCER SCREENING

Type of Programme	*Which Patients?*	*Which Technique?*	*How Often?*
Ideal?	Aged 20+	Cervical Scrape	Every Year
Compromise?	Aged 30–60	Vaginal Irrigation	Every 2+Years

DISCUSSION

Dr J. M. G. Wilson: Could I ask a little more about the Davis pipette and the experience in Birmingham with it. If it was extremely good and could be easily used, it would have been something which perhaps ought to have replaced conventional cytology. On the other hand, it may be slightly more difficult to evaluate smears from the Davis pipette, so that it does not give as good results as in conventional cytology, in that there are more false

results. On the other hand, it is said that you can get women to use the pipette who would not otherwise come at all for examination. If that were so, its place in the health service would be as a supplement to the ordinary cytology to get those women at the highest risk of cervical cancer whom otherwise we are not going to cover.

There is one other point on the enzyme test, which was not, I think, mentioned. I would like any views on that. I think the present feeling is you get about 50 per cent of false negatives with carcinoma *in situ*. As such, it would not be really suitable for detection of cervical cancer. Another thing is the question of health education. I wonder whether we are going to be advised that we should drop cervical cytology and educate men and women in certain aspects of health and thereby lower the incidence of cervical cancer.

Mr Little: A word about the Davis pipette first. So far, our experience in Birmingham is very limited, and we are still evaluating it. We had Dr Hugh Davis visiting us not very long ago. Our preliminary experience with the technique was very similar, I think, to that in other centres in this country which have embarked on this, I believe in Edinburgh among other places. We were disappointed. Dr Davis has put us right in two ways. He has first of all given us one or two tips about the technical aspects of the handling of the cell sample. The second point he has emphasised has got to do with cell interpretation. Our cytologists, the technicians principally who are reading smears, have been used to cervical scrapes, not vaginal aspirations; different cell populations then, and he makes a point of this. The sample which is obtained by this technique, needs different interpretation from that collected in other ways. The technique needs special training. It is unfair to make this kind of comparison on a limited experience. We have accepted this and we are embarking on a rather more extended trial. The only group which Dr Davis feels ought not to subject themselves to so-called irrigation techniques which involve suspending fluid into the vagina are women who expect they may be pregnant; otherwise it is largely fool-proof, he says. In Copenhagen and Maryland this was the case. It is not quite so true in Birmingham. We have one patient who produced, as far as we know, the first accident of its kind. Despite this very detailed instruction and personal explanation, she managed to use the pipette without taking the cap off, so she actually instilled this fluid with the cap still on and lost the cap somewhere. This was recovered in the course of a gynaecological operation. I would add that the group of women we have chosen to subject to this trial were all university wives. You can work that out for yourselves

From what has been published about the enzyme test, I would have thought that at the moment there were no grounds for thinking of it as a possible test screening-wise. This may change any time. One other point is perhaps worth making in that connection. It has been claimed that it is possible to increase detection accuracy by using multiple tests. Combination tests are said to increase the percentage of accuracy by one, two, or three per cent. These claims have no bearing as far as our situation is concerned. It is much more important to subject 200 women to one test than 100 women to two tests. Our situation now is to try and get the lot of them screened in some way.

Dr J. P. Horder: About the enzyme test, I have already referred to a trial run by the MRC in three London practices. The main purpose was to try out the enzyme test compared with cytology. We have been told the enzyme test was disappointing and that there was no reason to suppose that it would prove superior. In our own practice, the number of women coming was rather disappointing. We got only 33 per cent of those to whom invitations were sent. There was some variation according to the social class. More came from the higher social classes. We sent for them by letter from the senior partner who was pretty well known to all of them.

Dr E. V. Kuenssberg: I am worried about our programme and our discussion so far. I came here thinking we were going to discuss surveillance and early diagnosis. What I have heard up till now has been extremely helpful and interesting on the wider philosophy of these problems but nothing into which I as a general practitioner can get my teeth. I would like to get my teeth into something. So I would like to put a few points from another side, because I am sure that if we are taking this as an overall philosophical discussion we really will have had a very pleasant afternoon at Magdalen College but we will not have moved the frontiers of our endeavours any further. It seems to me we must divide things out into what can be done now, or perhaps tomorrow, and what can be done next year or the year after. What can be done now? There, I would like to take up the point as regards cervical cytology, because it is without doubt something, in spite of what has been said by a number of speakers that it does not seem to be the thing for the general practitioner to do. I am reasonably convinced from practical experience, which goes back ten years now, that this is something that the general practitioner can do *par excellence* without any difficulty provided he does what to my way of thinking is the immediate problem—defines his high risk groups—and does not attempt the universal screening. After all, surveillance does not necessarily mean that we must survey everybody. Let us survey those people who are at the highest risk. I am sure in all diseases and in all disease groups there is this business which earlier on was referred to as the watchfulness of the general practitioner. It is the same as a surveillance. One offers the type of investigation that is possible today and adjusts it for one's patients. Of course, the general practitioner will need premises for this. He will need records and ancillary help for this. But even without these being 100 per cent perfect, I think he is in a position to do the surveillance of the high risk groups in certain aspects anyway with some encouragement. This brings me back to what John Fry mentioned earlier, that we must have an incentive. I think it would be a tremendous help if a meeting like this could think about the incentive that the general practitioner must have in doing this sort of work. Quite apart from the professional incentive in doing a good job, you must have perhaps another incentive. Why should general practitioners do cervical cytology? For one very good reason, which Aberdeen demonstrated so very clearly. Dr Elizabeth McGregor, in Aberdeen, had in fact a slightly higher rate than 60 per cent of people who attended mainly because the general practitioners concerned personally invited their patients to come for this particular follow-up. I know this from other surveys which we have conducted. One we did in Edinburgh for the MRC on chromosome studies, we had to get 400

patients to come and indulge in a little blood-letting. That is not the sort of thing patients do cheerfully, but we had only one defaulter. This was not an extraordinary university practice; it was an ordinary working class practice. This one patient who did default was a doctor. The others all came out of the 400. The general practitioner has the opportunity and his relationship with his patients is such that he can do these surveillances for high risk groups if they need to be done.

I hope we can define our policy on the high risk groups, for today, tomorrow, and the day after, before we reach Utopia where some American scheme perhaps with automation can cope with everyone. I think such schemes are a good long way away as far as this country is concerned, especially in view of the financial resources available under the National Health Service. I may be a bit cynical but that is my thinking.

Another reason why the practitioner should do his own cytology is, for example, that when general practitioners inspect the cervix they may find the beginnings of an early polyp. These occur relatively frequently—in the order of two or three per 100—in the high risk group. This is something which has, of course, a far wider implication because, after all, patients frequently have more than one thing wrong.

What worries me even more is that when we are looking forward to things that we should do in the future we should also look back and see where there are some things that are unnecessary for us to do, and drop them. For example, in our prescribing we still use things that have become traditional which we have used for years and years without knowing why we are using them. I am speaking now in the moment of time where the manpower situation in medicine is extremely tight to say the least. We need to turn our attention to the fact that perhaps there are some medical groups or medical practices which we can cut out for the benefit of some of the newer things. I cannot dissociate screening and surveillance and early diagnosis in my own mind from detecting perhaps early handicaps, for example among children, of hearing and vision, and all the other things. Are we, in fact, using the School Medical Services, where there is quite a substantial manpower and womanpower? Are we as factory surgeons who examine annually up to 18 years old young people in industry, regularly once a year—a good many of them already married with families—engaging there in useful occupation? Or is this not just one of the things we might think about dropping and freeing ourselves for further efforts on something more productive?

Anaemia in practice

DR G. S. KILPATRICK

I THOUGHT I would try to deal with the subject of anaemia fairly briefly, and try to ask more questions than I can answer. Is anaemia common? What are the vulnerable groups? What people are susceptible to it? Is it important? How can it be detected? By whom should it be detected? How can it be treated? By whom should it be treated? What is the effect of treatment? Is it preventable? Who should try to prevent it? In dealing with many of these things, I hope to cover a fair amount of ground. I would like to have discussed the cost of the treatment, but I do not think that is within my technical competence.

As far as prevalence of iron deficiency anaemia is concerned, we in Cardiff have done a certain amount of work on this. Any of you who know our set-up in Cardiff will know, of course, we could not do this without Professor Cochrane's defined populations and we are all dependent on and grateful to him for the opportunity we have been given. Some years ago, we defined the prevalence of anaemia in one of his communities. At the same time we did a great number of other things. We investigated men between the ages of 35 and 64 and at that time post-menopausal women. We took blood in the survey centre and examined that blood over the whole range of haematological tests. We got in this defined community some 93 per cent response rate which we thought was satisfactory. We were able to show, as other people have shown, that anaemia is relatively uncommon in men of the ages we examined. Of the post-menopausal women from 55 to 64 some 12 per cent or 13 per cent had anaemia as defined. We defined men as anaemic if their haemoglobin was 12·5 grams per cent or less (85 per cent). In women we defined anaemia as 12 grams per cent or less (80 per cent). At that time we only did a haematological survey. We were not able, as we would have liked, to do a detailed dietetic survey; I think they are difficult to do on survey. We were obviously not able to do full clinical examinations, although at the same time we did ECGs, examinations for rheumatism and blood pressure measurements because we were interested in these at the time. We were not able to do a routine stool test for occult blood although we would have liked to have done it. In Professor Cochrane's recent experience this might not be so difficult as we originally thought. We extended the original survey to a rural area in England, in Wensleydale, where we were able to examine men and women of all ages from 15 and upwards. This was, in a way, very much more interesting as we were able to get a very much wider coverage. We discovered in young men no great problem of anaemia though between the ages of 15 and 50 some 1 per cent to 3 per cent of the men might be anaemic. In the older age

groups particularly aged 65 and over some 20 per cent of the men we examined were anaemic to the extent that they had haemoglobins of 12·5 grams or less. In the women we found an enormous amount of anaemia, although perhaps not as much as was discovered in Aberdeen in pre-war years by Professor Sir Stanley Davidson and his colleagues. In women aged 15 to 24, some 28 per cent had haemoglobin of 12 grams or less. The prevalence of anaemia ran along something between 15 per cent and 20 per cent through the child-bearing years. It agreed with the findings in the Rhondda in the post-menopausal women. In older women, again, over the age of 65, there was approximately the same amount of anaemia as we discovered in the men. That is, something about 20 per cent to 25 per cent of older people were suffering from anaemia. I think the problem of anaemia in older people has perhaps not been stressed quite as much as might be.

At the other end of the ladder, we have looked at school children. Anaemia, particularly in girls, must start somewhere. We have done prevalence studies in Cardiff of school children. We found in the school children aged 14 years only some 5 per cent of them were anaemic. It is likely the prevalence then increases. We have therefore started a cohort study of 14-years old school girls in Cardiff, which we intend to look at over the next five years. I think this is perhaps a little more than we had bargained for. It is fine when the girls are in schools, because the school-mistresses can tell them when to come and see us. It is going to be very much more difficult to follow them up after they have left school, but we are determined to do this if we can. Not only is it going to be a follow-up study of the natural history of the disease. It is going to be a controlled therapeutic study giving half iron and half placebo tablets.

As far as the question 'Is anaemia common?' is concerned, the answer is 'yes' but mainly in vulnerable groups. I would suggest that the vulnerable groups are women of all ages and that includes older women and pregnant women, and men of the older age group.

As we have already mentioned, who is to decide in what circumstances are people normal or abnormal? What we would like to know is: are people better with haemoglobin of, say, 15 grams than 13 grams? We would like your advice, if you have any, on how we could determine this. We have thought about trying to do it on the basis of a questionnaire. Questionnaires are difficult. They have limitations and are time-consuming. However, we hope by the use of a questionnaire about what are assumed to be the symptoms of anaemia to determine whether there appears to be a change from a level, say, of 13 grams to, say, 15 grams. I agree with Dr Wilson's point this morning when he said that there was 'hard' evidence that anaemia could be treated although I have some reservations about it. I think we can raise haemoglobin levels, but what we are doing when we raise them is more difficult to answer. Perhaps we should try to find some suitable section of workers, nurses or factory workers, and follow them up more closely, perhaps recording sickness and accident rates. As far as the ratio of known to unknown cases of anaemia is concerned, for every known case of anaemia as we defined it there were twenty unknown cases. Whether it matters or not is one of the things we are interested in.

How can anaemia be detected and by whom should it be detected? Following Dr Kuenssberg's remarks, I think it is a thing general practitioners can do today. I think some of the things about which I shall talk may have to wait some little time. I think anaemia can be detected in general practice and should be detected. I do not think any questionnaire will tell you whether the patient has anaemia or not. I think clinical examination to detect anaemia is also largely a waste of time, unless a patient has a haemoglobin of less than 8 grams, 60 per cent. The only method of determining whether anaemia is present or not is by examination of the blood. The ordinary Tallqvist papers are so useless, I think, as to be absolutely forbidden, and should be forbidden now. We would like however to have a more simple form of haemoglobin examination.

There are machines on the market. Dr Elwood and Dr Jacobs, in Cardiff, have recently done a study, admittedly in the laboratory on haemoglobinometers. They have found that the American Optics instrument, called the AO meter, is probably as good as many and better than some. It is simple to use. It is accurate. It is reproducible and correlates well with the most sophisticated methods of haemoglobin determination and uses, of course, whole blood and requires no dilution, thereby eliminating some of the many errors of haemoglobin examination. I think Professor Jungner was saying earlier this morning that his instrument required a great deal of calibration every day. This, I think, is true in the more sophisticated instruments. Perhaps it is less true in this relatively simple AO meter which, for your information, costs about £25.

Therefore, I would suggest the general practitioner should be able to determine whether anaemia is present or not. I would like to hear views on whether you think general practitioners should determine it in practice, do the estimation themselves, or merely take venous blood and send it to the nearest laboratory for detailed examination.

