Economic approaches to alternative patterns of health care

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There are various approaches to the definition of alternative patterns of health care. One is to consider methods of providing care which differ from those at present being applied. This raises many questions about *how* care might be delivered, or the techniques of care delivery.

Strictly defined, however, the word 'alternative' does not mean 'different' but 'offering a choice of two things'. One important way of viewing this is to consider the choice between doing and not doing, and interpreting the question of choice as simply *whether* policy Y is worth pursuing or not.

When 'alternative' is combined with 'patterns', the issue becomes even broader. Certainly, questions of choice in health care often do relate to how to achieve X or whether to pursue policy Y. But more often the choices to be made are related to *how much* of A should we be doing and also at what mix of A, B, and C should we be aiming.

Thus, there appear to be three interrelated strands of thought in 'alternative patterns of health care': how, whether, and how much of what? The main emphasis of this paper will be on the last question.

Posing such questions has certain advantages. Firstly, the questions have parallels in epidemiology. Secondly, economists who consider them would turn to the techniques of cost-effectiveness analysis, cost-benefit analysis, and the use of marginal analysis (this is not a different technique from the first two, but for expository purposes it will be given separate treatment). Some of the problems of measuring costs and benefits will be mentioned, but since Wright (1979) has covered this issue in detail, these problems will not be discussed at length.

In addition, the paper will concentrate on ideas and approaches, so no attempt will be made to review the growing amount of published material on cost-benefit and cost-effectiveness studies. Some reference will be made to the approaches of other disciplines but there will be no comprehensive attempt to draw out the similarities to and differences from those approaches and that of this paper.

COST-EFFECTIVENESS ANALYSIS OF ALTERNATIVE TECHNIQUES

Cost-effectiveness analysis is essentially concerned

with the 'how' of policy. It can assist in decisions both on the techniques and on the delivery of health care. It is constrained to considerations of how, at least cost, a particular objective may be met; or, alternatively, given a fixed budget to meet a particular objective, how best to deploy the resources of that budget. Normally, it provides no assistance *in itself* in deciding *whether* to pursue a particular objective or *how much* of a particular policy to pursue.

To use cost-effectiveness analysis, it is first necessary to be able to answer the question: what is the objective? This could take various forms. For example, in screening for breast cancer, it might be considered relevant to aim for one or more of the following:

- (i) the lowest screening cost per women screened;
- (ii) the lowest screening cost per positive case detected;
- (iii) the lowest cost, including treatment and screening costs, per positive case detected;
- (iv) the lowest cost, including treatment and screening costs, per true positive case detected;
- (v) the lowest cost, including treatment and screening costs, per death averted;
- (vi) the lowest cost, including treatment and screening costs, per year of life extended; or
- (vii) the lowest cost, including treatment and screening costs and allowing for savings in treatment costs for cases which would have presented symptomatically, per year of life extended.

This list could be extended and made even more complex. However, it serves to indicate that the specification of the objective is important in cost-effectiveness analysis. To have a simple objective, as in (i), might result in a very different policy than the one that would result if more complex objectives, such as (vi) or (vii), were pursued. Indeed, sometimes the final definition of the objective may be dependent on the cost-effectiveness study itself. For example, different screening techniques may result in different rates of false positives and some assessment of the

importance of these varying rates may be required (Kodlin, 1972).

The economist would tend to be suspicious about objective (i), to achieve the lowest screening cost per woman screened, because of the omission of certain costs which would arise as a result of screening and because of the lack of homogeneity of the 'output' as stated (Dickinson *et al.*, 1972; Kodlin, 1972).

Clearly, the definition of the objective in cost-effectiveness studies is very important, if for no other reason than that a careful definition may prompt a more appropriate study. While objectives will inevitably vary from study to study, two broad guidelines can be suggested. Firstly, the objectives should be couched in as near to 'final' outputs as is possible. Thus 'lives saved' or 'years of life extended' are outputs which would normally be preferred to, for example, 'women screened'. Secondly, in so far as the definition of objectives can influence which costs are included, the objective should be defined so as to include as many of the relevant costs as possible. Thus, for example, 'costs of treatment and screening' would normally be preferred to 'costs of screening' alone.

The second requirement in cost-effectiveness studies is to list all the possible options to meet the objective. It may well be that not all the options are actually included in the study, but one of the important features of cost-effectiveness analysis is that as many as possible of the feasible and reasonable options are assembled. Only in this way can there be any certainty that the most cost-effective option will be chosen.

