

Current Products and Practice

An Introduction to Economic Evaluation of Health Care

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Abstract *Economic evaluation is an accepted method for the appraisal of health care programmes. Although it is used widely in medicine, its use in the field of dentistry has achieved popularity more recently. Economic evaluation in dentistry is likely to become increasingly important in the future and this paper introduces readers to some of the basic concepts.*

Introduction

We never will have all we need. Expectation will always exceed capacity... This service must always be changing, growing and improving, it must always appear inadequate. (Aneurin Bevin, 1948)

Evaluation of health care programmes may be subdivided into evaluation of efficacy, effectiveness, efficiency and availability. The evaluation of efficiency is more commonly known as economic evaluation. Economic evaluation may be defined as 'the comparative analysis of alternative courses of action in terms of both their costs and consequences' (Drummond *et al.*, 1987). It is now a widely accepted tool for the appraisal of health care and this is reflected by the increasing number of research papers in this area in the medical literature. However, there remains misunderstanding, particularly amongst clinicians, as to the purpose and ethics of this technique. Economic evaluation basically sets out to answer two main questions: first, is this health procedure worth doing compared with other things we could do with the same resources and, secondly, are we satisfied that the health care resources should be spent in this way, rather than in any other way?

Economic evaluation in health care is most useful when certain other questions have already been answered and these include (Drummond *et al.*, 1987):

1. *Can* the health procedure/intervention work (the efficacy of the procedure)?
2. *Does* the procedure/intervention work (evaluation of effectiveness)?
3. Is it reaching those who need it (availability of the service)?

Economic evaluation is dependent on the quality of underlying medical evidence and, because of this, clinical trials are increasingly viewed as a natural vehicle for economic analysis (Drummond and Davies, 1991), although some have argued against this on the grounds that care in clinical trials is so different to normal practice that the data cannot be extrapolated (Evans and Robinson, 1980).

Why is Economic Evaluation Important?

As early as the seventeenth century, the British physician Richard Petty advocated greater social investment in medicine. This was based on his belief that the value of a saved human life far exceeded the cost (Torrance, 1982). Health care resources are limited by the total funds available, as well as through competition with other areas, such as housing and education. This raises the question of how to decide where the money should be allocated most appropriately. The establishment of a benchmark for an efficient level of health care provision is still to be found, and it must always be questioned whether the allocation of health care resources is efficient and equitable. It has been proposed that, faced with increased demands, but little increase in resources, the National Health Service has several options (Hine, 1999):

- (1) to become more efficient so that more individuals can be treated with the same resources;
- (2) to extend means testing so that some people may be excluded from certain services due to their wealth;
- (3) to increase 'rationing' or to provide a smaller range of services.

The way forward remains unclear and allocation of health care resources is likely to remain a contentious issue.

However, there is no doubt that resources are scarce and choices have to be made regarding their use. The aim is to maximize health from available resources whilst paying due concern to issues of equity (Donaldson, 1998). Allocation of funds is generally on two levels: planning and clinical (Carr-Hill, 1991). For planning decisions, this involves deciding whether or not facilities should be provided at all and, if so, where they should be located. Clinical decisions are then made by practitioners on behalf of individual patients or groups of patients. Economic evaluation is important because without systematic analysis, it is not possible to identify the relevant alternatives. In addition, the assumed viewpoint is important. A programme that looks attractive from a patient's viewpoint may look decidedly unattractive from the government's budget. The use of beta-interferon in the treatment of multiple sclerosis is a good example of this. Forbes *et al.* (1999) found that the benefits of interferon beta-1b were very low relative to its cost and estimated that in order to treat sufficient patients to prevent one

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individual becoming wheelchair bound would cost over 1 million pounds.

It is difficult to determine who should be responsible for this 'rationing' of health care. Health care and government agencies must decide how to allocate their resources for a wide range of very different interventions. This involves making difficult value judgements regarding the importance of certain health states. A number of arguments have been proposed in terms of 'need' for and/or 'right' to health care and certain moral issues, as well as medical decisions, need to be considered. Some procedure, therefore, has to be established to allow the most appropriate allocation. This was the basis for the introduction of cost-utility analysis, which assigns a ratio of cost to benefit and promotes efficient use of resources in a manner that is considered consistent with justice. Data from such studies may be used to produce QALY (Quality Adjusted Life Years) 'league tables' in which interventions are ranked based on their cost per QALY. The suggestion then is that those procedures that produce the lowest cost per QALY (and, therefore, give better value for money) would appear to be most attractive for funding. However, their use must be treated with caution and they should not be used to replace sensible judgement (Gerard and Mooney, 1993; Table 1).

What Does Economic Evaluation Involve?

Economic evaluation deals with costs and benefits and only when this information is available can decisions be made regarding the combination of health care interventions which should be made available to maximize benefits from the available budget. The basics of economic evaluation involve identifying, measuring, valuing, and comparing the costs and benefits of alternatives being considered (Drummond *et al.*, 1987).