What about treatment and investigation of anaemia? We have run into several problems and troubles about this. Should people with anaemia in fact be referred for specialist consultant type of opinion. Is it necessary or desirable or does it make any difference? We do not know the answers to this, so we are trying to set up some schemes and trials and studies to determine whether it is so or not. I think it is probably unrealistic, and unnecessary, to send women who are anaemic to hospital for detailed examination, which might include a barium meal and all the rest of it, provided you take a reasonable history dealing with possible sources of blood loss, such as haemorrhoids. In men it is more important. I think in the older group probably both men and women should be either examined carefully or referred for other special examinations to investigate possible causes of blood loss, because it is clear that the balance between the iron intake and blood loss is a very precarious one, particularly in women, of course. We have again set in motion controlled trials. We have, rightly or wrongly, included people in this controlled trial provided their haemoglobin level is greater than 10 grams, that is about 65 per cent. Below that level, we thought it perhaps not unjustifiable but unethical; perhaps we could watch half and see what happened. Without such studies we feel we may never know what are the important things to do. The other thing is, should we ask Medical Officers of Health,

or School Health Departments, to screen these people?

As you know, people stop taking iron tablets. We are again embarking on studies of school children and adults to see the acceptability of treatment. I think many people try to give too large a dose of iron. We have got iron dosage at two different levels, one giving the school girl 30 mg. of iron a day, one having 15 mg., and a third having nothing. We may get some idea about this. So far, it has been going just under a year. We have found by urine tests some 65 per cent of the girls take their iron tablets. The remainder do not. This is rather better than our patients we treat for tuberculosis, of whom only some 40 per cent or 50 per cent apparently take their drugs regularly. This drug treatment acceptability is terribly important. I think we are going to be even more involved in this when we start, as we shortly will, on trials of hypotensive drugs in people with minimal degrees of hypertension.

What are the effects of treatment and the long-term possible benefits of treatment? We do not know. We believe, of course, people should not be anaemic. We believe we can help them and we believe that people should have haemoglobin as near the normal mean as possible. Whether this will be so remains to be seen. I hope some of our studies will show us the way, though it will be some time before we have all the answers to it. Certainly, the treatment of anaemia ought to be carried out in general practice and certainly not in a physician's out-patient time or in that of the haematologists who have other things they can better be getting on with.

Finally, there is the question of the prevention of anaemia. I think the possibility of anaemia should be made known to the public. The public should realise that anaemia is a problem and could be prevented. This can be done by the usual means of mass communication. I think the awareness among general practitioners is important. I think they should do more frequent haemoglobin measurements, restricting their activities to the vulnerable groups of women of all ages and men and women in later years. What is the basis of prophylactic iron tablets in the prevention of anaemia? We hope to be able to say in about five years, from the results on the prophylactic treatment of Cardiff school girls. Certainly other groups should be treated, such as people who have had partial gastrectomy, for instance.

Whether we should try to prevent anaemia in other ways possibly by the addition of iron to some staple foodstuffs such as additional iron in bread, should be considered. We wonder whether if we could increase the amount of iron in bread, it might marginally improve or prevent a certain amount of anaemia. Again, we are in the middle of a lot of studies of this with the use of radio-active isotopes in various iron preparations. While undoubtedly the iron is there, whether it is absorbed or not is very much less certain. If we cannot put it in bread, could we put it into anything else? I imagine there would be something of a furore if we wanted to add anything else to water. There is the possibility of adding it to chocolate for girls, which might result in a problem of too many additional calories.

There are various problems. We would be interested to hear your views. We think anaemia is common. We believe it is important. We hope it is remediable and we hope we will be able to give you some answers in the future.

DISCUSSION

Dr J. Fry: Anaemia is *par excellence* a disease of general practice. I hope that Dr Kilpatrick has not given the view or the impression that it is the general practitioner who comes in at the second stage rather than the first stage and just to support his academic studies. In the survey which I carried out in my area—I suppose you would call it middle or upper middle class—we found (and this was done on a one in eight sample of all adults over the age of 15) that 2·5 per cent of males of 25 per cent of all females over age 15 had haemoglobin of less than 12 grams. We used this AO meter to which Dr Kilpatrick referred and in fact with a little bit of practice it does not take more than about 1½ to 2 minutes to do this in our consulting room. As Dr Kilpatrick said, the vast majority, I think about 95 per cent, of all anaemia in general practice is iron deficiency. Our routine is that we screen these patients and then, having access to the local laboratory, we refer all those with haemoglobin with less than 12 grams to the local pathologist who in fact substantiates the type of anaemia. Then, of course, we go into any possible causes. This is general practice management. What happens to these patients? We have also had a look at this. What Dr Kilpatrick said, does, in fact, happen. These women are treated and a substantial proportion of them give up treatment. In spite of what Professor Davidson found in Edinburgh, I would not say that most of the reason why they give up iron is psychological. I think they just cannot tolerate it. This underlines the need for continuity of care after screening procedure. We have got to move away from ideas of screening once and for all, as mentioned this morning. It is continuity of care we must look for, in the vulnerable groups. I agree with those Dr Kilpatrick mentioned, but I would add pregnancy, which he did not mention. One of the things I have been struck with is the high proportion of very pale faces in our practice. We are just about to undertake a prospective study. We will do continuing haemoglobin studies on all infants born in the next couple of years. We have got a health visitor attached to our practice. She is a keen member of our team. I would like to underline the importance of team work. No one has yet really mentioned that doctors need not be involved in this all that much; as general practitioners we have to rely more on ancillaries to work with us. I think general practitioners, health visitors, nurses and technicians are going to be important members of the team.

Dr R. F. L. Logan: I merely wanted to follow on John Fry's point which he was developing. It is not once and for all, because in fact you have to find people with anaemia, and then tab them because you know that they will relapse. You also know that it tends to run in families, so you tab the family group. I have been a little concerned that families have not been mentioned today in terms of general practice; it applies to diabetes as well. The points I wanted to bring out are first that it runs in families, secondly it is over a life-time. Because of these two very things general practice in Britain should not be talking about screening. It is a life-time process of surveillance. Industry has never been mentioned today at all. Lead workers are now being routinely examined for haemoglobin in industry. Urine cytology is now being done for those in contact with rubber—again, over a life-time.

Dr J. Williamson: I was slightly distressed to hear Dr Kilpatrick say that these were iron deficiencies. Of course, as far as the under-65s are concerned, this may well be true. I think it is gross over-simplification as far as over-65s are concerned. In an old person who is found to have anaemia this is very often a very sinister manifestation and may well be an indication of something pretty serious going on elsewhere. It may be on the one hand that the person is not only deficient in iron but deficient in many other essential substances as well, because he is living alone, neglecting himself, and it is a very precarious situation. Maybe, on the other hand, he is losing blood. As you all realise, there would be a malignant lesion in his intestine. I think we must remember the frequency of multi-pathology in the old person. That is a lesson which I never miss an opportunity to send home.

Dr G. S. Kilpatrick: Can I just answer that point? I appreciate only too well it may be due to malignant as well as simple conditions. I was meaning iron deficiency, not pernicious anaemia, or all those other things listed. Iron deficiency can be due in advance age to excessive loss of blood. I do appreciate that it may well indicate serious underlying disease.

Dr K. Schwarz: There is only one point I wish to make in connection with what Dr Kilpatrick said. When you look at a vulnerable family it might be of some interest to know where they have been. The family doctor has a tremendous advantage. It is one subject very much in the air at the moment—immigration. If somebody has been abroad, that would immediately represent another 'high risk' group.

Detecting disease in clinical geriatrics

DR J. WILLIAMSON

IT is very difficult for me to try to put across what I am supposed to, because I am not sure what it is. I seem to have been included to discuss not-really-pre-symptomatic disease. I am interested in a sort of neglected disease which nobody seems to know anything about. This concept, or idea, that we are going to discuss now, as far as I am concerned, arose from a survey we did in Edinburgh. We found that of a random sample of elderly men and women the average number of disabilities, that is to say lesions of one or other system, causing the person to be less well than he should be, was: 3·26 of which 1·8 were not known to the general practitioner concerned, in the males; and 3·42 of which 2·03 were not known to the general practitioner in the females. Somewhere over half the disabilities which we detected in this population, which was a random sample taken from the list of two general practitioners in Edinburgh, and one in a nearby small town, were unknown to the patients' general practitioners.

It seems, as a result of studying this group of people, that the conventional attitudes to care of the elderly had fallen down in rather a serious fashion. We coined the sentence 'the self-reporting of illness and disability in older people was not a satisfactory way of maintaining health'. We have worked on this basis since. Assuming our figures are not very unrepresentative of the rest of the country, and there is no reason to suppose they are, why do old people not bring their illnesses to the general practitioner? I think the first reason why general practitioners are generally ignorant to this extent is the fatalism of the old people themselves. They do not really think it is worth while coming to see the doctor with sore feet or with the fact that they are up three or four times a night passing water. Relatives either do not notice that they are dementing and becoming less able to fend for themselves or, if they do, they also share this fatalistic attitude and feel it is just old age and there is nothing one can do about it. Secondly, there is a factor of fear. I think old people are often afraid to go to the general practitioner to report symptoms because they feel this may lead eventually to them being put away somewhere, being admitted to hospital, an old people's home, or some form of institution. I think it is an important factor that old people are often quite scared to go along and have this matter ventilated. I think the third factor is one of dementia. Quite a high proportion of old people—we found actually 27 per cent of our sample—had recognisable degrees of dementia. It is far higher than anybody else has found. It may be we were over-diagnosing but we did it according to recognisable criteria. No doubt a substantial minority of people in this age group have some degree of impaired mental power. Very often one

of the first powers which goes is the ability to analyse their own situation or to be critical of themselves. Even if they can do that, it is difficult for them with this degree of dementia to know what they can do about it, where to take their troubles and where to apply for help. Then, of course, there is the other factor of multiple pathology. Some of these people were actually attending general practitioners on account of some recognised illness but, in addition, they had some other unrecognised one contributing to their general disability. It is a failure on the part of doctors to understand how almost universal multiple pathology is in old people. In old people over 75 it is unusual to get somebody with only one thing wrong, they usually have three or four. In Aberdeen, for example, the average number of pathological conditions detected in this age group in consecutive hospital admissions was 6·2 per person. This brings us face to face with the question, if the present situation is unsatisfactory—and I think few people feel that it is satisfactory in relation to the care of old people and anybody who does must be pretty blinkered—what can we do to improve it? Some form of medical inspection, or screening if you want to call it that, seems to be the only feasible solution. It is with this possibility that I would like to deal for the rest of this communication.

I would emphasise that these findings which we uncovered were made in conditions identical to those in which general practitioners themselves work. Examinations were done in a general practitioner's surgery with a few exceptions of one or two patients who could not go up to the surgery and whom we saw in their own homes. It was a simple, straightforward clinical examination with psychiatric screening done by a psychiatrist, urine examination, and blood sampling for haemoglobin estimation. So it was not a complicated or difficult manoeuvre although it was time-consuming and, of course, this creates a difficulty for the general practitioner. If we envisage some form of screening—the first question posed was 'who should have it?' I suggest that as far as old people are concerned we should aim eventually to have some form of screening for all old people, that is to say, all people over 65. Obviously we cannot jump straight to that stage at one go. So we would start perhaps with the older ones, those beyond 75, because there is evidence that it is quite easy to find relatively healthy people up to the age of 75, but it becomes increasingly difficult to find healthy people beyond that. There is some sort of biological barrier we pass through and never are quite the same again. Secondly, isolated persons living alone or two old people living together and not managing very well are obviously in special danger. Another group is the recently bereaved. With a life-long married couple, when one dies the remaining partner is at risk particularly from psychiatric illness. Then, last of all, possibly most important of all, the dementing person. This is rather begging the question, because you have got to examine them before you know whether they are dementing. If there were some method of uncovering people who are not managing so well and in whom it is suspected the reason is mental impairment, these people would justify a good screening examination with appropriate social and medical measures to bolster them up for as long as possible. I also include patients who have been recently in hospital. The fact that they have been in hospital suggests there has been something wrong with them, though that is not necessarily the reason why they went there. The fact that they have been in hospital in my experience means there probably still are a good many things wrong with them, which quite likely nobody knows very much about. I think old people discharged from hospital should be placed under some sort of special surveillance for a time.

Who should do it? We have suggested that a health visitor specially trained for the purpose should be employed for this actual screening activity. We think that this can only be done successfully if the health visitor and general practitioner are working together as a team, and the health visitor leaves the Town Hall and throws in her lot with the general practitioner to work alongside him.

We have recently conducted a little experiment in Edinburgh. It is in a very early stage. I will give you a very brief outline of it. We have collaborated with a group practice of three doctors and we have opened for them alone a consultative geriatric clinic. We think this idea is capable of more widespread adoption throughout the country. The experiment is quite simple. We have trained five health visitors to operate in the area served by this practice, and we have met them on several occasions. They have been to the geriatric hospital. We have had meetings, gone over cases with them, taken them on ward rounds, and done home visits with them. We feel they know more about our views on old people than any other health visitor in Edinburgh. They have been having patients referred to them from the three doctors in practice. The patients are people of 65 and over about whom the general practitioner either knows nothing or very little, or about whom he knows something and is slightly worried although not enough to refer them to an out-patients department. These are the people who are at risk. The health visitor has been visiting them and completing a questionnaire and conducting a very simple examination. We now have the results of the first forty or fifty patients they have been screening in this way. She makes an appointment for them to attend the clinic. We examine them, the psychiatrist sees them, and we do the batch of tests in the ordinary way. We have found that as far as physical complaints are concerned the health visitor is almost completely on the ball. She rarely misses anything of importance. Where she has missed it, a woman with haemoglobin, for example, of 52 per cent the health visitor had noticed nothing about this lady, neither had the physician when she attended. It was only when we got the laboratory result that we realised it was an important factor. So far as physical complaints are concerned, the health visitor seems to be generally competent to sift these and decide what is important. Perhaps in due course she may be able to take the decision whether it is worth referring this to the general practitioner, or whether she should discuss it with him and with his agreement refer it to us.

As far as psychiatric illness is concerned, the situation is more difficult, as one would expect. There were about ten patients with psychiatric disorders. In four of them the health visitor's comment agreed in every respect with that of the rest of us, including the psychiatrist. In three it was fairly good, that is to say, she knew something was wrong but was rather vague about whether it was depression, dementia or confusion. It did not matter much, she knew something was wrong and further action

was necessary. In only one was the health visitor's assessment bad and that was a lady who showed early or moderately advanced dementia. The health visitor completed the questionnaire perfectly, saying the patient had forgotten the health visitor's name, and got something in the memory test wrong. She had scored very high marks on the money test we give them. In spite of quite marked impairment of memory, the health visitor had scored her as having no dementia and no mental impairment at all. There was one point which was satisfying to me personally. I had forecast that the health visitors, who are females, would get a low score in detecting urinary disorders in old men and, of course, they did because the old men did not tell them about their urinary troubles. Presumably they felt embarrassed about it.