This requirement is not wholly independent of the first requirement of setting the objective. For example, in practice, it may be that while all the chosen options would meet the chosen objective some may also produce other effects. A judgement may then be required as to whether or not some of these additional effects should be included in the objective.

The third requirement is to be able to quantify, as far as knowledge will permit, the effect of the different options. It is not normally enough to be able to state that a particular option will have a beneficial effect. Because comparisons have to be made between the relative effectiveness of different options it is necessary to be able to measure such effectiveness for each option. If such information is not currently available it may then be an integral part of the cost-effectiveness study to mount research to obtain the information (Piachaud and Weddell, 1972).

While it is clearly ideal to be able to measure the effectiveness of all the assembled options, this could

be an extremely costly exercise or it could result in a lengthy delay. Consequently there can be no hard and fast rule about the precision required in the measurement of effectiveness. This will hinge on the importance of the issue in hand, the costs, and the extent to which there is or is not fairly clear evidence, without precise effectiveness data, that some options are superior to others. Good judgement is obviously important.

The fourth requirement is to be able to measure the costs associated with each option. Such costs will normally include *all* costs associated with implementing the option. These ought, therefore, to include not only the costs falling on the National Health Service budget but also those which would be incurred by other agencies, such as social work departments, as well as the patients themselves and the patients' relatives. The measurement of costs will sometimes be difficult or impossible. For example, if an option involves community care there may be some 'costs' falling on patients' relatives (such as stress) which may not be quantifiable, or at least not in money terms. One attempt to assess the 'burden on the family' has been made by Sainsbury and Grad (1974). None the less, an accurate description of the nature and extent of such intangible costs should, if possible, be included in the cost-effectiveness analysis. In this way the decision-maker will know about these costs even if it has to be left to his subjective judgement to estimate their value.

Another important aspect of costing is marginal costing. It may sometimes be that the option with the least cost per unit of output provides less of the output than other options. For example, Option A may provide 100 units of output at a cost of £100, that is, £1 per unit of output. Option B may provide 150 units of output at a cost of £450, which amounts to £3 per unit of output. Option A is clearly more cost-effective, but it may be that the decision-maker would still prefer Option B because it provides a greater output and because the costs—at £3 per unit of output—still appear very reasonable for the nature of the output involved. But the relevant figure in considering this question is not £3 per unit of output, but £7. This is because the 50 additional (or 'marginal') units cost an extra £350 (£450 minus £100), which means that these extra units can be obtained only at a cost of £7 per unit of output. Neuhauser and Lewicki (1975) give an example of the importance of marginal costing.

If all these requirements are met, then options can be ranked in terms of their relative cost-effectiveness. If a *level* of output is specified, then each option will be ranked by total cost in meeting the objective. If the objective specifies the *type* of output but not the

total quantity, then the ranking from cost-effectiveness analysis will be by cost per unit of output for each option. Again, if the objective is stated in terms of a *fixed budget* to obtain some type of output, then the ranking will be by number of units of output obtainable within this budget for each of the options.

COST-BENEFIT ANALYSIS OF ALTERNATIVE POLICIES

Cost-effectiveness analysis can be a very useful tool. However, it cannot of itself indicate whether something is worth doing in cases where there are both positive costs and desired outputs; nor, without a given budget constraint, how much to do. These require value judgements and values on the benefit side.

Clearly, the question of whether it is worthwhile to pursue a particular policy is important in health care. For this it is necessary to use some approach which can assist in the choice between competing objectives and not simply evaluate alternative ways of reaching some given objective.

To be able to judge the 'worthwhileness' of a particular policy, it is necessary to be able to form the judgement that the gain from pursuing it more than offsets the sacrifice involved in implementing it. In other words, there is a need to weigh the benefits against the costs, and this leads into the philosophy and technique of cost-benefit analysis. (Mishan, 1971; Dasgupta and Pearce, 1972; Klarman, 1974; Williams, 1974).

As Williams (1974) indicates: 'Cost-benefit studies stress the simple truth that the decision whether or not to pursue a particular course of action depends on both costs and benefits'. Bringing these two together is the single most important contribution of cost-benefit analysis. Economists perhaps tend to underplay the need to stress this point, because their training makes it self-evident to them, but it is still true that, as Williams says, 'We see far too many recommendations based on assertions that x is cheaper than y (without adequate consideration of relative benefits) or that x is more effective than y (without adequate consideration of relative costs).'

