MEDICAL PRACTICE

Occasional Review

Strategy of prevention: lessons from cardiovascular disease

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If an obstetrician had a case of eclampsia he would ask, "What went wrong?" The occurrence of a preventable disaster is a threat to his professional reputation, for an obstetrician accepts prevention as an integral part of his normal professional responsibilities. Antenatal care is in fact largely preventive, and the integration of prevention with treatment has led to an excellent fall in maternal and perinatal mortality rates. In paediatrics too there are no demarcation disputes between prevention and treatment; and a similar trend is now also appearing in general practice. If a stroke occurs in an untreated or badly treated hypertensive patient, a good general practitioner asks, "What went wrong?" For, in middle age at least, strokes are largely preventable. When one occurs it suggests a possible failure of practice organisation.

Clinician and prevention

Unfortunately, in other branches of medicine there is a continuing and regrettable separation of the therapeutic and the preventive roles, and doctors generally continue to see the care of the sick as their whole responsibility.

CORONARY HEART DISEASE IS PREVENTABLE

Figure 1 shows the recent trends in mortality from coronary heart disease in various countries of the world. In Japan the rates have throughout this period been extremely low. In Australia and the United States at the start of the period they were high, but they have fallen by some 25%. In England and Wales they started a little short of the American and Australian rates and have shown little change. The Japanese owe their low rates not to their genes but to their way of life: when they move to America they rather quickly acquire American rates. The large recent declines in Australia and the United States must surely be due largely to a declining incidence of disease, since

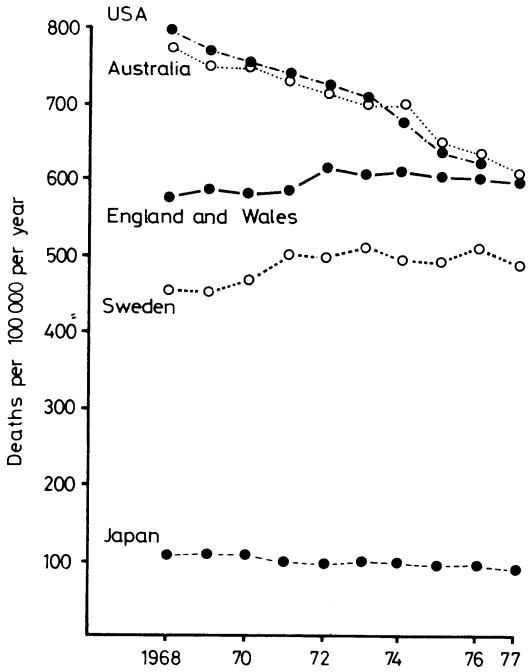

FIG 1—Age-adjusted death rates from coronary heart disease (ICD, 8th revision, 410-14) among men aged 35-74 in various countries.

Based on the Adolf Streicher memorial lecture given at the North Staffordshire Medical Institute, Stoke-on-Trent, on 13 November 1980, which will be published in full later this year in the *Journal of the North Staffordshire Medical Institute*.

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only a limited part of that large decline can be attributed to therapeutic advances. These patterns show that coronary heart disease is largely preventable.

In Britain, then, we are failing to prevent a preventable disease. If we had shared in the Australian and American decline each year in England and Wales there would be upwards of 25 000 fewer coronary deaths. One can imagine the outcry if some shortcoming in therapeutic services were to cause even a tiny fraction of this number of unnecessary deaths. Why then, one may ask, do we not as a profession evince a corresponding alarm at a failure of prevention? Why do we not feel that it is our fault? Why is so large a part of our research devoted to the "mechanics of dying," and so little to the scientific, social, and economic basis of prevention?

The answers to these questions are satisfactorily complex. We do not know why the Australians and the Americans have done well in their control of coronary heart disease, or whether (if we did know) we could have shared their good fortune. Yet surely, as a profession, we should at least feel deeply disturbed by the problem and involved in it. We have a professional responsibility for prevention, both in research and in medical practice. When ordinary doctors do not accept that responsibility then prevention is taken over (if at all) by uncritical propagandists, by cranks, and by battling commercial interests.