'How will it be organised?' In outline, the experiment I have described to you, I think, could be widely adopted. We could bring the health visitor and general practitioner together and with suitable training of health visitors hope that they would be able to uncover a lot of this unreported illness. Quite a lot of the necessary action could be taken at health visitor level without any more than just informing the general practitioner what she was doing and assuming his consent. I am sure this would be the usual way it could be done. As an older person became less mobile, in a severe winter, for example, the health visitor would be free to organise home help and laundry services, only letting the general practitioner know. As I said before, I think this scheme which we have evolved is superior to the Rutherglen experiment, in that I believe the Rutherglen experiment is ideal but there are not many Cowans and only one Anderson in the world, and only one professor of geriatric medicine.

There are some procedures which we might suggest immediately. First of all, training of health visitors is vital in this. At the present time the health visitor is not trained in geriatric practice or care of the old people at all. The new curriculum has improved this but it still is a very lop-sided training, still orientated towards the very young and neglects to a large extent the very old who are in much greater danger as a group today than the very young. It is something that would have to be put right. Meanwhile, we should have special training courses and refresher courses for health visitors about to embark on this type of work. As I say, the five health visitors with whom we have dealt took to this pretty readily. Some of the older ones were obviously hostile to begin with. They felt it was not really their job and it was rather an imposition. But the younger ones, particularly three or four of them, took to this with great enthusiasm. It was very easy to teach them because they were waiting for the information to drop into their laps. We have devised a simple questionnaire for the health visitor to complete and the simple examination which involves really just looking at them, at their feet, looking for oedema of the ankles, assessing the degree of breathlessness, disability on the stairs and so on. Perhaps if they are lame, they get them to walk across the room and if they are limping look at their knees, ankles, and hips to see if there is any obvious cause for this. We have devised a simple psychological test including a simple memory test, a simple test for the power of recall, and a simple test of their ability to do sums with money. Old people do not need to do abstract arithmetic; it is meaningless to them, and many of them left school at 11 or 12, but they ought to be able to know how much change they should get out of half-a-crown if they buy something that costs 1s. 11d. If they do not, they are going to be diddled down at the shop.

The long-term benefits of this procedure will, I think, mean long-term benefits measured in terms of the community, and also to the individual. The main benefit to the community is that we would secure a longer period of independence, or semi-independence, of these old people. The greatest disaster to befall old people is to get into such a state of dependency that they can no longer remain in their own home and they have to be whisked off to some institution from which they know very often they will never escape. This is a great tragedy to them. Very few of them can face this with anything but the greatest foreboding. Also for the community, it is extremely expensive and, I believe, extremely old-fashioned to care for old people in this way. The cost of this I do not know; you have to tell me. I am quite sure the cost of doing nothing, of not doing something of this sort, is almost incalculable not only in terms of £sd, but in terms of human misery and unhappiness, and in terms of the dislocation of our ordinary health and welfare services. Wherever you go you find within the general medical and surgical wards, specialists ask how they can deal with their waiting list when 25 per cent of their beds are occupied by old ladies camping there month after month with no prospect of them getting out until they die. Therefore, to my mind, this is something which needs the most urgent attention. It is quite crazy to go on building new expensive teaching hospitals in a place like Edinburgh, for example, where beds will cost £30, £40 or £50 a week, without at the same time doing something about the geriatric problem.

DISCUSSION

Dr C. M. Fletcher: When visiting the old people, did your health visitors only refer the patients who they found had lesions to your clinic, in which case do you know how many they missed?

Dr J. Williamson: We saw them all. We were doing it as an experiment, checking up on the health visitor, who knew she was on test, too.

Dr R. F. L. Logan: Were the health visitors sent by the general practitioners?

Dr J. Williamson: The health visitor goes every Friday morning and has a cup of coffee with the general practitioner and asks who he wants seen next week. The doctors know who needs visiting from their age and sex register. She goes and sees them.

Dr R. F. L. Logan: When the general practitioner refers a case to the health visitor who has a questionnaire, this is using the health visitor to make a physical diagnosis.

Dr J. Williamson: It is an assessment of disability. We are not terribly interested in physical diagnosis. We are only interested in what can and cannot be done, and whether the old people are disabled.

Dr R. F. L. Logan: The general practitioner will have known these old people, perhaps over a decade. He will have seen 95 per cent of these within his practice within three years. The health visitor is making an assessment of a relative stranger.

Dr J. Williamson: You are making an assumption in saying the general practitioner has known them over a

decade. One of the partners in the practice had only been there for six months. On the other hand, one of the senior partners had been in practice since he qualified, and his father before him. He has known *of* them for a decade, but has not seen them.

Dr R. F. L. Logan: Having said that very critically, may I say on the other side that in a *known* factory population I have been using state-registered nurses for this very kind of job. I have no doubt at all that the nurse can do it. She can do it in a pre-employment examination, and follow-up high risk groups. In that type of situation it is quite different. What I am trying to think out here is how do we use the limited resources of all kinds of skills in the country. You rightly point out the crazy situation of hospital institutions. That also applies in general practice and public health. May I say that your approach is equally crazy!

Dr J. Williamson: Well, you are wrong! The point is that the situation we see in geriatrics and which we showed in our survey is well-nigh disastrous. We studied the situation of the old people in a little town and it was quite different—as different as night and day—from their situation in a city. In a city, a huge amorphous city, the most vulnerable person in that city is the old person, particularly if he is living alone and particularly if he is dementing. It is a crisis in our society, and we have got to do something about it. I am not saying it is the permanent pattern for the future. It is something, as Dr Kuenssberg says, that we can do today or tomorrow. We have done it three months ago. This can be done within the cities where this problem exists. We must do something immediately and build on it and try to provide better services in the future. In the meantime, we cannot go on having old people brought in with permanent contractures and bed sores, and the general practitioner admitting he saw the person for the first time yesterday.

Dr R. F. L. Logan: I agree. In Stockport, in fact, in the absence of systematic surveillance of the high-risk ages, we had to use the refuse man, who was the only regular weekly visitor to provide some kind of early warning system of this early impairment. In one case the doctor was called in because cinders were coming out under the door.

Dr J. Williamson: That is not early impairment, that is disaster! We want to make sure the coals are going in first before we worry about the cinders coming out.

Professor R. Scott: I have two comments on Dr Williamson's excellent paper. He referred to conditions under which this team of doctors worked. I think this is absolutely germane to many of the things we have been discussing today. This team, did it not, comprised of a physician—a very good physician—a psychiatrist, a psychiatric social worker, a medical social worker, a secretary, and a research assistant? That is very different from a general practitioner working without help.

One other comment on the role of the health visitor. I do not personally believe it resolves our problems to attach the health visitor to general practice. If she is a really good health visitor she should really be making trouble not helping the doctor, because there is essential conflict between preventive and curative medicine. We should welcome and accept that there is conflict. There are now two approaches: one where the doctor waits for patients to come to him and the other where his agent takes the initiative on his behalf in going to people who happen to be on his register. I think you need an organisation that can really embrace these two. I do not really see any hope for the future of general practice in relation to these subjects we are discussing unless there is a complete reorganisation of general practice as we know it in this country. I cannot see any real future for the independent person who owes no allegiance to or has no contact with the hospitals, and his superiors or inferiors, who works as an individual. This surely must be out, by and large.

We have to think of general practitioners working in large groups, that is twenty or more. Their work must be related to that of consultants and specialists, and what we now think of as preventive medicine. We will have to reorganise our medical system, keeping records of everything that is going on in this large group, and will examine this data as it comes in every week or month, decide on this basis what to do next year, who will do it, what special grouping, re-training or re-organisation is required in this group, quite apart from relating this group to the concept of the hospital and the community services. Many of the things we have heard about today are simply a question of organisation and equipment. General practitioners cannot do all these things with their bare hands—which is what we are asking for now. It does involve quite far-reaching changes in training, in getting individuals who are medically qualified to work with para-medical and non-medical auxiliaries, superiors and inferiors, and colleagues from other disciplines.

Dr G. J. Norris: I am very grateful to Dr Kuenssberg and Professor Scott for bringing us from the highlands of philosophy to the lowlands of practice. I have been thinking what would be the practical implications in my practice tomorrow of all the things I have been hearing about. Naturally, I would consult my age–sex register list for people over 65, then make a list of people with a high risk of glaucoma, diabetes, anaemia, and then draw up lists of twenty or so people to attend weekly for examination and screening. I would have to invest in the haemoglobin AO meter—I was also told by Dr Logan in the lunch-break I could buy a couple of electrocardiographs for my partner and myself. What on earth would happen to my ill patients, I dare not think. I think there is a tremendous gap between what we ought to do and what we can do. I think, speaking practically, the only thing under the present organisation of general practice that we can do is to be aware that these people are at risk. I would not like to say that at present all practitioners are fully aware that these groups are at risk. When they attend surgery we should follow them up and try to screen them to the best of our ability with the equipment we have. I think we must not lose sight of the fact that this is a compromise arrangement and that we ought to be able to do almost as well as the Kaiser Permanente Organisation in America. Perhaps it would not be quite like that but we should provide an equally good service to our patients. I hope that those responsible for the moulding of the health service in the next ten to twenty-five years will take note. I myself am both encouraged by the scope that I can see in the future practice and disheartened by the fact that we have not got the tools for the job.

Dr D. L. Crombie: I would like to make another point, and I make this particularly as a general practitioner. We have to be careful that what we are discussing is not

just intensified medical care. In other words, the benefits that have arisen to any community as a result of any of the things we have heard of today are still not established as benefits, resulting only from prevention, even from the geriatric study. Nobody has yet established what will influence the pathology in a meaningful way, although we may be able to manipulate the social background in a way which helps the patient and the community.

There is some slack in the health service organisation, which Dr Fry and Professor Scott have mentioned. However, I have a nasty feeling there is not as much slack as all that, and when we get on to any of the next phase of general application of these preventive procedures it will involve large numbers of ancillary workers, and large amounts of money. All this adds up to intensified medical care. Unless the preventive procedures we are talking about specifically bring in returns comparable with the amount of effort extended on them, the only real benefits will be those associated with the intensive medical care which follows the deployment of more resources.

Dr C. M. Fletcher: I was a little surprised about Dr Williamson's reference to patients filling beds in teaching hospitals. As far as my beds are concerned, old people are brought there because they need acute medical attention.

Dr J. Williamson: We are talking about two different things. I agree, a person blocking a bed in your ward should be in some bed. Sometimes it could be a local authority bed, sometimes a mental hospital, but it should not be your bed. However, the important thing is the biological processes of ageing. A person at the moment reaches a certain degree of decrepitude at say 75 and there is nothing we can do about it now. However, we can prevent it affecting personal independence to such great extent. Take a bad knee. If you neglect it, the person becomes more and more immobile and may eventually be presented at the general practitioner's surgery, or hospital out-patients' department, or emergency in hospital, and end up with a permanently flexed knee. By that time it is a disaster and nothing can be done about it. Meanwhile in these years, pain, misery, urinary infections, obesity, all these things can stem from it. Being unable to do shopping the person's nutrition becomes neglected. Or when an old person is going deaf, if you do nothing about it till 75 you can never do anything about it. They are too old to use the hearing aid, past the stage of learning to lipread and permanently cut off from society. Any rational society ought to be able to do something about this. All I am pleading for is that we do do something about it now. We must not be fatalistic about the logical implications of age. We can bring social and medical measures to bear upon these people and prevent deterioration or slow it down very much. There is no doubt that is what geriatrics is about.

Dr G. H. K. Hodgkin: I disagree, of course, with a lot of Dr Williamson's figures. I am sure it is because we are in different areas. We are in a 40,000 sized town. I think a lot of these things are varied, but I do make a plea for more information from other areas, because our figures are entirely different. We found we were seeing 89 per cent of the old people in our practice more than once a year and two-thirds of them three or more times a year. The figures on mental disease were also quite different. There were 3 per cent frank psychotics, and 6 per cent hypochondriacs and difficult people who one jollied along perhaps by calling them by their christian names and pulling their legs and giving them a trial on antidepressives, and so on. The point about looking after all these old people was continuity. As Dr Crombie said, it is more intensive care that is really needed. Dealing with these old people is perhaps not a question of screening tests at all. It is getting wardens and volunteers, people to keep in touch with them, to ring up every day. I am sure in Edinburgh if you had a system of communication and wardens for old people you would not need these screening things and you would be looking after old people far more effectively in the process.

Dr J. Fry: I agree with what Dr Hodgkin said and want to add one or two other points. I think you have to remember the general practitioner is working in quite a different situation from, say, the hospital. He is working in a static community, fixed and of relatively small size. As Dr Hodgkin said, he is in essence practising continuity of care. The general practitioner sees between 70 per cent and 75 per cent of his patients once a year, and he sees at least 95 per cent of them at least once every five years. He sees between 85 per cent and 90 per cent of his old people at least once a year. It is the 10 per cent to 15 per cent he does not see where the health visitor comes in. She does not have to see all the old people. Our health visitor goes and sees the ones we do not see. I think the important fact is that we do not have to have mass community surveys because we are seeing them all the time. As Dr Logan has said, once we have tabbed them we have got to go on looking at them. We cannot help it because we do in fact see them.

I would also think that Dr Williamson's figures are extremely high, for the simple reason also in our practice we are engaged in a more sophisticated survey. We have got someone attached to a psychiatric unit looking at the mental state of old people. We are also doing some investigations to see whether they are vitamin deficient. Another person going round looking at their urines to see what level of hidden bacteriuria they have and also doing their jerks. This is an ex-nurse who can do this quite well and also does some simple psychiatric tests. From an interim report, so far, we have been both disappointed and gratified to find a very small rate of urinary abnormality. They are going very well, and not suffering with any gross diabilities. Also in this we have done the haemoglobins and they are not all that low, which does not fit in with our previous experience. At least in our practice, I would support what Dr Hodgkin said. I am sure there is not a wealth of hidden, undiagnosed illness amongst the elderly. I think the important thing to remember is that the general practitioner is working in his community and he does not need to have masses of people trooping through.