By assessing the costs and benefits of different policies, judgements can be formed about the relative worthwhileness of different ways of committing scarce resources. No health care policy should be pursued if it results in a cost to society greater than the benefit it bestows, but it does not automatically follow that all policies which result in a greater benefit than cost can be pursued. Ideally, if cost-benefit analysis were to be widely applied in health care, those policies showing the greatest

benefit per £ of resources used should be given the highest priority. Thus, cost-benefit analysis has all the virtues and requirements of cost-effectiveness analysis, as indicated earlier, as well as the capacity to assist in decisions about 'worthwhileness'.

But what is meant by 'costs' and 'benefits' in cost-benefit analysis? Consumers of health care do not normally have to bear the full cost at the point of consumption because most health services are zero-priced. However, it is the pecuniary and non-pecuniary costs falling on society as a whole—be it on the health service, on other public sector agencies, or on the patient (for example, in loss of time)—that are relevant in cost-benefit studies.

The same principle applies to benefits: the relevant benefits are those accruing to society at large. But the problems of benefit measurement are considerable. Every decision in health care which involves the commitment of resources to a particular policy implies measurement of benefit, as does any decision *not* to pursue a particular policy. If policy A is implemented at a cost of £10 000, this implies that the decision-makers have formed the judgement that the benefits of the policy are at least £10 000. Failure to implement policy A would imply a value of less than £10 000 for the benefits.

It is certainly true that the theory underlying cost-benefit analysis suggests that the consumer knows best what is good for him and so exerts the principle of consumer sovereignty. However, as regards health care in this country, it can be argued that one of the reasons for creating the NHS was that the consumer did *not* know best what was good for him. Without wishing to pursue the debate on the nature of the commodities health and health care, it is clear that decisions are being made daily in the health service by politicians, planners, administrators, and clinicians which imply values for the benefits provided.

Two very much simplified examples will serve to illustrate this. In 1971, the Government decided on grounds of cost not to proceed at that time with the child-proofing of drug containers. Allowing for the cost of drug-proofing and savings to the NHS from reduced hospital admissions, it was calculated by Gould (1971) that the cost per child's life saved would have been of the order of £1000. Thus by its decision the government implied that it valued a child's life at less than £1000.

The second example of implied values arises from the changes in building regulations after the partial collapse of a high-rise block of flats at Ronan Point, which killed some of the residents. Calculations made by the Science Policy Research Unit at the University of Sussex (Sinclair *et al.*, 1972), based on estimates of the expected numbers of

lives that would be saved by the changes in the regulations and of the cost of these changes, suggested that the implied value of a life was at least £20 million.

While it is possible to quibble about the accuracy of the figures in these examples, they do serve to illustrate three important points about decision-making in the public sector. Firstly, values are being attached *by implication* to such apparently intangible benefits as 'life'; in other words, the valuation of benefits *cannot* be avoided or ignored. Secondly, the range of values is extremely large for broadly similar outputs, which in this case are lives saved. Thirdly, if values were made explicit this might result in different decisions being taken. It can also be claimed that the decisions would be better. In the context of these examples, more lives might have been saved by a switch of resources from buildings to child-proof containers.

There are problems of measurement in cost-benefit analysis but these can be over-stated. Even where there are potentially large intangible costs and/or benefits, cost-benefit analysis can still be a useful evaluation approach in health care, not least by systematically identifying areas where costs and benefits may arise. It seems unlikely that a much more emotive issue could arise than screening for spina bifida. Yet even here cost-benefit analysis has been able to assist decision-making (Hagard *et al.*, 1976).

In summary, therefore, cost-benefit analysis provides a valuable approach to evaluation in health care. It is still at a relatively early stage of development as a technique, largely because of problems of measurement. While the valuation of benefits must remain, for the present at least, the subjective province of the decision-makers, some progress can be made with existing valuation techniques, and the use of implied values can at least engender a greater consistency in health policy-making. An understanding of cost-benefit analysis can also ensure that appropriate costs are used and that they are valued correctly. As yet, cost-benefit analysis cannot act as a *decision-making* tool in health care, but its potential as a *decision-aiding* tool remains underexploited. Some might argue that cost-benefit analysis can only be of assistance in planning health care once the problems of measurement of costs and benefits are overcome. If this were so we would have a long wait before looking to it to assist planning. Fortunately, even without the ability to measure all costs and benefits, cost-benefit analysis as an approach to and a philosophy of planning can make an important contribution to health care decision-making.