"High-risk" strategy

As doctors we are trained to feel responsible for patients—that is, to care for the sick; and from that position accepting responsibility for those with major risk factors is not too difficult a transition. They are almost patients. A general practitioner, say, makes a routine measurement of a man's blood pressure and finds it raised. Thereafter both the man and the doctor will say that he "suffers" from high blood pressure. He walked in a healthy man but he walks out a patient, and his new-found status is confirmed by the giving and receiving of tablets. An inappropriate label has been accepted because both public and profession feel that if the man were not a patient the doctor would have no business treating him. In reality the care of the symptomless hypertensive person is preventive medicine, not therapeutics.

ABSOLUTE AND RELATIVE RISK

Life insurance experts concerned with charging the right premiums taught us that "high risk" meant "high relative risk," and in this until recently they have been abetted by the epidemiologists. Figure 2(*a*), taken from life insurance data,[1] shows for each of four age groups the relation of blood pressure to the relative risk of death, taking the risk for the whole of each age group as 100. The relative risk is seen to increase with increasing pressure, but the gradient gets a little less steep as age advances. That is perhaps not surprising, because a systolic pressure of 160 mm Hg is common in older men, and we would not expect it to be so unpleasant as at younger ages, when it is rare.

In figure 2(*b*) the same data are shown but with a scale of absolute instead of relative risk. The pattern now appears quite different. In particular, the absolute excess risk associated with raised pressure is far greater in the older men. A systolic pressure of 160 mm Hg may be common at these ages, but common does not mean good. To identify risk in relative units rather than absolute units may be misleading.

To take another example, at any given age a woman taking oral contraceptives has a risk of cardiovascular death about 2·8 times that of her contemporary who is not taking the pill. This relative risk is more or less independent of age, and it is the same in smokers and non-smokers.[2] But although relative risk does not change, the absolute excess or *attributable risk* is profoundly different (table I). We are nowadays discouraging

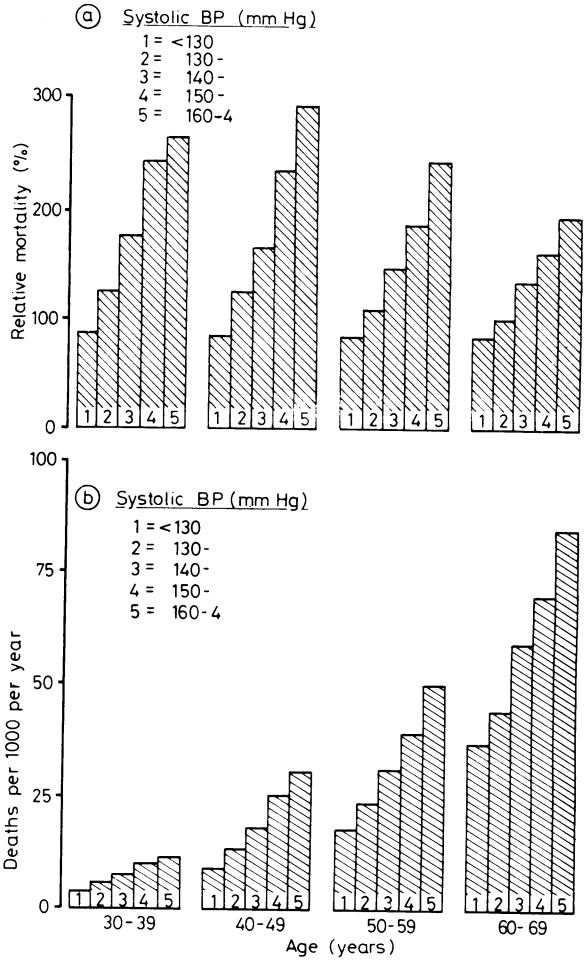

FIG 2—Age-specific mortality in men according to blood pressure and age, from life insurance data: (*a*) relative risk, and (*b*) absolute risk.