Dr H. Keen: As an outsider to this particular problem, one might question typicality. It is easy to see things from outside. As a matter of interest, Dr Fry, how many people do you have working in and around you?

Dr J. Fry: There are two partners in the practice. We have a health visitor attached to us. Of the other two persons referred to, one has got a research grant from the local regional hospital board, doing a study on our old people, and the other one is doing a vitamin study, to see if there is any deficiency. We are a fairly normal set-up really.

Dr J. Williamson: It is very difficult to compare one area with another. Of course, it is not really fair to compare the findings of a man who does tendon jerks and us. We were pretty objective about it. We took a lot of time over it. To that extent we may have over diagnosed. We were always guided by the whole situation of the person. If he was having difficulty with walking due to something wrong with his feet, we would classify that as a disability. I think that is reasonable. The same thing with sight and hearing. If he wanted to read the newspaper and could not, that is a defect of vision. I do not think you can get away from it. The harder you look the more you will find in every branch of medicine.

Professor J. Cassel: As a visitor, it is rather confusing to hear some of the things that have been said today. There is a slight difference of opinion. On the one hand very experienced general practitioners are telling us they see the majority of their patients over the course of three years and know them very well. On the other hand, the majority of studies from this country indicate for a considerable number of conditions there are almost as many unknown cases found by the surveys as are known. For example, an equal number of diabetics now are found to those known. I am sure there are many cases of cancer of the cervix coming to attention when they are already inoperable today. It would appear then that there must be considerable variation in the stage at which it is detected, and perhaps more variation in the degree to which patients come for treatment when it has been detected. Perhaps one of the points that has not been stressed enough is the value of well-planned detection programmes in motivating people to go for care even if they had known of their condition prior to the actual survey. In this context, it seems to me enormous advantages accrue to a country with a National Health Service in this type of detection technique. In those countries without a health service, the major breakdown usually happens between screening and treatment, because of economic barriers, because of mobile populations, or because the large majority of people in many countries do not have personal physicians. None of this applies here to any material extent. Therefore perhaps the essential question should not be so much who should do the screening or detection but whether there should be a uniform policy over the country as a whole with room for local variation and experimentation. The only principle is that if there is to be detection it should be done with all parties involved fully participating. Therefore, whether the actual detection is done by the local authority, general practitioner, or some other less important body, all these bodies should be involved, agreeing it should be done and agreeing upon the arrangements according to the local situation. Perhaps a more important question of policy arises over who should do the follow-up and care of patients who are detected. For this, it seems that there are certain avenues in the National Health Service that can be followed.

The question of incentive has been raised. I think it is a terribly important question but I am not competent to talk about it. The question of the need for facilities has been raised. I am wondering if we are waiting for what Professor Scott says needs to be done in reorganisation. I am wondering to what extent the existing resources are being fully utilised by general practitioners in the follow-up and care of the patients. To what extent more adequate use can be made of existing ancillaries, health visitors, district nurses, social workers, and the like who could be employed more specifically for the continuing care. A more efficient employment of these resources would allow much of the present activity of the general practitioner which, I believe, does not require his full training to be done by someone more appropriately trained or with lesser training. The general practitioner would have more time for the work for which he has been trained, to the benefit of the patients concerned.

As an aside, I might make two unrelated points I think which are not unimportant. One is that I wish we would stop trying to determine the cut-off patients by using the word 'normal' in applying normal statistical distributions, when talking about levels of blood pressure and so on. I think we tend to mix up the question of statistical mean with what is the desirable level. The question should be posed: what are the deleterious consequences of comparing levels of blood sugar in terms of criteria independent of the distribution of the population? While a person may be only a few degrees away from the mean, the levels of his haemoglobin or whatever may be on the whole undesirable.

The other point is also miscellaneous. I listened intently to the question of yield from certain surveys in terms of cost. Very little attention has been given to the problem to the consequences of reporting false negatives, which have to be put into the equation, I think, quite seriously. It varies, obviously, with diseases. The consequences of missing a certain proportion of anaemia is very different from that of missing the same proportion of cancers.

The Chairman: I have to draw the session to a close. I am sure you will agree the rather unorthodox decision to include Dr Williamson's paper in the present context has been fully justified. Throughout the day, I have been tempted to take part in the discussion myself but I have managed to resist it. There are one or two points I would like to make now.

Two issues have come up very strongly on the discussion as I have understood it: conditions under which general practitioners do their work and how realistic it is to speak of these various developments. That is tied up immediately with the question of what is the correct team for domiciliary medicine. It is obviously doctor and secretary, but beyond that there is very little agreement except that certain nursing skills are required. The only reason why I am intervening at the present time is that I hope we will not pre-judge this issue rather as I think Dr Williamson pre-judged it. There was talk of health visitors. I personally do not agree at all that it is proven that we need the health visitor for this job as a realistic choice in terms of numbers and expensive training, etc. If we are to develop in this field, it seems more realistic to think in terms of tapping the large married S R N community which is doing nothing except look after their families. We have got to think of unconventional methods of finding staff and then think in terms of a simpler training than that of the present health visitor.

I was also horrified at the casual way Dr Williamson talked about taking the health visitor out of the Town Hall and arranging her salary through the post. It seems to me total dis-diagnosis. It is necessary to have the closest co-operation between the health and welfare services. To detach the health visitor would put us back to the position of ten years ago and we would then be

thinking of re-integration again. I hope I have not taken the point unfairly. It is just that these issues are very open. To my mind, we require a lot of study and experiment before we can hope to find what in fact are the appropriate teams for domiciliary medicine.

Practical implications for the future

PROFESSOR E. M. BACKETT

IT is arguable that there are six main implications to be derived from what we have been talking about today.

The first sets the stage for the others. If we accept the need for presymptomatic diagnosis, it seems inescapable that we are really accepting the notion that, as doctors, we should become as deeply involved with the 'healthy' as with the 'sick'. In taking the step to presymptomatic involvement with our patients, we are automatically committing ourselves to go further. We become involved at once in the care of normal, healthy people who are not yet ill, but who are particularly vulnerable. This involvement implies the 'treatment' of these families whose ways of living are pre-disposing them to disease.

The first practical implication of these discussions, therefore, is that we must start thinking a little more about the role of the doctor, and particularly of the general practitioner, in altering ways of living of apparently healthy but especially vulnerable families. This may not mean a sinister interference, but perhaps no more than dissuading a few adolescents from smoking. The implication of involvement of some sort is, however, inescapable.

The next, and most important, implication is the increasing need for epidemiological research to give substance to the kind of notions that have been heard today. A great many questions have been asked and almost every one can only be answered by long-term and very careful study. It is probable that in many studies we shall need the help of the general practitioner himself. In turn, of course, he will need all the new gadgetry, the advice and co-operation of epidemiologists, data linkage systems, and almost completely new records. Perhaps the greatest need of all is for a number of long-term clinical trials to determine what happens to patients whose diseases have been diagnosed very early. How valuable is treatment at this stage, how difficult and how well accepted? These clinical trials will not only be of drugs but also of all other methods of early treatment of the people and the families who are diagnosed as highly vulnerable or already sick. In all this exacting research, it is appropriate to ask: what is the role of the university, the Research Foundations and the Medical Research Council? Their responsibility seems clear. Without the active fostering of these studies, little will be done. This is a pity, for, among all countries in the world, Britain is probably the best equipped for this kind of research. It is the only country in the world, for example, where the total population is registered with a general practitioner and where there is no cash barrier to contact with him. These two features of our health service make the kind of research we are talking about more likely to succeed here than elsewhere.

The third practical implication of our discussions is the need for demonstration areas and demonstration practices. If we are going to attempt the early treatment or prevention of disease (even in the modest ways dictated by our present knowledge) these attempts must be well organised and documented. Ideally, they should take place in the new General Practice Research and Teaching Units—a joint effort between universities, local authorities and general practice with, if possible, the Ministries showing an interest.

Fourth in this brief list of practical implications is the need for a detailed study of the economics of the kind of medical care that we have been talking about. We must know the costs and benefits in the widest of terms. For example, we must know how many man- or woman-years (if any) we save by screening the population in the ways that we have talked about. The economic implications are vast and it is sometimes too readily assumed (particularly by responsible civil servants impressed by the high price of screening) that a cost–benefit analysis would show a deficit.

Next, is a plea to face the fact of the lack of interest of the majority of general practitioners in the kind of work we have been talking about. We shall give our visitors from abroad a completely wrong idea of British general practice if we imply that doctors in this country are keen on health surveillance. The interest is growing, but there are so few answers to our questions that it will be a long time before our family doctors are convinced that family medicine involves treatment prior to illness. It will take even longer to translate these ideas into practice. Once more, of course, the need is for hard facts, and to provide them is a research problem.

Finally, I want to attack a fashionable nihilism which is prevalent among my academic colleagues whenever the subject of health maintenance is discussed. They say (and some have said it today) that the problem is too difficult. However, the changing pattern of disease in this country (and in most other highly-developed countries) demands that something be done. At this moment there is much evidence to support the hypothesis that the early diagnosis of some diseases and the early recognition of vulnerability will lead to treatment which will, in fact, assist in the promotion of the health of the population. It may indeed be difficult, but it is high time that more of the necessary research was started.

DISCUSSION

Dr R. Smith: I think we tend to feel that the problem of doing anything of a sufficiently dramatic nature in general practice presents such enormous problems that we must continue to make progress by nibbling here and there, by calling upon the few good, energetic general practitioners who make themselves available to take part in these exercises. We feel that to learn from these is the only way immediately open to us. I would like to point out that since 1948 in this country, twenty completely new communities have been created—twenty new towns have been built. It is very sad indeed that this wonderful opportunity was not grasped at an early enough stage for these areas at least to be used as field experiments for new types of development, with controlled observations of the results. However, it is not too late to start and there are, I am glad to say, still opportunities ahead for looking, initially in theory, at the type of community-based medical services which an entirely new community should require. These exercises are extremely difficult to launch and require a tremendous amount of preparation, but the towns themselves appear very slowly indeed. I am very glad to know that in Scotland this opportunity is not being missed. In the two new towns at present being constructed in the south there is evidence, too, that the opportunity will not be missed. In these new towns there is no established practice yet, and consequently no problem of disturbing an existing pattern. I would hope that in these developments all medical and related social and welfare agencies become involved from the start, because it is no use talking about the future of general practice in isolation. If we are thinking of comprehensive medical care, we have to go hand in hand with the regional board, the local authority, and the executive council, to grasp these opportunities—and they are waiting to be grasped. Where approaches have been made recently they have been most encouraging for the start to these schemes.

From what one can gather, not only new towns are involved. Many provincial cities have very large expansion programmes—several of these are going to expand easily by 50 per cent of their total size within the next ten to fifteen years. We have to think in this period of time of the sort of advances which Professor Backett was referring to.

Dr R. F. L. Logan: Following on that, and without being nihilistic about it and merely reporting a still-birth, you have in fact to bring three groups of people together. These three groups have got to be able to talk and have a common aim. Without a threat from outside to bind them together, this is asking an awful lot in any kind of situation. I can only see therefore, that the threat has got to become more apparent to general practitioners, to the hospitals and to the public health authorities. Let us face it, the universities have not done anything about it either. To look for any one of these groups to take the lead is unreal because the situation in this sense is not for one of them to take the lead. Therefore, all I can see is a dialogue going on, as we are having today between the interested parties. We must expect more and more dialogues of this nature, and a dissemination of this within the profession. So far society has accepted us as a profession; but if we do not take on these things, the shape of disease is going to change so fast that the profession will fail and, if so, society will probably become impatient and look elsewhere for community care. This is the kind of issue we are up against. Those of us here are already converted. It usually happens at this kind of stage. If we are going to think how we can take advantage of the particular opportunities we have in the new towns, leaving it just to goodwill will not be enough.

Dr J. Fry: I would like to make a point following Dr Logan's train of thought, because I think if we leave here today without trying to go on to the next step we will have lost an important opportunity. Really what we ought to do as a result of this is to see how the converted can spread this Gospel. We are not ready yet to jump into the whole mass of this on a nation-wide scale. I think, as the next stage, a series of experimental projects, based on the work of the converted, would be useful. To try to co-ordinate this I think we need some group of those who

are here today to plan and continue this thinking. Also perhaps—as Dr Schwarz mentioned to me—we really need an information centre to collect details of the studies that are going on so that they are not being repeated.

Dr J. M. G. Wilson: I have tried to think about the demonstration area type of approach. It is very interesting, but how does one get a control study? If you try and apply this type of early diagnosis, it foxes me how you can evaluate the benefit of what you are doing. I certainly tried as far as I could to think of some kind of controlled trial, but it is rather complicated because one is always dealing with things that need to be treated. This is different, of course, from the type of epidemiological surveys which are already going on. I did not mention one this morning—early mental illness. I think that despite the difficulties we are going to try and get something going on this. Again, I do not think there is any evidence yet whether seeking out unreported early mental illness can affect its prognosis. It is something we ought to know.

Dr M. F. Collen: I have been greatly impressed by all the presentations. I very humbly want to point out that any comments I make are based only on our experience. I have learned that what may apply to one area may not apply to the other. One of the things I would like to emphasise, which appears to apply here, is that our main problem is the matter of physician time. Physician time is our most valuable resource, so that every cent possible we try to shift routine repetitive procedures from the physician onto less costly personnel. However, this is a compromise in that ancillary personnel cost less, but often they are also lower quality. Thus we have to go back to adequate instrumentation and technology to supervise and restore some of that quality control which we have lost. Both of these steps, interestingly enough, will tend to lower costs. Transferring routine procedures to ancillary personnel will lower cost, but because of lower quality you have to hasten on to add control instruments. The resulting automation lowers cost by being able to produce more in less time. The combination of personnel plus technology will end up overall with lower cost, while still maintaining quality.

There is another thing we have learnt. When we discuss our programme, new technology, or new computers, the first reaction is one of scepticism, sometimes downright hostility. However, as physicians who work with a programme with its instruments and technology get to know it better, they learn what a useful tool it is and you cannot take it away from them. What worries the practising physician is that we are giving him so much information. Every step in medicine has been the same. Imagine when the microscope was invented, it must have had the same reaction. The computer will extend our mental vision the same as the microscope extended optical knowledge. We will meet the challenge, I am sure. Will the computer replace the physician? That is a question that very often comes up. The answer is no, it will be a tool to help him practise better medicine.