MARGINAL ANALYSIS OF ALTERNATIVE PATTERNS OF HEALTH CARE

In considering alternative patterns of health care, individual options—on how to treat particular diseases, for example—can be approached through cost-effectiveness analysis; decisions on whether and how much to treat particular problems can be assisted by the application of cost-benefit analysis. Both these evaluative techniques can be costly and time-consuming to apply. It quickly becomes evident, however, that is not possible to apply such techniques to the whole range of options available in health care.

This is particularly true of planning specific programmes, where alternative patterns of care are complex and planning may centre on finding the best balance of care between different services for a particular care group. Here the community medicine specialist comes into his own. 'Perhaps the most important contribution that community medicine can make to the future Health Service will be the development of integrated programmes of health care in which the contribution of the different parts of the service and different clinical interests are co-ordinated and developed on the basis of the needs of people in various disease and population groups' (Scottish Home and Health Department, 1973).

There is some help to be had from the planning tool of programme budgeting (Pole, 1974; Department of Health and Social Security, 1976; Mooney 1977) as an information framework for planning, both at the policy level of total health care—in a region or area, for example—and within individual care groups. Briefly, this tool allows trends in resource patterns and activities, which serve as proxies for output, to be set against one another to see how programmes have been developing in the past and how they might develop in the future. Programme budgeting is a rather imprecise tool. None the less, it allows broad consideration to be given to potential imbalances or surprises which might otherwise be missed and it also allows for thought about possible changes in direction or shifts in priorities.

But the step from such a broad planning framework to comprehensive analysis by cost-effectiveness and cost-benefit techniques is daunting. Some intermediate form of analysis is required in those programmes or groups of services where further examination appears justified. Let us now consider alternative patterns of care at the level of a care group, disease group, or programme.

One approach is to try to determine what the 'needs' of the relevant population are, set specific standards of care for those with these needs, and

thereafter let the balance of care be determined by these two sets of factors (Gruer, 1975). For example, it might be discovered, through a survey in a particular area, that 2% of the elderly are incontinent. It might then be argued, in terms of specific standards of care, that individuals who suffer from incontinence ought not to be cared for in their own homes. It might also be suggested that residential homes are neither staffed nor designed to cope with incontinent individuals. It therefore follows that incontinence is deemed to require hospital care; hence, on the basis of this condition alone, the provision of hospital beds for the elderly would need to be at least sufficient to take all of the elderly who are incontinent. Similar considerations, applied to other characteristics of the elderly, might lead to quantified levels of provision being set for sheltered housing and residential home places.

In maternity care, standards can be related to the levels of risk of various complications which may arise and which will in turn determine whether it is 'safe' for women to have their babies in a GP unit or whether their confinement should be in a specialist maternity unit. For example, it might be decided that all first pregnancies, and all pregnancies where the woman is over 25 or where complications arose with a previous birth, should be confined in a specialist unit. Further decisions could then be made about the required levels of provision of GP units and specialist unit maternity beds.

This approach of first defining need and then setting some minimum standard to meet this need is a fairly common practice in health care. But a number of problems are associated with it.

These can be seen in terms of (a) defining need; (b) determining standards; and (c) resource considerations.

NEEDS

The question of defining need is fraught with difficulties. Need ought always to be a *relative* concept in the sense that there will normally be a consensus that some needs are more important than others, which is to say those needs which, if met, would result in a greater increase in health or satisfaction obtained. Need is too often defined in an absolute sense; consequently no mechanism exists for determining the relative priority to be attached to meeting different needs.

Planning services according to need can lead to other problems. If, as suggested above, the needs of the incontinent elderly were defined as requiring institutional care, then those of the elderly who exercised their rights to remain in their own homes, or whose relatives felt able to cope, would not move to institutional care, and there would then be

overprovision of institutional accommodation. Again, if need is somehow viewed in terms of total need, total met need, or total unmet need, then marginal met need, which is the least valued need that is currently being met, may be overlooked.

Again, if the needs of the incontinent elderly are defined in absolute terms and in isolation from the needs of, say, the mentally confused elderly, no mechanism will exist to determine how much of which needs to meet—assuming that not all needs can be met (Cooper, 1975; Culyer, 1976; Williams, 1978).

STANDARDS

Given these difficulties with the concept of need, it is not surprising that problems arise in laying down standards of care to meet need. Very often little is known about the effectiveness of different forms of care and this adds to the problems of deciding the type and level of care that ought to be provided.