TABLE I—*Cardiovascular risk in users of oral contraceptive*[2]

	Age (yr)	
	30–9	40–4
Relative risk	2·8	2·8
Attributable risk (per 100 000 a year)	3·5	20·0

the use of oral contraceptives in older women, especially those with any coronary risk factor, because we recognise that advice must relate to absolute not relative risk.

ABSOLUTE AND RELATIVE BENEFIT

The same argument applies in assessing the benefits of preventive action. In the Veterans Administration trial of antihypertensive treatment[3] the effectiveness of treatment expressed in relative terms was around 50-60% regardless of age or the presence of cardiovascular-renal abnormality (table II). The final column of the table, however, expresses treatment effectiveness in absolute units; and again we now see a quite different pattern. The absolute benefit received from this form of preventive action is nearly five times greater in the older age group with risk factors than in the younger age group without risk factors. To express the results of trials only in terms of percentage effectiveness is to conceal what the user really needs to know.

TABLE II—*Relative and absolute benefits from the treatment of hypertension, according to age and the presence of cardiovascular-renal abnormality*[3]

Age (yr)	Cardiovascular renal abnormality	Treatment effectiveness (%)	Lives saved per 100 treated
<50	−	59	6
	+	62	14
>50	−	50	15
	+	60	29

POPULATION RISK

If we are to take decisions, then, we need to measure risks and benefits in absolute rather than relative terms. Nevertheless, although such measures will describe the situation for individuals they tell us next to nothing about the effects on the whole community of a strategy based on identifying and caring for high-risk individuals. Unfortunately the effects of a "high-risk strategy" may be more limited than we imagine, for the community benefit depends not only on the benefit that each individual receives but also on the prevalence of the risk factor. If a large benefit is conferred on only a few people then the community as a whole is not much better off. In familial hypercholesterolaemia affected men have a risk of premature coronary death or more than 50%; but fortunately it is rare. Consequently, serious though the disease is for affected individuals, the deaths resulting from it make up less than 1% of all coronary deaths. What we may call *population attributable risk*—the excess risk associated with a factor in the population as a whole—depends on the product of the individual attributable risk (the excess risk in individuals with that factor) and the prevalence of the factor in the population.

Figure 3 illustrates the relation in the Framingham Study[4] between coronary mortality and the concentration of serum cholesterol when men entered the study. The risk rises fairly steeply with increasing cholesterol concentration; but out on the right, where the risk to affected individuals is high, the prevalence is fortunately low. If we want to ask, "How many excess coronary deaths is the cholesterol-related risk responsible for in this population?," we simply multiply the excess risk at each concentration by the number of people with that concentration who are exposed to that risk. In fig 3 these attributable deaths are shown as the numbers on top of the bars. They add up to 34 extra deaths per 1000 of this population over a 10-year period, of which only three arise at concentrations at or above 310 mg/100 ml (8 mmol/l)—which would be called high ("outside the normal range") by conventional clinical standards. The rest (90%) arise from the many people in the middle part of the distribution who are exposed to a small risk.

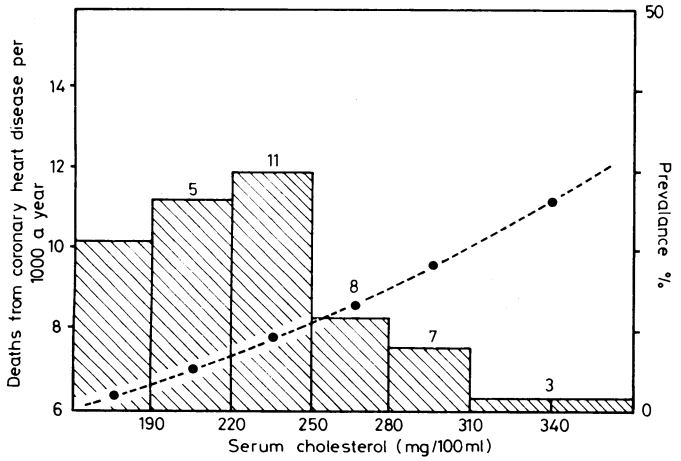

FIG 3—Prevalence distribution of serum cholesterol concentration related to coronary heart disease mortality (- - - -) in men aged 55-64. Number above each bar represents estimate of attributable deaths per 1000 population per 10 years. (Based on Framingham Study.[4])

Conversion: SI to traditional units—Cholesterol: 1 mmol/l ≈ 38·6 mg/100 ml.