The last point I want to make, is that within our own programme the approach is very flexible. We have seven hospitals in the San Francisco area and we tailor the programme to meet the interests of the doctors and the size of the population in relation to the centre. However one can introduce a programme with as low a cost as three dollars a patient.

Professor G. Jungner: The scheme I told you about was a very simple one in respect of one problem that worries you quite a lot—the borderline problem. We had a very simple solution of putting very high cut-off points. Therefore we were fairly sure if we sent a patient to see the doctor he would find something. I am not at all sure that our method was right, but it was done under the assumption that all health screening projects should be repeated periodically. Also in that connection, I would like to remind you that our scheme is intended to be a service for any general practitioner in the region so that the results are just reported to the general practitioners. It is more or less up to him to decide if he knows the patient well enough. For Britain, it seems to me as an outsider that there is a very bad need for the general practitioner to get more facilities. But also I think there is something missing in co-operation. If anything like this had been discussed in Sweden, we would certainly have found that the general practitioners had come together and decided what they very strongly would wish and ask for, and they would have got it. There is also another question of the co-operation between our general practitioners and our hospital doctors. Our system is very different. Our trend in Sweden is to establish a routine in the hospital that actually is meant to fit the general practitioners' need also. We, in hospitals, would like to have as much information about the patient as soon as possible before he is entered for admission to the hospital and also in the field of preventive medicine before the patient actually gets sick. We are trying also, by locating the general practitioner's office close to the hospital, to get a direct connection so that the specialist in the hospital can be used very much more than today for giving advice. We feel that this is very important. I would think that this might be of some interest to you because I think very definitely that co-operation is of very great importance and it will be more important in the future.

Dr R. H. L. Cohen: I want to say how keen we are that there should be an expansion in epidemiological research and more frequent setting up of the kind of pilot experiment for which Professor Backett is asking. We are, of course, very anxious that services should be increased or new services introduced as needed and in the best possible way and also that they should not be introduced until there is good evidence they will do more good than harm. We are very conscious that pressures are apt to build up for immediate action but when we look round we find none of the needed research has been done. The people concerned have been too busy with other things. We would like to make a plea for more of this sort of work and to support Dr Fry's suggestion for a study group.

Dr C. L. Sharp: I got interested in this research approach in 1958. At the moment we have a study on the glaucoma programme. We are in the process of setting up one on the needs of children by surveying the child population with Professor Tizard. With regard to the need for demonstration areas, I did in fact go forward with this idea because north Bedfordshire is fairly stable, reasonably accessible to London and can be compared with south Bedfordshire based mainly on Luton. It would therefore be a good study area. Our proposals were perhaps rather large. We were going to tackle multiphasic screening programmes and evaluating significant

borderline findings and trying to find whether normal values could be defined by referring to a distribution curve. We wanted to have this as a study area, with its pure research side, developing new indices for making inter-area comparisons of the quality of medical care possible. Comparing infant mortality rate between one area and another, for example, is a waste of time, unless you know social class structure and other features of the areas. All that side could come in on a comprehensive study. We all thought the problem of reorganisation of medical practice should be tackled in the sense that we ought to put a health team in the field instead of having a lot of people with pretty tenuous connections working rather individually. We should give them full support, and the apparatus they need in perhaps five centres. They cannot do a decent job unless they have this. I am pleased to see there is growing support for these concepts. I hope the study group can be formed and it will drive forward.

Professor A. L. Cochrane: I would like to say publicly how much pleasure I have had from my close association with the Ministry. Drs Cohen, Wilson and Cheeseman take much more interest in my work than the MRC does. I rely on them a great deal for morale and everything else. I think the suggestion that patients stay apart from research is wrong. I feel that in a meeting like this, which I have enjoyed very much, discussing the work of general practice it is quite ridiculous to have this highly selective group of general practitioners. If anyone wants another meeting I will produce a group of general practitioners negatively selective the other way. I think it might give us a little more information and keep our feet more on the ground and show what we can actually expect from general practitioners in the mass.

Dr C. M. Fletcher: It seems to me that all my young registrar colleagues would be delighted to work in the Permanente sort of institute among a healthy population, looking into figures and seeing their significance. I think part of the weakness of epidemiology so far has been the crude tools we have had to use. Here is Dr Collen with a whole mass of technical equipment, yet in a position to do epidemiology. If Dr Cohen could persuade the Minister to set up such a unit, he could recruit the cream of young British medicine into this. There is great value in this sort of work. One great handicap in hospital is that for nearly all our patients we have no previous information—except the old chronics who have been in and out of hospital for years. It is not only in preventive medicine I think we need surveillance, but also from the point of view of the sort of medicine I practise.

Dr J. Williamson: There is one philosophical point I missed before. I think I must make good the defect. I think one of my diagnoses of the malaise of general practice today is the general practitioner does not know what he is supposed to do and suspects strongly what he is allowed to do is not terribly important. Also, as we have heard in connection with what Dr Collen is doing, the public is much enchanted and bemused by the machine. It is a very serious thing. The patient does not think the doctor matters a heap of beans any more; that is what it boils down to. The trouble is a lot of general practitioners are beginning to think the same thing. We are in danger of becoming slaves of the machine. I would be the last person to say we should not have multiphasics. But I think we have got to be very careful we do not get carried away with machinery and lose sight of the basic concept of medicine. Dr Collen reassured us that he himself is in no danger of being carried away. The popular conception of medicine today is the American-type Ben Casey and Dr Kildare. Comparing these two programmes with our own Dr Finlay, there is no doubt who is the better doctor. I see this in geriatric practice. I am quite sure the general practitioner should make the diagnosis in the great majority of cases. He can make an assessment just as good as mine; but he has not got the confidence to examine the patient, does not know where to start, because he has not got a whole range of tests and machinery at his elbow and he is bound to fail and someone will sneer at him. This is the basic malaise I see in general practice as far as it affects old age.

Dr R. J. Donaldson: I feel that what we have in fact done in Rotherham is probably a very pale imitation of what the Americans are trying to do. I feel that as far as general practice is concerned anyhow not all general practitioners are as bad as they are painted. I feel many of them do very, very good work under quite difficult conditions and it may be that we in the local authority could do very much more to help them. There has been some talk about cocktail parties. There is no doubt it is a question of personal relationship. One builds up a fund of goodwill over a number of years, and one draws on it at certain times. I do not feel quite as despondent about general practice as some people here do.

We have had a screening clinic in Rotherham for about a week. We worked out we could get through about 600 people a week. We have had over 4000 and had to turn them away as we could not cope. This quite clearly shows there is something about it which the public like. So far as the general practitioners are concerned, they were very happy about it and liked it very much. All this talk about who does what I think has no importance. The work is being done for the general practitioner by someone else. If he wants to do it himself, fair enough. But it is not so easy for him to do it. It is in the end the general practitioner who makes the final decision as to what is going to happen.

On a philosophical point, I feel that the standard of medicine in this country depends on the standard of the general practice. It may be very tempting for us sometimes to bypass the general practitioners to get a quick answer. This, I think, in the long-term can only reduce standard in general practice and by doing so the standard of medicine.

Dr H. Keen: I have a strong feeling that events will push us along to a very large extent. One begins perhaps to see this happening as far as cytology services are concerned; one hears of parochial bodies of women saying something must be done. We will be taken by the scruff of the neck and made to do something. One does not at the moment see this in relation to diabetes, I think for the fairly good reason that we have not yet made a terribly good case that we are able to reduce disability or prolong life by early diagnosis. We will jolly soon be pushed along and somehow we will have to construct some sort of organisation to cope. In a way, the dialogue now going on is in preparation for the situation we will have to meet when we are forced by public opinion of one sort or another to do something.

Dr E. D. Acheson: May I say that my name was taken in vain when it was said possibly record linkage would help these sort of things! I would not like it to be thought this was in any way a panacea for the sort of problems we have mentioned today. However, I do think a system of linked records would help the sort of things we have spoken of today in two ways. One is in trying to define some groups of population who are particularly vulnerable; in many conditions we are still very deficient on that point. The second is to assist with the follow-up after you have screened somebody. It does not in any way replace carefully-planned ad hoc studies, but I think if we could get a system of records in this country a little bit more up to date using modern methods of data processing many of the things we have been talking about would be very much simpler. I would support completely and strongly Dr Hodgkin. I think that one of the great difficulties of the general practitioner is that he has virtually impossible records to work with. This is a matter of national policy. It is not his fault and there is tremendous opportunity to tackle this problem both in the individual surgery and at executive council level, and at national level in view of the recent developments in data processing. I think this is a matter of the greatest importance.

Closing comments

DR J. H. F. BROTHERSTON

WHEN I was coming to, about an hour after breakfast, I was asked if I would mind summing up; all I would have to do would be to scintillate for about half an hour or so and bring out all the really salient points. Of course, if I had known I was going to sum up, I would have prepared my notes before I came to the meeting, undistracted by the facts But I did not have the advantage either of the warning or the knowledge to do the job. At least it can be said, I suppose, that I started with a fresh mind this morning.

First, I would like to underline the major change that this kind of thinking is in our strategy, this movement from an 'on demand' service to seeking out those who need care. It is, of course, true that there have been traditional practices of this kind for many years, for example in maternity and child welfare, school health services, the armed forces, and so on. These by and large have been regarded by the profession as a rather off-beat kind of activity in which they were not very interested. The dramatic change is, I think, that we see now this thinking in clinical medicine itself. This really, as I say, seems to me a profound strategic change involving profound psychological changes in ourselves as a profession. It is certainly not a change that is going to be accomplished without time, or without a great deal of trial and error.

Why is there this movement? Why is there this urgent need for a change of strategy of this kind? Let us dismiss right away the bad reasons which applied sometimes in the past to screening campaigns. There is, where you can do nothing else, a certain kind of feeling of earning your corn, a feeling of personal satisfaction, if you like, to be gained by activity for its own sake. There have, I think, in the past been elements of this kind in certain mass campaigns in certain fields. The sheer volume of ballyhoo, as it were, has given satisfaction to one and all, including the general public, without anybody really pausing to consider whether the time, the effort, and the energy paid off. One is a little suspicious still of the emphasis which has been put several times at this meeting on the popularity of this kind of activity. Of course, the public are anxious and will respond in certain circumstances eagerly to chromium-plated activity. It does not follow necessarily, however, that the activity is rewarding just because of that. No. We can dismiss the bad reasons. I think they are out of date. That kind of screening campaign has been debunked.

Apart from this, there is always a scientific curiosity, a desire for further epidemiological study of the natural history of disease, and a humanitarian urge to detect illness earlier, and to help sooner. I think probably that underneath it is the social economics of the situation

which is pressing us here. This is a point which has been referred to a number of times. I think it is seen on a small scale explicitly in the Permanente Scheme. I believe that it is in fact accepted explicitly in Swedish policy where they have in recent years been undertaking, it seems to me, a rigorous process of thinking about where they are going in terms of health care policy. Accepting the difficulty, the challenge of a future in which manpower—skilled manpower particularly—will always be limited, we face a mounting social demand for services including medical services. Specifically an ageing population inevitably carries with it a considerably greater number of units of demand, as it were, than a younger population. In particular, as I understand it, the Swedish strategy has been to mount and to finance attempts to discover how the degenerative disease process might be attacked at earlier and earlier stages and how too by follow-up and effective rehabilitation the condition when discovered can more effectively be assisted and the disability limited. This is the logic, I think, of the social economics; the case is certainly made out that we must attempt to discover what pay-off we can get in this attack on our problems of degenerative disease by such methods.

It is clear that today we have been, in a sense, talking about a number of different things which are related to some extent in time, in series. For example, the term 'screening' does not inevitably have to be linked to the concept of detection of pre-symptomatic disease. Screening can, of course, be used for picking up and controlling declared diseases as well as for a much more difficult problem of detection of pre-symptomatic disease. I just make this obvious point so that we remember that there is probably a considerable potential immediate pay-off from screening in certain fields of declared disease; we can benefit from this while we wait for the much more difficult dividends to emerge from the know-how which we are trying to gather in the pursuit of pre-symptomatic disease. This latter kind of pursuit is quite clearly a research exercise needing the most careful controls, and needing the most careful standardisation of techniques. The general practitioner's primary role is probably to stimulate public response to such investigations at the grass roots. He must also play that very special part of 'continuity man' afterwards to ensure the patient gets his treatment.

Screening for recognised pathology is a different matter and in many ways primarily an organisational problem. Sometimes it is obviously appropriate to do it on a community scale, but often enough it is right for the general practitioner to do this, if you like, for his own parish or in a group practice for a group of parishes. I just make the point here almost as an aside that we have recognised in our discussion today that screening is not necessarily to be thought of only in terms of whole populations. Indeed, it may be most effective in its pay-off when applied to 'high risk' groups. It may, of course, be necessary to have total community studies first of all to delineate what these 'high risk' groups are. Sometimes, I think, we would find that there are situations where to go for the whole community is a dangerous dispersal of resources and it is better to concentrate the resources we have on 'high risk' vulnerable groups. For example, at the present time, it can at least be argued that our traditional screening service in the maternity and child welfare field is dispersing its resources over many children who for a variety of reasons no longer really require it. It has not sufficient time left to get down thoroughly to the particularly vulnerable children who almost by definition do not make use of the services. Often enough, although by no means always, of course, 'high risk' will equal socially inept. Those are the hardest to get at, the lingering remnant of the situation, like the rabbits in the middle of the cornfield at harvest time, where most of the problems often enough will lie. They are especially difficult to reach without the general practitioner playing his part in the process.

We have been pretty clear, I think, in our discussion that our present organisation in the health service does not really very completely lend itself to the kind of exercise which we have been discussing today, which we feel is important for the future. It is scarcely surprising. I do not suppose this kind of exercise was particularly being thought about when the organisational structure was arranged. I think this points up an important fact. We started in 1948 with tremendous assets from our National Health Service and still have them in our possibilities for providing health services for the community. But perhaps there is a risk that we may dissipate some of these advantages which we created for ourselves if we are not willing to re-examine some of our structure and some of our assumptions. It is clear that all three elements of the health service, as we have worked it out, are essential to the strategy for the kind of exercise we have been discussing. The technology and expertise of the hospital service is essential; and the general practice grass roots contact and continuity are essential. I think there is a third element too, which is essential. That is the kind of strategic command post element which could, and I believe should, be provided by the Medical Officer of Health. At least to encourage us in our perhaps occasional gloom about this kind of thing, let us appreciate that there are certain technological developments which have taken place which facilitate the meshing together of different events: and the co-ordination of people into one team in a way that was never possible in the past.