To the decision-makers who define need and set standards of care it may seem ideal to propose that all incontinent elderly should be in hospital, but presumably these decision-makers would accept that even if it is not ideal, it is better that the incontinent elderly should be in residential homes rather than, say, living alone in the community. Such decision-makers would presumably also accept that if the incontinent elderly have to or want to live alone in the community, they should be provided with good support services, for example, from the district nurse. Thus, even with only one particular type of need, there are different levels of care involving different levels of resources which might go to meet that need to varying extents. With a blanket concept of need and a blanket concept of standard-setting there is a danger of giving little or no consideration to the *relative* strengths of different services or types of care in meeting need.

This becomes particularly important when 'need' is a continuously increasing function. For example, in maternity care, over a certain range of ages, the risk of complications in pregnancy increases gradually with age but there is no particular age at which this risk increases very suddenly. In forming a judgement about the age at which women should be confined in specialist units as opposed to GP units, it is therefore necessary, in the absence of resource considerations, either to have an arbitrary cut-off age or simply to argue that *all* babies should be delivered in specialist units.

USE OF RESOURCES

In the approach outlined above, a notable omission is the consideration of costs or resource use. Given this omission, it is not surprising that such

exercises may indicate that there is a large element of unmet need and that it is necessary to raise existing standards, thereby providing more and better facilities. However, in practice, there will not be enough resources for all the need-determined standards to be met. When this occurs, and too little thought has been given to relative priorities or to relative costs, it becomes extremely difficult to judge which needs should be met and which should be left unmet. It may not be possible to rethink either the problems, in terms of redefining standards at a lower and cheaper level, or the relative priorities associated with meeting, perhaps only partially, different needs. Bringing in cost draws attention to the fact that the priority attached to meeting a particular need is not just a function of the importance placed on that need—at least in a situation where it is not possible to meet all needs. It is also a function of opportunity cost, in terms of the benefits foregone through inability to meet other needs.

Generally, therefore, the approach of defining need, and then setting standards of care to meet that need, is bedevilled by the scarcity of resources, the difficulties of defining need, the problems of defining standards when little is known about effectiveness, the problems of meeting, often only partially, some needs as opposed to others, and the effort to ensure value for money in the context of opportunity cost. Many of these problems cannot be overcome without mounting sizeable research studies, but the use of marginal analysis can at least alleviate some of the difficulties.

The major change of emphasis in using marginal analysis to consider alternative patterns of care is that it starts from a wholly factual base: the fact that resources are scarce. There is a finite limit to the resources available to, and likely to be made available to, the health service. Within the health service, there is also a finite limit to the resources available to, and likely to be made available to, any particular programme. Marginal analysis thus immediately moves away from the question of attempting to define total need and concentrates on the following questions in a model of patterns of care:

- (i) given the existing resources available for a particular programme, could some re-deployment of these resources result in an increased benefit in toto from the programme?
- (ii) If additional resources were made available to the programme, how best could these be deployed to ensure the greatest possible increase in benefit from the programme?

- (iii) If resources for the programme were reduced, how best could cuts be made to ensure the minimum loss in benefit from the programme?

In practice it is not normally possible to answer all these questions in the kind of detailed, systematic, and quantified fashion that would be ideal. However, it is better to ask the right questions than to provide answers to the wrong ones.

In any programme in which balance of care is an issue it will be possible to examine the component parts of the programme between which a balance is to be struck. In maternity care, the component parts might be seen as family planning, ante-natal care, birth/confinement, and post-natal care; or, alternatively, as community care, GP unit care, and specialist unit care. Each of these subprogrammes can be viewed as an entity in itself, competing with the other subprogrammes for the limited resources available for the programme as a whole. There will be various costs and benefits associated with each subprogramme and, given a budget constraint for the total programme, the objective of planning will be to make the most of the resources available by deploying them across the subprogrammes in such a way as to maximise the benefit of the programme as a whole. This will be achieved when no switching of resources from one subprogramme to another results in an increase in total benefit from the total programme.

In essence, therefore, the approach looks at balance of care in the context of opportunity cost so that resources will be moved to subprogramme A from subprogramme B if by so doing the increase in benefit in A is greater than the loss of benefit in B. By looking at the effect of resource shifts between subprogrammes, the best pattern of care is reached. Note that there is no thought of setting *standards* of care, but rather of allowing levels of provision of care in different subprogrammes to be determined by the relative costs and benefits derived from the various subprogrammes, and of allowing what emerges to be determined endogenously rather than by exogenously and arbitrarily setting definitions of needs to be met and standards to meet those needs.