This illustrates a fundamental principle in the strategy of prevention. A large number of people exposed to a low risk is likely to produce more cases than a small number of people exposed to a high risk. In business the same principle underlies the mass market: profits are larger when small amounts are taken from the masses than when large amounts are taken from the few rich people; and this principle of the mass market applies to many community health hazards.

In our Whitehall Study[5] we examined some 20 000 middle-aged male civil servants in London, noting among other things their blood pressures. Follow-up shows that mortality rises rather steeply with increasing pressure. One may calculate (just as with the Framingham cholesterol data) the numbers of deaths attributable to the different levels of raised blood pressure (table III). Two-thirds of the attributable coronary deaths and three-quarters of the attributable deaths from stroke occur in men with diastolic pressures below 110 mm Hg, and about half the attributable coronary deaths and a quarter of the attributable deaths from stroke occur below 100 mm Hg.

TABLE III—*Population attributable mortality from coronary heart disease and stroke arising at different levels of blood pressure*[5]

Diastolic BP (mm Hg)	Cumulative % of excess deaths attributable to hypertension	
	Coronary heart disease	Stroke
≤80	(0)	(0)
≤90	21	14
≤100	47	25
≤110	67	73
>110	100	100

In the "high-risk" preventive strategy we go out and identify those at the top end of the distribution and give them some preventive care—for example, control of hypertension or hyperlipidaemia. But this "high-risk" strategy, however successful it may be for individuals, cannot influence that large proportion of deaths occurring among the many people with slightly raised blood pressure and a small risk. Hypertension clinics, lipid clinics, diabetic clinics—excellent though they may be for the individuals who receive their benefits—offer only a limited answer to the community problem of heart disease.

Mass strategy

We are therefore driven to consider mass approaches, of which the simplest is the endeavour to lower the whole distribution of the risk variable by some measure in which all participate. Supposing that some dietary measure, such as moderation of salt intake, were able to lower the whole blood pressure distribution, we may estimate how the potential benefits might compare with what is currently achieved by the "high-risk" strategy of detecting and treating hypertension. From the Whitehall study data one can consider two strategies whose effects might be expected to be equivalent. The first predicates a 100%-effective treatment for high blood pressure given to and accepted by everyone with a diastolic (phase 4) pressure of 105 mm Hg or more. We can estimate how many lives that would save, assuming a commensurate fall in risk. On the same assumption, a similar benefit might follow a mass lowering of the whole blood pressure distribution of the population by 7-8 mm Hg. In practice, however, treatment is

not completely effective, all cases are not detected, and the people who are detected will often not take our treatment. Making allowance for these shortcomings, we may estimate that all the life-saving benefits achieved by current antihypertensive treatment might be equalled by a downward shift of the whole blood pressure distribution in the population by a mere 2-3 mm Hg. The benefits from a mass approach in which everybody receives a small benefit may be unexpectedly large.

THE INDIVIDUAL GAINS LITTLE

The mass approach is inherently the only ultimate answer to the problem of a mass disease. But, however much it may offer to the community as a whole, it offers little to each participating individual. When mass diphtheria immunisation was introduced in Britain 40 years ago, even then roughly 600 children had to be immunised in order that one life would be saved—599 "wasted" immunisations for the one that was effective. If all male British doctors wore their car seat belts on every journey throughout their working lives, then for one life thereby saved there would be about 400 who always take that preventive precaution: 399 would have worn a seat belt every day for 40 years without benefit to their survival. This is the kind of ratio that one has to accept in mass preventive medicine. A measure applied to many will actually benefit few.