The measurement of costs is similar regardless of the type of analysis being undertaken. Resources consumed can be divided in a number of different ways. For example, Robinson (1993b) used the classification of direct (staff wages), indirect (for example, loss of income due to illness), and capital costs (investments in buildings), but costs may also be divided into those borne by the NHS (staff, hotel services, drugs), those borne by the patient and family (for example, travel), and costs to the rest of society (for example, health education).

TABLE 1 Example of a QALY league table (Adapted from work by Culyer (1991), cited in Petrou and Renton (1993)).

Intervention	Cost per QALY gained (£)
GP advice to stop smoking	170
Pacemaker implantation for heart block	700
Hip replacement	750
CABG for severe angina (left main disease)	1040
GP control of serum cholesterol	1700
CABG for severe angina (two vessel disease)	2280
Kidney transplant	3000
Breast cancer screening	3500
Heart transplantation	5000
CABG for mild angina (two vessel disease)	12,600
Hospital haemodialysis	14,000

The benefits of an intervention are usually health improvements, which can be measured in a number of ways including:

1. Health effects, for example, cases found, cases prevented, lives saved.
2. Economic benefits that can be measured in direct (savings in health care costs because the programme makes the person healthier), indirect (individuals are able to return to work), and intangible benefits (monetary value of the reduction in pain and suffering).
3. Value of the health improvement itself to the patient, family and society, regardless of the economic consequences.

However, the real cost of any health care intervention is the loss of health outcomes from other programmes that have been forfeited by putting the resources in question into the first programme, this is known as the 'opportunity cost' (Donaldson, 1998). Opportunity costs rest on the two principles of scarcity and choice. Scarcity means that societies do not have enough resources to meet all their citizens' desires. As a result of scarcity, choices have to be made as to which activities a society should undertake and which should not be undertaken. Opportunity cost is of major importance to the economist and the aim of economic evaluation of health care services is to ensure that the benefits of the programmes implemented are greater than the opportunity costs of such programmes.

Methods of Economic Evaluation

Drummond *et al.* (1987), Donaldson (1990), and Robinson (1993a-e) discussed four methods of economic evaluation:

- (1) cost-minimization;
- (2) cost-effectiveness;
- (3) cost-utility;
- (4) cost-benefit analyses.

Table 2 provides details of the four types of evaluation.

Cost-benefit and cost-utility analysis both address the issue of outcome valuation and, therefore, shed more light on whether certain treatments are worthwhile. In contrast, cost-minimization and cost-effectiveness assume that the intervention is worthwhile. However, as mentioned earlier, it is important to realize that none of these analyses can be used to replace sensible judgements, but may be used as an adjunct to decision-making. Care is also called for when studying papers that claim to use a certain analysis. Zarnke *et al.* (1997) studied papers that claimed to use cost-benefit analysis. Of 95 papers that met the inclusion criteria, only 30 (32 per cent) met the definition of a cost-benefit analysis and the majority of the remaining papers were cost comparisons. Interpreting cost comparisons as if they were true cost-benefit analyses makes communication between health care researchers and policy makers very difficult, and may have detrimental consequences when resources are allocated.

Economic evaluation studies require critical appraisal in the same way as any other research paper and certain key questions must be asked. For example, are the study questions clear and relevant and are the conclusions appropriate? In addition, it must be asked whether the under-

TABLE 2 Types of economic evaluation

Type of analysis	
Cost-minimization analysis (CMA)	Used when the outcomes of two procedures being compared are proven to be the same (for example, day stay or overnight stay treatment for removal of impacted third molars) The aim is usually to find the lowest cost programme May be included as a form of cost-effectiveness analysis
Cost-effectiveness analysis (CEA)	The most widely used method of economic analysis until the 1980s Answers the question 'Given that it has been decided that this type of health care will be provided, what is the best way of doing so?' Used when the programmes may have differential success in outcome, as well as differential costs. The outcomes vary but can be expressed in common natural units such as 'life years gained' or 'blood pressure reduction' and cost-effectiveness is normally expressed as cost per unit effect A useful technique for comparing alternative programmes whose effects are measured in the same units but cannot be used to assess an isolated single programme and it is not possible to compare interventions which have several types of clinical effects. It was this disadvantage that led to the development of cost-utility analysis (CUA)
Cost-utility analysis (CUA)	Should be the method of choice when quality of life is either <u>an</u> important outcome or <u>the</u> important outcome The ideal method when the intervention affects morbidity and mortality or when treatments have a wide range of different outcomes and a common unit is required Said to lie somewhere between cost-benefit and cost-effectiveness analysis 'Utility' is a term used by health economists to refer to the subjective level of well-being that people experience in different health states Utility-based measures are usually expressed in terms of quality adjusted life years (QALYs) which are weighted utility values. Information from QALYs, along with costs, can be used to guide resource allocation.
Cost-benefit analysis (CBA)	One of the most comprehensive methods of economic evaluation which is available If the outcomes of two health programmes differ (for example, comparing hypertension screening with flu vaccination) then a common denominator must be established to allow comparisons of outcome. Cost-benefit aims to do this, usually in terms of money. It can look at one health care programme in isolation, although the alternative of doing nothing or continuing current practice is always implied (Donaldson, 1990). May take one of two approaches: the human capital approach or individuals' observed/stated preferences