Probably in any service or subprogramme that may be examined, some attempt is already being made to get as much benefit as possible from the service. Thus, if a service organised on a rational basis is to be expanded, it can be expected that the benefit provided by each additional unit will fall. In other words, there will be a 'diminishing marginal benefit' (Williams and Anderson, 1975). This is shown in the Figure overleaf.

If the service is operating at the level OQ_1 , then

Figure Diminishing marginal benefit.

for each unit of the service the amount of benefit provided will be equal to or greater than OB. If the amount of the service is to be reduced by one unit, clearly the unit to cut is the last one, which is the Q_1^{th} unit itself. To take out any other unit would mean removing a unit (a visit, for example) which provided a higher level of benefit than that provided by the Q_1^{th} unit. If the service were to be expanded by, say, 10 units, then the choice of what to do with these additional units should be based on which of the possible ways of using each additional unit would yield the highest benefit. In the Figure these would be 10 units immediately to the right of Q_1 . If the cost of providing the service were zero, then the optimum level of the service would be OQ_2 , the Q_2^{th} unit being the last one which provides any positive benefit at all.

In practice, within any individual service, it is possible that organisation is not quite as rational as the example above suggests. But in an individual service where decision-making on deployment of resources is in the hands of a single individual or a small group familiar with that service and the objectives it is trying to meet, the decisions

probably are made approximately as described. The real problems arise when different services with different unit costs, different benefits, and different managers have to be brought together to obtain as much benefit as possible from the combined services and so to establish the best pattern of care for a programme.

In a programme with, say, two subprogrammes between which the best balance of care has to be achieved, the objective will be to try to ensure that the levels of the two subprogrammes are such that no switch of resources between them will result in an overall increase in benefit from the two subprogrammes in combination. This means that for each subprogramme the benefit and the cost of the marginal units should be compared. If it can be shown that the ratio of benefit/cost of the last unit currently being produced in subprogramme A is greater than the similar ratio in subprogramme B, then some reduction in B and some increase in A will be justified, because this will increase the overall total benefit from the available resources. This procedure would be continued until the benefit/cost ratio for the last unit produced in each subprogramme is the same, in other words, the ratio of the marginal benefit to the marginal cost is equal in each.

To help illustrate this, let it be assumed that the benefits and costs of the two subprogrammes are those shown in Table 1. To facilitate exposition, let it also be assumed that marginal cost is constant in each subprogramme, although in practice this may well not be so. If it were possible to measure all costs and benefits in money terms, as implied in Table 1, it would be much easier to solve many problems of health care planning. It is not possible, so the difficulties remain. But although the numerical example in Table 1 implies knowledge which is not normally available, what really matters in helping to solve these difficulties is the thinking behind the process rather than the numbers in themselves.

In subprogramme A, the most that should ever be supplied of this service would be six units. This is

Table 1 A hypothetical example of marginal analysis comparing two subprogrammes

Unit	Subprogramme A				Subprogramme B			
	Marginal costs	Total costs	Marginal benefits	Total benefits	Marginal costs	Total costs	Marginal benefits	Total benefits
	£	£	£	£	£	£	£	£
1st	10	10	35	35	20	20	60	60
2nd	10	20	30	65	20	40	50	110
3rd	10	30	25	90	20	60	40	150
4th	10	40	20	110	20	80	30	180
5th	10	50	15	125	20	100	20	200
6th	10	60	10	135	20	120	10	210
7th	10	70	5	140	20	140	0	210
8th	10	80	0	140	20	160	0	210

because the seventh and eighth units each provide a smaller benefit than the cost of producing them. Similarly, the maximum number of units which subprogramme B should be asked to produce would be five. In other words, the total benefit of eight units in subprogramme A is £140 and the total cost is only £80. Since the total benefit exceeds the total cost, is it justifiable to produce all eight units? The answer is 'No', because the production of both the seventh and the eighth units reduces the 'net benefit'—that is, the difference between benefit and cost. This example illustrates the importance of considering *marginal* benefits and costs.

If the total budget for this programme was £100, a number of combinations of outputs from A and B would be possible. Table 2 gives some examples.

Table 2 *A hypothetical example of choice of balance between two subprogrammes when the total cost is fixed*

Subprogramme A		Subprogramme B		Total programme (A + B)	
Units	Benefit £	Units	Benefit £	Total benefit £	Total cost £
8	140	1	60	200	100
6	135	2	110	245	100
4	110	3	150	260	100
2	65	4	180	245	100
0	0	5	200	200	100

The question then arises: which combination should be selected? To obtain as much benefit as possible from the combined subprogrammes, the choice would be four units of A and three units of B. For an expenditure of £100, this is the combination that yields the highest total benefit (£260).