Table IV presents some estimates made from the Framingham data.[3] If we supposed that throughout their adult life, up to the age of 55, Framingham men were to modify their diet in such a way as to reduce their cholesterol levels by 10%, then among men of average coronary risk about one in 50 could expect that through this preventive precaution he would avoid a heart attack (if change in a risk factor leads to commensurate reduction in risk): 49 out of 50 would eat differently every day for 40 years and perhaps get nothing from it. For the same preventive measure in a higher-risk group (those with a little hypertension and a slightly raised cholesterol concentration and smoking cigarettes), the ratio rises to one in 25. For women the prospects for individual benefit from this preventive measure are much smaller.

TABLE IV—*Estimated proportion of men and women who might avoid clinical coronary heart disease before age 55 if they had reduced their serum cholesterol concentration by 0·65 mmol/l (25 mg/100 ml) throughout adult life, based on Framingham estimates of risk*[4]

	Men	Women
Average risk*	1 in 50	1 in 400
High risk†	1 in 25	1 in 150

*Serum cholesterol 6·1 mmol/l (235 mg/100 ml), systolic BP 120 mm Hg, non-smoker.
†Serum cholesterol 6·7 mmol/l (260 mg/100 ml), systolic BP 150 mm Hg, smoker.

THE "PREVENTION PARADOX"

We arrive at what we might call the prevention paradox—"*a measure that brings large benefits to the community offers little to each participating individual.*" It implies that we should not expect too much from individual health education. People will not be motivated to any great extent to take our advice, because there is little in it for each of them, particularly in the short and medium term. Change in behaviour has to be for some the larger and more immediate reward.

SOCIAL MOTIVATION

There has been a gratifying decline in smoking by male doctors in Britain in the past 20 years. In most cases the motivation has probably not been the intellectual argument that in the end some will obtain health benefits; it has been social pressure. Being a smoking doctor is uncomfortable these days for your colleagues either pity you or despise you. Not smoking may be easier. Social pressure brings immediate rewards for those who conform.

Few doctors are optimistic about their ability to achieve weight reduction in obese patients and to maintain it. But many young women make strenuous, sustained, and successful efforts to control their weight, not for medical reasons but because thinness is socially acceptable and obesity is not. So in health education our aim should perhaps be to create social pressure that makes "healthy behaviour" easier and more acceptable, thereby bringing immediate social rewards for those who conform.

Another major determinant of behaviour is the force of economics and convenience. In the United States and Australia, and more latterly in Britain, there has been a large market shift away from butter and towards soft margarine. Though the medical argument has helped, the main reason has probably been the price, and the fact that butter when kept in the refrigerator goes hard and soft margarine does not. Thus the friends of butter, quite apart from the bad scientific basis for their case, have little chance of making much headway. To influence mass behaviour we must look to its mass determinants, which are largely economic and social.

SAFETY IS PARAMOUNT

The recent World Health Organisation controlled trial of clofibrate produced disturbing results.[6] In the treated group non-fatal myocardial infarction was reduced by 26% (about the effect predicted from the fall in cholesterol concentrations). Mortality from non-cardiac causes, however, increased by one-third, an effect rather unlikely to be due to chance. This finding is important to the strategy of prevention. Clofibrate has been in use for many years and has been given to enormous numbers of patients. Until the results of this trial appeared there was no suspicion that it might kill. Indeed, by clinical standards it can still be called a relatively safe drug, since the estimate of excess mortality works out at only about one death per 1000 patient-years. In patients with severe hyperlipoproteinaemia we would be prepared to take such a risk if it was thought that the drug might reduce their very high death rate.