I have in mind specifically here, the simple but very significant exercise that Dr Galloway, Medical Officer of West Sussex, has been carrying out. He has demonstrated by using a computer as the memory and 'prompter' of the system that you can control a whole series of clinics and general practitioners in an immunisation programme very happily and effectively. He has controlled, too, the parents who are also partners in the exercise. He has had well nigh a 100 per cent response as a result. I think this simple exercise could be applied to much more complicated problems and certainly should be applied to many kinds of established screening activity. In the meantime, we have devised—and I think in a sense we have all been party to this—barriers which make it difficult, to say the least, for the three parts of our service to mesh together. Specifically we have made it difficult to give the general practitioner the set-up he needs to play his part in the exercise. This is a challenge and, it seems to me, we have to answer this challenge.

How can we make things mesh? In particular, how can we assist the general practitioner to be able to play the part which, in our kind of concept of a health service, only he could play? Clearly, theoretically, our general

practice gives assets of access and continuity. To some extent in the United States and in Sweden they are doing what they are doing because they do not have in the same sense as we have a general practitioner service. They do not have a doctor of first contact in the sense that we have. But if we have had any danger of complacency about our assets, this has surely been shot to pieces by some of the discussion today. For example, the evidence of the detection rates by survey suggested the extent to which comparatively simple problems are uncontrolled. For example, the evidence of the failure of continuity of care mentioned by Professor Cochrane, and emerging also in Dr Keen's tables from the Bedford diabetes study. If general practice is going to play its part, what changes are needed in organisation, premises, equipment, records, ancillary help, or incentives? This is, I think, really for the profession to examine. It is for the profession to say what is the way ahead. We can always blame the politicians or other people for our problems but fundamentally I believe this is a matter of professional organisation and a matter for professional thinking and decision.

We have had a gentle rebuke from one of our visitors today, Dr Jungner, about our failure of co-operation. I think that in itself was something that might send us all away thinking.

Finally, it is clear, I think, that arising from this discussion, we must increase our activity in screening for early detection as a controlled exercise in scientific epidemiology. We must do this because we cannot afford not to explore the possibilities of this method of attack on degenerative disease. We must do it, as has been mentioned, because if we do not pressure will be put on us to do it. We have been feeling some of these pressures recently, for example, in the field of cervical cytology. There is a danger that if we do not keep ahead in the field we may be pressured into misdirected action. As a subordinate but nevertheless useful reason, we must do it also because the kind of information which emerges acts as a kind of control and check on our normal systems. Heaven knows, we badly need all the checks and controls that we can get. We need it also because it is an important educational exercise for us all, for general practice, for the hospital, for the medical officer, for the whole professional team. I told Dr Keen this morning that I thought the really staggering thing about Bedford was not what they had found but the fact that it had happened at all. This really is a most encouraging and significant demonstration of change in itself.

Specifically, it seems clear, I am sure, to all of us that if general practitioners are to move into action effectively in this field, both in terms of work and in terms of pressure for the resources they need, they must think a great deal about 'The What' and 'The How' and the 'With What'. As a means to doing this I am sure we all wish the maximum effect to the working party proposed by Dr Fry.

The Chairman then thanked all concerned in producing such a rewarding day.

APPENDIX I

Chemical Health Screening

Paper by GUNNAR JUNGNER MD and
INGMAR JUNGNER MD

CHEMICAL health screening implies that one ascertains, by means of chemical analyses of blood and urine samples, whether any signs of pathologic changes exist or whether the patient is, with some degree of probability, in good health. Most often, the patient notices the onset of a disease by its association with fever, pain, bleeding, paralysis or other such manifestations. When this occurs, the symptoms are a better indication than any blood tests, and no health screening is needed. But many diseases start insidiously, and produce no distinct signs at an early stage. Some of the chemical changes produced in the organism by disease can, however, be observed in the blood, and in this way give chemical symptoms. The tests chosen for chemical health screening are intended to detect diseases which can otherwise easily be overlooked.

Chemical health screening can suffice for all and reach all

Chemical health screening can be done wherever a blood sample can be taken. This implies that highly specialised diagnostic techniques can be available to all, and not only to those who live near hospital centers. In contrast to, e.g. roentgenologic examination, blood sampling for chemical health screening can be repeated as often as the need arises. The sampling is done quickly, and the patient loses little time. From the automated laboratory instruments one can then, directly and rapidly, through electronic analysis of the data, follow the investigation of transient or lasting variations in the state of health. In certain cases, chemical health screening gives valuable information over and above that obtained by other forms of health screening, and it covers most of the important groups of diseases that can be detected in a pre-clinical stage.

Chemical laboratory diagnosis has made extremely rapid advances in recent years, and can now offer great diagnostic possibilities, not only in sick care but also in health care. The decisive importance of laboratory tests for clinical diagnosis, as well as the constantly increasing number of chemical methods, have made great demands on hospital laboratories. As long as the situation with respect to treatment of sick persons was so strained as hitherto, the possibilities have been lacking for utilizing, at reasonable cost, refined chemical tests for screening of healthy persons.

Automation gives a sufficiently large analytic capacity

The laboratory automation which, particularly in the USA, has been achieved in recent years places the question of laboratory health screening in a completely new position. As clinical chemists we have, for more than ten years, been interested in increasing the capacity

and reducing the cost of clinical analytic work by mechanisation, to enable chemical methods to be used for health screening as well. Initially, this could be done only in a very limited field, i.e., for chemical diagnosis of certain special forms of cancer, such as phaeochromocytoma and carcinoid. On the other hand, until lately it has been impossible—both technically and financially—to realise such a comprehensive analytic project as that required for general health screening, since this necessitates making several elaborate analyses on each blood sample.

However, by utilising the latest technical advances, as well as our experience from American laboratories concentrating on automation, we have now suggested a method for large-scale health screening, which will be tested in the Swedish county of Värmland.

Simple laboratory tests are a routine part of an ordinary medical examination

In connection with a medical examination, it is customary to make certain laboratory tests which, as a rule, are confined to determinations of the haemoglobin and erythrocyte sedimentation rate (ESR) and tests for protein and sugar in the urine. If, in addition, the electrocardiogram (ECG) is recorded or, e.g. miniature photofluorography of the chest is done, the examination is generally regarded to fulfill fairly high demands for thoroughness.

There has, however, been a distinct tendency during the past few decades for laboratory tests to be increasingly used as a basis for definitely *establishing the diagnoses* and illucidating presumptions that have emerged from the history and physical examination. The development of laboratory diagnosis has therefore been focused on finding methods that are as specific as possible. This attitude is common to the diversified forms of investigation that can be offered by bacteriologic, clinical-physiologic, clinical-chemical, histologic, roentgenologic and serologic laboratories.

It is, however, scarcely fortuitous that chemical and serologic investigations have long had a unique position, in that certain such tests have been used with the general purpose of ruling out the existence of various conditions. Among these tests are those for protein and glucose in the urine, as well as the ESR and Wassermann reaction. Although the distinction from extensive laboratory health screening might appear diffuse, the practical procedure has fairly sharply delimited such general investigations from those motivated by clinical suspicions. The reason is the high cost of refined laboratory analyses. Hospital laboratories have found it exceedingly difficult to meet the demands both for a steadily rising number of analyses and for improved techniques with greater diagnostic value. One has therefore been forced to sift and greatly limit the number of tests.

The essentially new feature which enables chemical health screening to be realised is, therefore, laboratory automation. It was not until several methods had been automated that the possibilities were created for making, at relatively low cost, the many chemical analyses for each blood sample that are required today to give an adequate survey and check-up of the function of the various organs in the body. In view of the high capacity, it is also possible to repeat the tests as desired, and—under control of a physician—to follow the state of health at closer intervals than is otherwise practicable.

Which analyses are most suitable for chemical health screening?

There can scarcely be any doubt that, by means of modern chemical blood analyses, one is in a position to follow and characterise the state of health. It must, however, be borne in mind that the choice of analyses for chemical health screening takes place according to other principles than in care of the sick. For hospital purposes, as well as in special industrial health screening, the analyses must be as specific as possible, and of maximum diagnostic value. In general health screening, it is desirable to use, instead, analytic methods that are sensitive indicators of general and common pathologic changes in the organism. The object of health screening is not, in fact, to diagnose pathologic conditions which have already given rise to symptoms. Its main object is, on the contrary, to detect latent pathologic changes, or to disclose diseases of which the patient is unaware. Chemical health screening thus has a twofold purpose. One is to diminish the patient's anxiety as to the possible existence of disease. The other, somatic-medical purpose, is only to obtain objective grounds for selecting those patients who need a more thorough and costly investigation.

To achieve early diagnosis with the help of chemical analyses, it is essential to choose a suitable combination of tests. In certain cases, this may lead to some overlapping, so that several analyses reflect the same type of pathologic change. The pattern formed by the results enables even faint tendencies to be distinguished with some certainty. This is borne out by our experience of the frequency distribution of slight chemical changes associated with an epidemic accumulation of, e.g., liver damage.

A varying degree of sensitivity and specificity can be attributed to the chemical tests, not only according to different bases of evaluation, but also according to the technical procedure. An extremely high ESR can, for example, lead to suspicions of such a special lesion as a hypernephroma, whereas a slight rise gives no idea of the cause. For certain analyses, different procedures can be chosen, so that one obtains either relatively great organ-specificity but lower sensitivity, or a greater ability to detect slight chemical changes, of which the cause may, however, be highly variable. An example is the thymol turbidity test.

By decreasing the possibilities of an exact diagnosis, and using instead relatively generally informative tests, one obtains such a survey of pathologic changes that it merits the name of *chemical health screening*.

The analyses which can now be offered, and which give essential information for health screening, are the following:

1. Serum lipids, e.g. cholesterol, β-lipoprotein.
2. GOT (glutamic oxalacetic transaminase)
3. GPT (glutamic pyruvic transaminase)
4. Serum iron
5. Colloid-stability reactions, e.g. thymol turbidity, Kunkel's test
6. RA test (rheumatoid arthritis factor)*
7. Protein-bound carbohydrate, e.g. hexose, sialic acid.

These analyses deserve some brief comments.

*Replaced in the Värmland project by serum creatinine as a renal function test.

Serum lipids attract great medical interest in these days. Particularly if one has the opportunity of following repeated tests, the cholesterol and ß-lipoprotein levels are known to give a good idea of the patient's general constitution, as well as his liability to arteriosclerosis and cardiovascular accidents as a future cause of death. Obviously, the analytic results usually correspond to the physician's impression of the patient, but they also provide an objective measure that can be followed throughout the years. Moreover, tendencies may be apparent long before the patient shows any clinical symptoms.

GOT and *GPT* are representative of enzyme activities in serum which are sensitive tests, and also of great diagnostic value. These enzyme tests are not utilised in the same way in health screening as in the hospital, where more attention is focused on their differential-diagnostic role, e.g. to distinguish between myocardial infarction and angina pectoris, or between various liver and muscle diseases. In health screening, one utilises instead the great sensitivity of the tests, and the fact that determinations of GOT and GPT support and complement each other. If both show a tendency to a rise, separately too small to be significant, the possibility increases of the existence of some pathologic disturbance. Most often, it is a question of slight liver damage, which in many cases is secondary. A tendency to raised GPT but normal GOT may persist for a long time after an illness involving the liver. Thorough penetration of the history is then indicated. Finally, if the GOT activity is slightly above the normal range without a corresponding tendency in GPT, this is an unspecific finding, which may have a commonplace explanation. Usually, it is caused by inflammatory changes, such as necrosis, and a comparison with different protein-bound carbohydrates will then give guidance.

Our experience hitherto in examination of blood donors, as well as in screening of clinically healthy persons, has given much evidence that with the use of such a system of analyses—not least serum transaminase determinations—one obtains grounds for the existence of pathologic changes before the appearance of clinical symptoms and definitely pathologic values.

Serum iron. Its importance in the diagnosis of iron deficiency, just as of pernicious anaemia, fully motivates use of this determination in health screening. It can be pointed out that evaluation of a single serum iron value is more reliable in combination with other analyses. This is because the serum iron is affected by such processes as infection. The combination with other screening tests then outweighs much of the uncertainty which, in ordinary sick care, often obliges the test to be repeated.

Colloid-stability reactions are routinely included in health screening in other countries. Of the several thousand existing procedures, which by no means run parallel in different conditions, we have decided on the thymol turbidity test in a more sensitive version than that commonly used in our hospitals, as well as Kunkel's test (zinc sulphate reaction). As far as Gros's titration—so common abroad—is concerned, we are not convinced that it increases the reliability.

RA-test. This is intended to demonstrate incipient or past rheumatoid arthritis. The reaction is of particular interest, since the rheumatic diseases play such a large rôle from the prognostic point of view. It depends on a rheumatoid factor, whose exact nature is unknown, and has been introduced to detect and diagnose the disease at an early stage. This type of health screening analysis is important from the technical aspect, as it can be hoped that similar tests for other systemic diseases will be found, and subsequently be incorporated in chemical health screening.

An increase in *protein-bound carbohydrate* is a sensitive but highly unspecific measure of various inflammatory changes. The value of the test lies in its great sensitivity, but the result can seldom be judged other than in association with additional tests and the case history. In some places, such analyses are used as so-called cancer reactions, since malignancy may be one cause of the raised values. In this group of analyses, perhaps more than in other tests, pathologic values without any acceptable explanation imply that repeated analyses should be made after one or several weeks.

It cannot be judged with certainty which tests in the respective groups will prove to be of the greatest value. Presumably, new methods will continue to be elaborated, and several enzymic and serologic tests are, in fact, about to be automated. Our intention is not to arrest development by keeping strictly to a fixed programme, but the tests described in the foregoing are those available at the moment.