It should be noted in Table 1 that the benefit of producing the fourth unit of A is £20 and the cost is £10. Therefore the ratio of marginal benefit to marginal cost is £20/£10—that is, two. For the third unit of B, the benefit is £40 and the cost is £20, so the ratio is again two (£40/£20). Thus, at the point where the greatest benefit is obtained from the combination of the two subprogrammes, the ratio of marginal benefit to marginal cost is the same in both subprogrammes. This, in effect, provides the 'decision rule' for determining the deployment of resources across different subprogrammes, no matter how many there may be. In other words, the point at which the maximum benefit is achieved from a given budget is the point where, for each subprogramme, the ratio of marginal benefit to marginal cost is the same in all subprogrammes. This rule is of central importance in considering alternative patterns of care.

One of the great strengths of this approach is that it does not require estimates to be made of total

costs or total benefits or total needs. It is *marginal* costs and *marginal* benefits that are fundamental.

It might appear, however, that the method can operate, as indicated above, only if marginal costs and marginal benefits can be measured. Fairly good estimates of costs, and of marginal costs in particular, can very often be made when patterns of care are being considered; for example, the balance of care of the elderly between the community, sheltered housing, residential homes, and hospitals; the pattern of maternity care with varying emphases on antenatal services, confinement/birth and postnatal care; or the mix of cancer services between health education, screening, and curative services.

Benefits are usually much more difficult to estimate and value. But judgements have to be made about the benefits of different services and programmes, whichever approach to evaluation is used. In the numerical example outlined in Table 1, given marginal costs in the two subprogrammes A and B (the former twice the latter) but no monetary values for benefits, the optimal distribution of resources between the two subprogrammes would be obtained when a *judgement* was reached that the marginal benefit in A was twice that in B and the budget was consumed. Thus, unless or until some of the very difficult problems of benefit measurement are solved, the use of marginal analysis will depend on the judgements of decision-makers about the relative magnitude of marginal benefit. It is important that these judgements should be about the right issues, namely, the *marginal* benefits.

Studies of the balance of care of the elderly have sometimes used this approach (Wager, 1972; Fanshell, 1975; Mooney, 1978). Thus, in deciding about the relative merits of domiciliary care, sheltered housing, residential homes, and hospitals, estimates should be made of the relevant marginal costs and judgements formed about the relevant marginal benefits.

For example, in seeking the balance between places in residential homes and geriatric beds, estimates can be made of the cost of providing additional places in residential homes to be taken up by geriatric inpatients, of the savings in resources for the hospitals, and a description at least of the patients likely to be involved in such a move. Similarly, estimates can be made of the cost of providing additional hospital beds to be taken up by old people in residential homes, of the savings in resources for the homes, and a description of the residents likely to be involved in such a move.

In deciding on the best balance, judgements would have to be made about the relative benefits

for the people concerned and compared with the costs of making the changes. The process of equating marginal benefit/marginal cost ratios would then come into play.

The important points about all this are:

1. The determination of the boundary between two types of care—and hence the balance of care—is a function of the relative costs and benefits of care in the different locations.
2. The determination of the balance of care does not require estimation of the costs and benefits of care for all individuals but merely for those likely to be affected by small shifts in the existing boundaries of care. This means those of relatively high dependency in residential homes and those of relatively low dependency in hospitals.

It is at present assumed that the question of benefit measurement has to be based on the judgements of the decision-makers, so *to this extent* the approach outlined does not differ from present procedures in deciding about health care. But there are important differences. Firstly, judgements take into account the costs of alternative policies, especially the marginal costs. Secondly, those judgements of benefits that have to be made are not of total benefits but only of *marginal* benefits. Thirdly, because the approach provides data about the characteristics of the people and/or care which are likely to be affected, information is obtained which allows relevant judgements to be made in an informed manner.

Thus, in the example discussed above, cost data can be provided about individuals who are close to the existing boundaries of care and a picture of their characteristics, of dependency, disability, and so on. built up. The relative costs of shifting different boundaries of care can be estimated and examined against informed judgements of the likely effects by presenting this type of cost data, not only on the margins between residential homes and hospitals, but also on the margins between the community and sheltered housing, the community and residential homes, the community and hospitals, sheltered housing and residential homes, and sheltered housing and hospitals.