Intervention for prevention where the risk is low is totally different. I suggested earlier that a large number of people exposed to a small risk might yield more cases in the community than a small number exposed to a big risk. There is a counterpart to that in regard to intervention. If a preventive measure exposes many people to a small risk, then the harm it does may readily—as in the case of clofibrate—outweigh the benefits, since these are received by relatively few. Unfortunately we cannot have many trials as large as the clofibrate study, nor are we able to keep such trials going for longer than a few years, usually five at the most. We may thus be unable to identify that small level of harm to individuals from long-term intervention that would be sufficient to make that line of prevention unprofitable or even harmful. Consequently we cannot accept long-term mass preventive medication.

Conclusions

In chronic diseases the clinician's first contact with the patient comes late in the natural history of the disease, usually after a catastrophe or major complication and when there is already much irreversible pathological change. Indeed, in some 20% of

cases of coronary heart disease there is no contact with physicians at all, the first recognised occurrence being sudden death. It follows inexorably that prevention is essential. With coronary heart disease, the recent experience of Australia and the United States shows also that prevention is possible, at least in part.

The preventive strategy that concentrates on high-risk individuals may be appropriate for those individuals, as well as being a wise and efficient use of limited medical resources; but its ability to reduce the burden of disease in the whole community tends to be disappointingly small. Potentially far more effective, and ultimately the only acceptable answer, is the mass strategy, whose aim is to shift the whole population's distribution of the risk variable. Here, however, our first concern must be that such mass advice is safe.

ADDITION AND REMOVAL

We may usefully distinguish two types of preventive measure. The first consists of the removal of an unnatural factor and the restoration of "biological normality"—that is, of the conditions to which presumably we are genetically adapted. For coronary heart disease such measures would include a substantial reduction in our intake of saturated fat, giving up cigarettes, avoiding severe obesity and a state of permanent physical inactivity, maybe *some* increase in the intake of polyunsaturated fat, and maybe avoidance of those occupational and social conditions that are conducive to so-called "type A" behaviour. Such normalising measures may be presumed to be safe, and therefore we should be prepared to advocate them on the basis of a reasonable presumption of benefit.

The second type of mass preventive measure is quite different. It consists not in removing a supposed cause of disease but in adding some other unnatural factor, in the hope of conferring protection. The end result is to increase biological abnormality by an even further removal from those conditions to which we are genetically adapted. For coronary heart disease such measures include a *high* intake of polyunsaturates and all forms of long-term medication. Long-term safety cannot be assured, and quite possibly harm may outweigh benefit. For such measures as these the required level of evidence, both of benefit and (particularly) of safety, must be far more stringent.

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Dealing with the Disadvantaged

Psoriasis

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Over one million people suffer from psoriasis and many others carry a predisposition. It is a common skin condition that can occur on any part of the body, at any age, as raised red patches covered with silvery scales. It should be made clear to patients and their relatives that it is definitely neither infectious nor contagious. In simple terms it is only an acceleration of the usual replacement processes of the skin, but the basic causes remain unknown. Hereditary factors are thought to play an important part, with a genetic tendency being triggered off by such things as injury, throat infection, certain drugs, and stress. There are many clinical forms and considerable variations in intensity. Widespread ignorance and the real or imagined reactions of non-sufferers may also lead to a withdrawal from society and to feelings of isolation and depression. Permanent cures are not yet possible, although many people are helped by treatment.

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Useful points

The following points may be useful when dealing with psoriatics:

(1) It is important that the patient understands in simple terms what is happening to his skin. The word "psoriasis" is difficult to pronounce and spell and often in itself causes distress.

(2) The patient should not be told that it is incurable and that he or she must live with it before an explanation of the condition is given and time has been allowed for the facts to be absorbed.

(3) Often the patient is worried when technical terms are used, such as exfoliate, remission, epidermis. Many mothers are terribly upset to hear guttate. Care should be taken to use simple terms and to make sure that the patient understands.

(4) Many psoriatics are introverted and depressed about their skins. It is important that they should be made to feel "whole persons" and not just "skins." A little while spent listening to them will help reduce the stress they are experiencing.

(5) Many psoriatics learning of the diagnosis think that they have something rare and feel isolated. They should be told that