lying epidemiological data is of sufficiently good quality, and whether the assumptions made in estimates of benefits and costs are appropriate? If there is doubt over these issues then sensitivity analyses must be undertaken as a way of dealing with unreliable or missing data (Donaldson, 1998). A further issue that must be taken into account is the fact that not all costs and benefits occur at the same time, for example, costs of prevention are incurred early to produce benefits later. Most economists agree that costs (and benefits) occurring at different times should be weighted differently. Allowance needs to be made for the differential timing of costs and consequences, so-called 'time preference', and this is achieved by 'discounting' (Drummond *et al.*, 1987; Torgerson and Raftery, 1999).

Economic Evaluation in Dentistry

It is likely there will be an increased demand for economic analyses of dental interventions by the public and by those funding health care. Both the NHS and private insurance companies are likely to demand increased evidence of value for money in the future. This is particularly important in fields that may be perceived as 'cosmetic'.

To date, the analyses that have been used most frequently are cost-effectiveness and cost-benefit, and studies have focused largely on comparison of restorative materials (Mjör, 1992; Smales and Hawthorne, 1996; Mjör *et al.*, 1997; NHS Centre for Review and Dissemination, 1999) and preventive techniques (Klock, 1980; Morgan *et al.*, 1998). One example of clinical trials and economic evaluation being undertaken concurrently is that by Severens *et al.*

(1998), who assessed the short-term cost-effectiveness of pre-surgical orthopaedics in babies with a complete unilateral cleft of the lip and palate. There was a significant difference in both medical and indirect costs for the two groups with the pre-surgical orthopaedic group being higher. However, the outcome, which was assessed in terms of operating time, was found to be non-significant. Thus, concluding that pre-surgical orthopaedics was not cost-effective in terms of reduced operating time. Other important outcome measures such as appearance and function are to be reported at a later stage.

There are relatively few utility or cost-utility studies in the field of dentistry, which probably reflects the increased difficulty and time-consuming nature of utility studies. However, the utility method is particularly useful in the field of dentistry because treatments frequently produce improvements in quality of life. In addition, QALY-based investigations in dentistry would also allow comparison of dental interventions with other forms of medicine. A paper in 1997 expressed surprise that the QALY has rarely been used in dentistry and noted the importance of training more personnel in the techniques necessary to undertake utility analyses (Sendi *et al.*, 1997).

Krischer (1976) investigated the utility structure of decision-making in the treatment of cleft lip and palate (CLP). Utilities were assessed from a questionnaire, and both clinicians and families of CLP children were included. The author found significant differences between clinicians and families when assessing cosmetic outcome and speech. However, because the questionnaire was devised by the author and did not use one of the standard methods of utility assessment, it is difficult to draw conclusions.

Other utility studies have been undertaken in the fields of:

1. Restorative dentistry: Fyffe and Kay (1992) assessed the average utility values for four different 'tooth states' in which the highest mean utility values were for the restored tooth, and lowest values for the decayed and painful posterior tooth. Downer and Moles (1998) used a computer simulation to study the influence of relevant factors on health gain from restorative treatment under varying assumptions and compared this with a 'do nothing' approach.
2. Maxillofacial surgery: Armstrong *et al.* (1995) and Brickley *et al.* (1995) studied the relative utility values for possible outcomes of surgery and non-intervention in the management of third molars. Downer *et al.* (1997) used a convenience sample to elicit the public's perceptions of different oral cancer states (pre-cancer, small cancer, and large cancer).

There are few examples of economic evaluation in orthodontics. Although there are no true cost-utility or cost-benefit analyses, some authors have determined utility values for certain health states and this research could be combined with costings to fulfil the criteria of a cost-utility analysis. For example, Cunningham and Hunt (2000a) determined utility values for orthognathic patients pre-operatively using three standardized techniques (rating scale, standard gamble, and time trade-off). A further paper by Cunningham and Hunt (2000b) compared utility values with willingness-to-pay values for orthognathic patients. Fox *et al.* (2000) used a utility approach in which they developed a questionnaire using the aesthetic component of the Index of Treatment Need (Evans and Shaw, 1987) and found that patients seeking orthodontic treatment gave lower utility values for the aesthetic components 5 and 8 than those not wanting treatment.

Conclusions

The number of papers describing economic evaluation in dentistry is increasing rapidly and such data is likely to be required in the future when resource allocation is considered. It is therefore of great importance that clinicians understand the basics of these techniques if they are to play a part in the decision-making process. The application of the principles of economic evaluation are necessary to design health services that produce the best health care for the community based on available resources.

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