The approach is not restricted to obtaining the best balance of care with existing resources. It can also easily be used to indicate the new balance of care that would be desirable if there were an increase or decrease in the resources available. It can also provide useful data on possible 'misplacement' of old people, which might lead to relocation of patients rather than to redeployment of resources.

The approach as so far outlined assumes no

qualitative changes within particular sub-programmes; it is solely concerned with quantitative changes in the balance of care between existing types of subprogrammes. But it need not be limited in this way.

For example, a case might be made for some kind of halfway house between residential care, with unqualified staff, and geriatric hospital care. Such accommodation might be proposed for very frail and dependent elderly people living in residential homes and/or for those in hospital who, in that setting, are relatively independent. The approach can accommodate a new form of care or a shift in quality of an existing form of care in the determination of the optimum balance of care, provided that (a) data can be obtained about the costs of the halfway house as well as about the characteristics of old people who are possible candidates for this type of care but who are currently in residential homes or hospitals and (b) decision-makers can make judgements about the relative benefits for these old people in the different institutions.

Marginal analysis of this kind provides a useful evaluative framework for examining questions of alternative patterns of care. It avoids the question of measurement of total need, which means that those who believe such measurement is impossible, costly, fruitless, or all three, do not have to concern themselves with the issue. It concentrates initially on the fact that limited resources are available both to the health service as a whole and to individual programmes of health care. It does not *solve* the question of benefit measurement, but by providing cost data on care, and offering descriptions of the effects of relatively small changes in the supply of services, it brings out the questions of trade-off which are essential in any planning of alternative patterns of care.

The use of this approach leaves a great deal to the judgements of the decision-maker. It provides estimates of the resource implications of redeploying resources within, to, or from a programme where alternative patterns of care are possible. The decision-maker is left to judge the relative effectiveness of different forms of care and the relative values attaching to them at the margin. But the framework is created through marginal analysis to allow him to see the opportunity costs involved in the different options between which he has to choose.

It must be emphasised that the application of marginal analysis in no way eliminates the need for epidemiological studies. In effect it serves to emphasise the importance of combining interdisciplinary skills when considering the complex issues of alternative patterns of care.

Conclusion

Certain economic techniques can be of assistance in examining alternative patterns of care and the thinking behind these techniques, rather than their practical application, has been emphasised here.

None of the techniques is particularly difficult to understand; indeed their apparent simplicity can lead the unwary into unfortunate errors in using them. In cost-effectiveness analysis, cost-benefit analysis, and the use of marginal analysis, the measurement of costs or benefits or both are recurrent themes. But they are recurrent themes in all health service evaluation. Economics may perhaps have an advantage compared with other disciplines in getting to grips with cost and benefit measurement, but this should always be carried out on a multidisciplinary basis.

There is no objective, scientific way of measuring benefit. There is no magic solution in terms of 'norms' or 'standards' which are 'right'. As Feldstein (1973) states: 'The search for a formula to identify the "correct" number of beds . . . is understandable. Finding a formula relieves the responsible officials of the difficult task of choosing on the basis of their preferences'. There is the nub of it. In part, at least, the reason why measurement of benefit can become an obsession is that it is all too easy to argue that, if it cannot be solved, then some 'formula' must be invented. Perhaps the obsession with benefit measurement arises from a reluctance to get on with expressing *explicit* preferences.

Economists frequently claim that health care planning is obsessed with ideals, standards, and meeting total needs, but the planners may readily reply that 'optimising' is a word that appears too often in economics textbooks. It is suggested that if the ideas expressed in this paper gained acceptance in health care planning, the health service might not be ideal but it would be improved.

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Mooney's enthusiasm about the potential of marginal analysis as a method for planning health care is, I believe, well placed. In the circumstances in which he describes it, it has much to offer. I cannot agree, however, that if it is used it will no longer be necessary to measure need. A small but significant proportion of the frail dependent elderly people to whom he refers do

not derive benefit from residential homes or geriatric hospitals. They are struggling, with or without support, in the community at large. Realistic planning must take their needs into account. The consolidation of epidemiological data relating to them with data derived from marginal analysis is certainly a field for co-operation between economists and epidemiologists. A second comment I would make is that, while I accept the usefulness of marginal analysis in planning chronic care for a considerably under-resourced group, be it the aged, the mentally ill, or the mentally handicapped, I suspect it would be more difficult to apply in planning acute services, especially those which employ high technology.

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