Practical procedure

The analyses can be made on serum samples of 3–4 ml, but in view of the prospects of new methods, 5 ml of serum is a suitable standard quantity. The samples are taken in acid-washed tubes and stored in special disposable plastic tubes. The laboratory report includes an evaluation of the analytic results, as a guide to the clinical interpretation.

Value of general, comprehensive chemical health screening to the individual

A great advantage of chemical health screening is that many analyses are made on each blood sample, and that new samples can easily be taken for continued control. By combining a sufficient number of analyses of each sample, such comprehensive screening is actually achieved that—as far as can be judged—some other investigations may be of limited value. Since the samples are taken in the home district and are sent to the laboratory for analysis, chemical health screening is relatively easy to carry out in practice. It is also reasonable to presume that the public will show rapidly increasing interest. In this connection, one can cite sundry experience even of unpleasant examinations with a greatly limited scope, such as a systematic check for uterine cancer, of which the public of the USA has availed itself on a large scale. The advantage is evident of obtaining complete health screening through one's own doctor in the home district, and by means of comparatively simple blood tests.

It is questionable whether any other form of health screening is practicable on such a large scale as that permitted by laboratory studies, i.e., many million investigations per year. One of the merits of health screening is that it provides a survey of pathologic symptoms in different population groups, which can give information about the causes, as well as about the effectivity of measures to counteract them.

So-called cancer reactions

In many countries, health screening is done with the specific aim of detecting malignant tumours, which implies that several laboratory tests of a special nature are used. As the question of chemical health screening cannot completely avoid taking a stand with respect to cancer diagnosis, this matter must be touched on. It is beyond the scope of this paper to enter into the possibilities of the laboratory methods used. Purely in general, however, it can be said that no methods exist today which are generally applicable and sufficiently reliable to be denoted as cancer reactions. Certain special tumours can be demonstrated by specific chemical methods, but these can be regarded as exceptions and, statistically, lack importance in relation to the large number of tumours.

However, cancer—like other neoplasms—often produces certain unspecific changes in the blood or urine, and these unspecific changes may appear at an early stage. These sensitive methods thus have a drawback, in that it cannot be stated whether such chemical changes are, in fact, due to cancer. In most cases they are presumably caused by other, more or less serious illnesses. They differ with different tests, but inflammatory conditions, liver

damage and pregnancy are examples. If, on the other hand, such pathologic changes can be ruled out by other examinations and tests, the probability obviously increases that these unspecific methods will give an indication of which patients there may be reason to investigate further. These viewpoints, combined with medical examination and thorough penetration of the history, presumably explain why in certain quarters it has been possible to report favourable statistics also as regards the detection of tumours.

On this basis—which seems to reflect current opinion—it is reasonable to refrain from so-called chemical cancer diagnosis. It must nevertheless be admitted that, when choosing methods for demonstrating in as general a way as possible the existence of pathologic changes, one deals partly with analytic methods that are more or less closely related to those erroneously denoted as 'cancer reactions'. These consist of unspecific but highly sensitive reactions, such as certain protein-bound carbohydrates. From the point of view of health screening, the decisive factor is not whether a chemical change has arisen on the grounds of inflammation, liver damage or pregnancy, or whether it may possibly be due to cancer. The most important factor is to sift out these patients and recommend them for more detailed investigation. This implies that there may be relatively many 'false positive' reactions. However, according to the amount of trouble that is taken and rules out commonplace explanations, one can expect from 4 up to 10 per cent of comparatively unnecessary medical examinations to be made.

It must be emphasised that, in certain cases, the results of health screening should be confidential, and great caution observed when informing the patient about them. As early as 40–45 years of age, a large percentage of certain chemical changes will be pronounced and, on a long-term basis, will give guidance about the prognosis and increased probability of certain causes of death. The laboratory tests have been chosen to cover the large and more common groups of diseases. Patients who are otherwise in good general health, but show slight chemical blood changes, should naturally be informed with great cautiousness when control or more extensive investigation is advised.

Statistical analysis of the results

A medical material of the kind emerging from chemical health screening has a topical value which implies that it should be analysed statistically. In view of its extent, electronic data processing should be used, and the material collected in an appropriate form, such as punched tape. Certain grounds already exist which indicate that continuous following of the analytic results with statistical methods may be of definite interest. For example, the frequency distribution of the results of certain analyses during stated periods has changed in a way which seems to affect evaluation of the results, and comparison with normal values. It seems possible that one would, by this means, be able to follow the appearance of sub-clinical conditions of various kinds, probably virus infections, in a way that cannot be done otherwise.

For the statistical analyses, a careful case history is of paramount importance, to make the basic material as ample as possible. Physicians taking part in the health screening who wish to contribute would have the opportunity of access to the results, not only as a whole but also in the planning and application to their own cases. It can be predicted that it will be of value to the practising physician to be made aware of tendencies to disease, both in individuals and in the population of the territory in which he practises.

August, 1962

APPENDIX II

A Pilot Study on Mass Screening with Application of a Chemical Test Battery

The Health Screening Project in Värmland

Report by GUNNAR JUNGNER, MD and INGMAR JUNGNER, MD.

Background: For a long time, we have been working on a system of chemical analytic procedures on blood samples which would cover a variety of important diseases. Initially, it was intended to help practitioners in detecting diseases in a pre-clinical stage, and thereby reduce the risk of asymptomatic complications in a simple way. It was considered that ten chemical analyses would suffice, in addition to the simple laboratory tests that are usually done in the doctor's office, *i.e.*, haemoglobin determination, sedimentation rate, and urinary sugar and protein.

In order to make the laboratory work possible and economically feasible on a large scale, mechanisation and automation were necessary. The development of automatic analysers in recent years gave an important impetus to the improvements in the apparatus system, and afforded possibilities of getting a high capacity.

The choice of methods had to be based on general considerations and experience. The analytic system was tested on a small scale and seemed promising. Investigations during epidemics of hepatitis, mononucleosis, etc. showed variations, as might be expected, and indicated that it would be possible to disclose cases which are in a pre-clinical state.

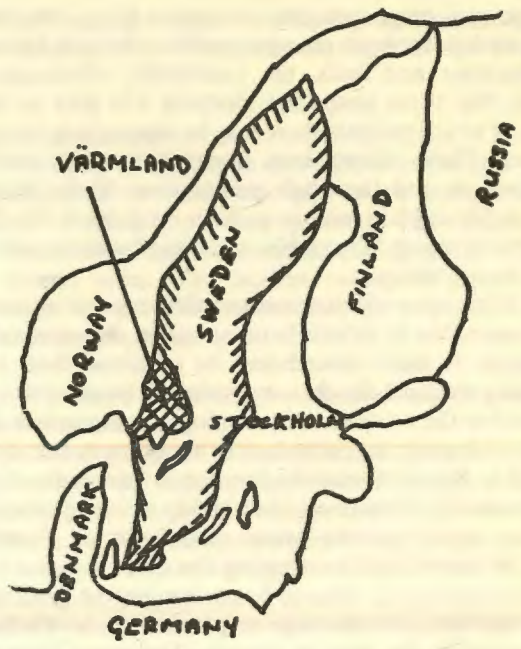
However, only very limited and scattered experience could be achieved until tests could be done on a larger group. When the possibilities of making broad laboratory investigations were reported to the Swedish National Board of Health in the fall of 1961, it was immediately decided to try the chemical test battery for chemical health screening.

In November of the same year, the National Board of Health suggested to the Government that a health screening project with the chemical analytic system should be carried out in association with the general mass photofluorography which it was decided to start in the county of Värmland in October 1962.

In the beginning of 1962, the Swedish Riksdag entrusted to the National Board of Health the task of testing this type of health screening on 100,000 people during a period of three years.

The examination district: Värmland is a county in the western part of Sweden and has nearly 300,000 inhabitants, *i.e.*, about 0·04 of the whole Swedish population. The county has vast forests surrounding agricultural areas, but there are also industrial centres exploiting the raw materials: wood and wood products, iron ore, etc. Värmland has seven towns, of which Karlstad is the biggest with about 40,000 inhabitants.

This means that the part of Sweden chosen is a rather distant region, where the population is spread over a



comparatively large area. For health screening investigations this is an unusual target, but offers many problems to be solved and is in many respects highly interesting.

Organisations: The project planning had to solve problems regarding the long distances between villages and had also to avoid overloading the hospitals and other medical facilities.

In principle the set-up was the following:

1. *A field group:* To the photofluorography unit (capable of 350 examinations a day) was added a blood-sample collecting group for 250 samples a day.
2. *A medical station* was organised as a semi-mobile unit, and connected to the nearest hospital with one or two specialists for clinical follow-up examinations. The capacity is 80–120 physical examinations per week.
3. *The laboratory* in Stockholm for automated blood analyses is run by Drs Gunnar and Ingmar Jungner on a contract with the National Board of Health. It is arranged to fit for the very special purpose of mass-analysis with a fixed analytic programme. The different analytic channels are connected to a unit also containing equipment for registration, digitising, print-out devices, as well as signal and alarm systems, etc. At the moment, the capacity is about 5000 analyses, *i.e.*, 400 patient samples per day.
4. *Head office:* within the National Board of Health in Stockholm, Ass. Prof. G. Malmström is leading the project in a special section of the Health Care Dept. Professor C. Wegelius is in charge of all photofluorography conducted by the National Board of Health. Medical advice is given by an expert committee.

Extent: All inhabitants ten years old or more in Värmland have been offered photofluorography (with frontal and lateral projections). From 25 years of age they are also offered the chemical health screening.

The persons get a questionnaire. At the examination, height and weight are registered, and also the time of

taking the sample and of the latest meal. The blood pressure is measured and a urine sample is analysed for the presence of sugar and protein. A blood sample is drawn, and is divided into a heparinised tube (for determination of haemoglobin and haematocrit) and a tube for preparation of serum. Each day's samples are sent to the laboratory by rail in insulated boxes, chilled by ice batteries. Disposable syringe needles (tested to be iron-free) are used. All tubes and stoppers are acid-washed and stored in plastic coverings.

The chemical health screening includes the following analyses, which are made automatically in the laboratory: *haemoglobin* and *haematocrit; serum iron* (to detect iron-deficiency conditions); *creatinine* (as a kidney function test); two enzyme tests: the *transaminases GOT and GPT* (for liver damage etc.); *thymol turbidity*, as well as *zinc sulphate test* for the gamma-globulin content; *beta-lipoprotein* and *cholesterol;* and, finally, *protein-bound hexoses* and *sialic acid* as non-specific inflammatory detection tests.

General aspects of the Värmland Project: The National Board of Health has for some time suggested systematic tests with health investigations. Many local communities and counties, as well as larger industries, have made small-scale attempts of various kinds. The biggest project has been the National Board of Health's general photofluorography programme with more than half a million examinations yearly.

In Sweden, as well as in other countries, the lack of trained medical personnel has hindered the progress in this field. The approach in Värmland can be regarded as *an extreme way of carrying out mass screening in a labour-saving way.*

The purpose of this kind of health screening is only to find objective reasons for advising people to see their doctor. The screening as such is, in fact, justified as a means of getting results with restricted resources. This approach does not imply that physical examination can be replaced or omitted in health examinations. The object is to prepare for the physical examination, and to limit it to the cases really needing medical care or further investigation.

In short, the Värmland project can be characterised as follows:

1. *The examination is made by an ambulant unit in the home district.* It is known from experience that voluntary examinations are gladly undergone, provided that they are easily available and that the time loss is not too great. This has been borne out by the public photofluorography service.
2. *Highly specialised examinations can be offered to everyone, even far from well-equipped medical centres.* Owing to automation, costly methods now sparingly available can be used on a large scale.
3. *The project is based on the fact that the technical evolution favours mass investigations.* The main advantage of automation is the increase in capacity. In the medical field this is more valuable in preventive medicine than in sick care. Because health screening is still more valuable if repeated periodically, there is a need of extremely high capacity.
4. *The screening procedures used are intended to detect asymptomatic diseases.* Health screening based on chemical and serologic tests offer greater possibilities than traditional screening methods to detect metabolic disorders and malfunctions. Most laboratory methods are intended to disclose very specific changes and symptoms in sickness. A battery of less specific tests, however, can be highly informative about the state of health.

The health screening has varied somewhat and the technique has improved, but the basic principles and set-up are unchanged.

Preliminary Results until September 1964

During the fall of 1962, health screening was carried out on about 8,000 persons. During 1963, the screening continued, and up to September 1964 some 65,000 persons have been examined. This report is based on the experience of about 3,200 follow-up examinations and from the laboratory results of about 60,000 persons.

During the period now to be reported on, the general health conditions have been favourable, as far as can be judged from the standpoint of infectious diseases.

An average 73 per cent of those offered health screening attended the first time they were summoned. The question arises whether this corresponds to a cross-section of the whole population. As far as the *age distribution* is concerned, Figure 1 shows that there is fairly close agreement between the distribution of those examined and all those offered health screening.

A certain systematic deviation can be seen in the higher age groups. The fact that elderly people attend in a lower degree may be explained by the larger number being already under medical care. In the middle age groups, which are dominating and most important, as many as over 80 per cent have attended. This high participation may justify conclusions about the *latent* need of further public health service.

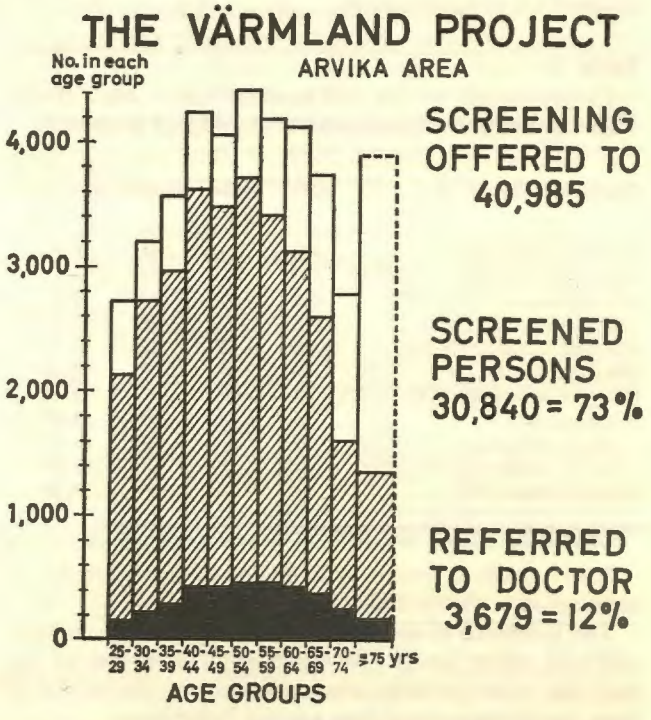


Fig. 1 Age distribution of the population and of people screened together with the number of persons referred to doctor.

In this health screening with a chemical test battery, positive findings are fairly common and the chemical blood changes were in many cases rather pronounced. Altogether about 12 per cent of all screened persons were referred for follow-up examination (Fig. 1).

The following results were reported by the medical station when 3118 patients, selected by the screening procedure of about 30,000 persons, had undergone follow-up examination:

	No. of diagnoses	*Percentage*	*Relative percentage*	*Per cent of screened persons*
Earlier *unknown* disease	1599	43	58	5
Earlier *known* disease	1144	31	42	4
No diagnosis	981*	26	—	3
Total	3724	100	100	

*Among these, the following findings could not be verified:

proteinuria	128 cases
glycosuria	152 „
low haemoglobin	310 „
hypertension	88 „
	678

It should be noted that in this health screening—in contrast to many others—the figures given do not include the diseases known by the patients and stated by them in the questionnaire. Thus, all 'earlier known' diseases in the table above were established by closer questioning of the patient by the physician at the follow-up examination. Bearing this in mind, it is obvious that this health screening has disclosed really *unknown* diseases in a high percentage. Such a result is not surprising in a broad chemical investigation, since metabolic disorders seldom produce early clinical symptoms.

Altogether 1201 persons, *i.e.*, 39 per cent of all follow-up examinations, were recommended for out-patient treatment, and ninety-four cases (3 per cent) were referred for hospitalisation.

Table A

Examples of *earlier unknown diseases* are: (from 3200 follow-up examinations among 30,000 screened)

Diagnoses (Classif. No.)	*No.*	*Men*	*Women*	*Per cent of screened persons*
Anaemia (290–296)	472	111	361	1·4
Hypercholesterolaemia (289·0)	237	86	151	0·7
Mb. hypertonici (440–447)	214	87	127	0·6
Diabetes mellitus (260)	148	96	52	0·4
Mb. thyroideae (250–254)	49	7	42	0·15
Mb. hepatis (581–583)	46	44	2	0·14
Mb. prostatae (610·611)	41	41	—	0·12
Neoplasmata*	22	11	11	0·07
neopl. malignum (156–204)	(9)	(5)	(4)	(0·03)
neopl. benignum (211–229)	(13)	(6)	(7)	(0·04)
Pyelonephritis (600)	14	6	8	0·04

*Exclusive twelve cases of paraproteinaemia.

Some medical issues will be mentioned briefly in connection with results hitherto obtained.

The incidence of *hypertension* is fairly low in comparison with other health investigations. This is due to the fact that most patients, especially women, are aware of their hypertension and thus are not listed here.

It is known that there is a comparatively high incidence of *hypercholesterolaemia* in Värmland. This has been verified, and the arteriosclerosis problem in this area is illustrated in Figure 2. The mean values in each age group are given for the chemical determination of cholesterol and β-lipoprotein, as well as the systolic and diastolic blood pressure. Cholesterol and β-lipoprotein are fairly well correlated, and increased values are noted at an earlier age than the rise in blood pressure. Elderly persons have lower blood pressure (and possibly always had so) but also a comparatively low content of cholesterol and β-lipoprotein. It can be mentioned that about the same blood pressure levels as in the field investigation were recorded at the follow-up examination.

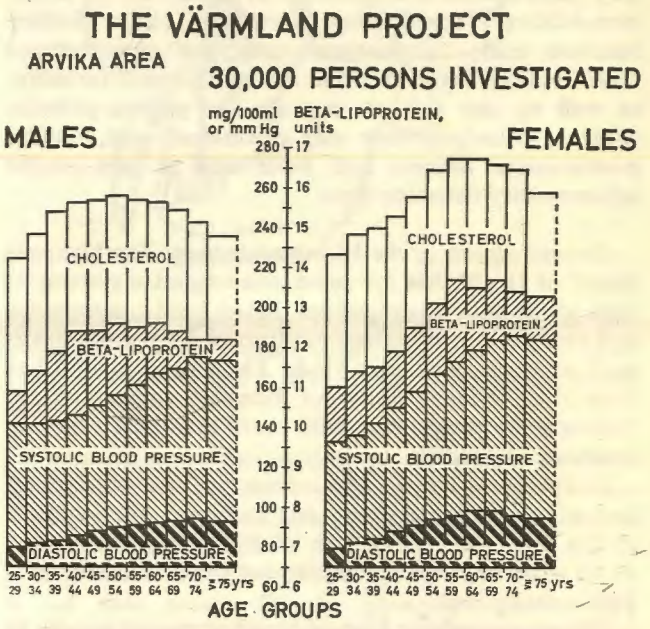


Fig. 2 Beta-lipoprotein and cholesterol in serum in comparison with systolic and diastolic blood pressure in different age groups.

Anaemias, especially *iron-deficiency anaemias*, are common in Värmland. Figure 3 shows the age distribution of the tests indicating iron-deficiency anaemia, *i.e.*, haemoglobin and serum iron. It is seen that patients who are recommended to see the doctor because of a low haemoglobin value often have a low serum iron level as well. As expected, this problem is more serious in women. Low serum iron in men is very frequently found in blood donors and after gastric resection.

The figures for *liver damage* are low, definitely lower than we have found in other parts of Sweden. This might be explained by the fact that the incidence of epidemic hepatitis has been very low in Värmland during this period.

The *malignacies* obviously offer special problems, since no specific chemical tests are available for cancer. The non-specific, inflammatory changes that sometimes appear in blood serum can pick up some cases, and others may be suspected from a low haemoglobin level, pathologic liver test, changed serum protein pattern, etc. In eight cases, in addition to those listed, the follow-up examination disclosed a malignant neoplasm. However, the diagnosis proved to be known, which is the reason why these cases are not listed. Naturally, the many other patients who, according to the questionnaire, had cancer were also omitted.

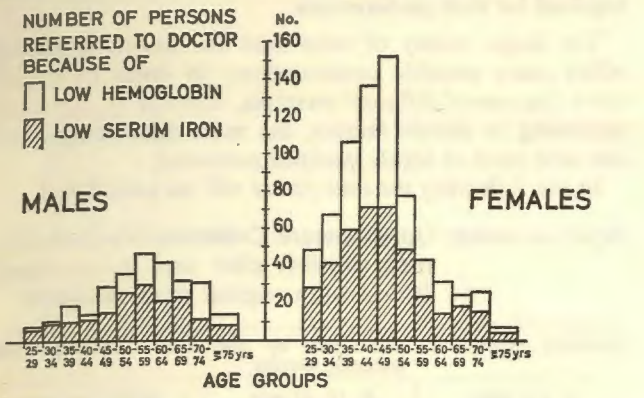


Fig. 3 Number of persons referred to follow-up examination because of a low hemoglobin and/or a low serum iron value.

We know of some twenty cases that have not been detected by the health screening, but have been reported later through the cancer register of the National Board of Health. Many of these have had no or insignificant findings. In a few cases with suspect laboratory values, not even the doctor's physical examination has given reason for a more thorough investigation that might have disclosed the cancer. In the asymptomatic stage, with no history of symptoms, and no complaints at all, the diagnostic possibilities of diagnosing malignancy are very limited. Any means of detecting cancer of an early stage are then important.

During the investigation, increasing attention has been given to the possibilities of detecting paraproteinaemia or myeloma. Altogether, we have found some fifty cases, but in the first 30,000 screened only twelve cases were found.

Blood chemistry, which here includes haemoglobin determination, detects pathologic changes in many cases, and is by far the most important investigation.

In Table 1 (below) a survey is given of the results of the chemical analyses from nearly *60,000 persons*. It shows how often the laboratory tests for different analyses deviate from the normal values, as well as the priority by which the patients are referred for follow-up examination.

Table B

How different methods (alone or combined) have led to a clinical diagnosis—previously unknown or known—is shown in the following (the figures derive from 3118 follow-up examinations of about 30,000 screened persons):

METHODS GIVING DIAGNOSIS	*Males*				*Females*			
	Unknown		*Known*		*Unknown*		*Known*	
	No.	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*
Blood pressure	72	11	68	17	106	11	116	16
Urinalysis	156	23	81	19	78	8	47	7
Blood chemistry	446	66	263	64	802	81	556	77
Total	674	100	412	100	986	100	719	100

As seen from the table, about 14 per cent of the analyses show marked changes, and altogether 58 per cent show abnormal values. This supports the statement that chemical analyses are sensitive in disclosing pathologic disturbances.

Only patients with unexpected findings, and not under treatment by a physician, are offered the free follow-up examination at the medical station. The patients are grouped according to the need of examination. By 'Priority 1' is meant that the examination is urgent, and '2' that it should be done as soon as possible. With some delay, it has been possible to do the examination also of the patients in priority group 3, although this is not always considered necessary from the medical point of view. Sometimes only a laboratory check-up has been made, *e.g.* another blood specimen (group 4) or urinary control (group 5).

The Värmland Project has already shown that chemical changes in the blood are frequently found in apparently healthy persons. These changes can be innocent as a sign of an earlier disease, or can be temporary and completely disappear in a few months. As an average, however, every tenth screened person has a pronounced change in one of the chemical tests.

Table 1. HEALTH SCREENING IN VÄRMLAND 1962–1964. SURVEY OF ABOUT 60,000 PERSONS

No. of persons screened and periods	*No. of patients*					*No. of analyses with values outside the normal range*														
	Referred to doctor			*Lab. check*		*Serum iron mg per 100 ml*		*Creatinine mg per 100 ml*		*GOT units*		*GPT units*		*Thymol turb. units*		*Zinc reaction units*		*β-lipoproteins units*		*Cholesterol mg per 100 ml*			*Protein-bound hexose mg per 100 ml*		*Sialic acid mg per 100 ml*	
	Priority					⩽ 40	41– 60	1·9– 2·4	⩾ 2·5	41– 60	⩾ 61	41– 60	⩾ 61	6– 8	⩾ 9	12– 15	⩾ 16	18– 21	⩾ 22	⩽ 150	351– 400	⩾ 401	141– 150	⩾ 151	85– 90	⩾ 91
	1	2	3	4	5																					
Oct. 62—Oct. 63 30,500	68	1095	2196	320	229	1370	5055	186	30	380	81	392	114	1126	260	1719	246	1985	374	112	636	184	2776	1501	8842	6633
Oct. 63—June 64 27,500	20	583	1423	1045	121	442	2593	140	33	237	64	136	40	1291	329	695	143	1544	176	87	368	130	2768	966	930	637
Total 58,000	88	1678	3619	1365	350	1812	7648	326	66	617	145	528	154	2417	589	2414	389	3529	550	199	1004	314	5544	2467	1772	1300
						xxxx	mmm	mm	xx	mm	xxx	mm	xxx	mmm	xxx	mmm	xxx	mmm	xxx	xxx	mmm	xxx	mmm	xxxx	mmm	xxxx
%	0·2	2·9	6·2	2·3	0·6	3·1	13·2	0·6	0·1	1·1	0·3	0·9	0·3	4·2	1·0	4·2	0·7	6·1	0·9	0·3	1·7	0·5	9·6	4·3	3·1	2·2

As per cent of total number of persons tested:

xxxx = 7,985 findings = 13·8 per cent marked changes
mmm = 25,799 findings = 44·4 per cent moderate changes
Total = 33,784 findings = 58·2 per cent

Chart I.

Health screening with basic programme and/or disease-detecting procedures

A possible way of combining tests is to arrange a basic programme, aiming at symptoms of common diseases, and supplemented by more specific diagnostic tests. The basic programme would then be very simple and rely on centralized laboratory service. The choice of supplementary methods, if any, depends on facilities available.

As an example, the following table is shown:

Basic programme	*Disease-detecting procedures*
1. Self-administered questionaire (poss. controlled)	1. Physical examination
2. Blood pressure (poss. ECG–I)	2. Gynaecol. examination, specimen for cytology
3. Haemoglobin (poss. E.S.R.)	3. Serology: VDRL, AST, etc.
4. Urinalysis (poss. blood sugar)	4. Glucose load test Functional tests
5. MMR chest (poss. MMR heart)	5. Sigmoidoscopy
6. Blood sampling for chemistry and serology	6. Tonometry, etc.
7. Vaginal pipette sample with chemical determination of enzyme activity	7. Visual and hearing acuity
	8. Questionnaire for detecting mental illness
	9. Soft X-ray mammography
	10. Clearance tests

Such planning is similar to that tested and recommended.

The differences are due to the advances in techniques for increasing productivity and saving personnel.

Chart II.

MULTIPLE SCREENING

Different combinations of tests according to the time required for their performance

The large variety of tests used for health screening offers many possible combinations. In order to survey some features of different attempts, they can be classified according to certain factors, the main ones being *time*, *cost* and need of *highly qualified personnel.*

In the following *the time factor* will be considered.

Before screening: Questionnaire. Collection of urine specimen, possibly after oral glucose load. If desired, a vaginal wash specimen.

Screening programmes: Classified by the time involving the screened person

A. 1–2 *min.*	*B.* 10–30 *min.*	*C.* 60 *min. or more, poss.* 2 *occasions*
MMR, taking of film	As in A, with addition of:	As in B, with addition of:
ECG–one lead	Questionnaire (comprehensive)	Thorough physical exam.
Blood pressure	Sigmoidoscopy	Doctor's interview
Blood sampling	Gynecol. investigation	Haematology (blood count)
Height/weight	X-ray of heart	E.S.R. etc.
Urinalysis	Lung function tests	Complementary chemical tests if indicated
Questionnaire (return of)		Mammography
Panorama X-ray (dental region)		Cytology specimen (other than gynaecol.)
Biometric tests		Load tests
(Inoculations, health advice, etc.)		

After screening: (poss. at a distant laboratory, health centre or similar).

MMR (or X-ray) reading	Also lab. invest for:	Also lab. invest for:
Blood analyses (chemistry)	Haematology	Bacteriology (urinary infection)
Statistics	Serology	
(Cytology, serology)	Physiology	
	Cytology	

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