

Economic evaluation of healthcare — is it important to us?

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Economic evaluation is now an accepted method for the appraisal of healthcare programmes. Although it is used widely in medicine, its use in the field of dentistry is only just beginning to achieve popularity. Economic evaluation in dentistry is likely to become increasingly important in the future and this paper aims to introduce the basics of the technique as well as describing some of the dental settings in which it is currently being used.

'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.'

ANEURYN BEVIN, 1948

What is economic evaluation?

The economic evaluation of healthcare programmes has become more important in recent years and this is reflected by an increase in the literature. It is now an accepted tool for the appraisal of healthcare programmes. Studies may be conducted from the viewpoint of individual recipients of healthcare, healthcare providers or society generally¹ and such investigations are now being undertaken by researchers from many different fields including economists, medical researchers and clinicians. Economic evaluation may be defined as 'the comparative analysis of alternative courses of action in terms of both their costs and consequences.'² It involves two main areas, first, the costs and consequences of programmes and, second, choices which have to be made in allocation of resources. Although sometimes viewed with suspicion by both clinicians and the general public, economic evaluation does aim to determine how resources can give the greatest benefit.

Any economic analysis involves measure-

ment of both the benefits of healthcare and also the costs.³ It aims to answer two main questions:

- Is the health procedure in question worth doing compared with other things we could do with the same resources?
- Are we satisfied that the healthcare resources should be spent in this way rather than in any other way?

Benefits may be divided into gains in health status (direct benefits) as well as other indirect benefits (eg production gains). Costs may be divided into direct medical costs (eg costs to the NHS), direct non-medical costs (eg family expenditure, social services) and indirect costs or productivity costs (eg changes associated with treatment such as time off work, earlier return to work). One term which is particularly important is 'opportunity cost', or the

value of a resource in its best alternative use, and evaluations therefore aim to compare opportunity costs with the improvement in health as a result of the intervention under examination.⁴

It is important that those individuals who are involved in the provision and purchase of healthcare fully understand the background to this concept and understand some of the terms which are commonly used. Without good economic analysis, healthcare is unlikely to progress and only by undertaking systematic reviews is it possible to identify alternatives to existing or new programmes. Such evaluation is dependent on the quality of underlying medical evidence and, because of this, clinical trials are now viewed as a natural vehicle for economic analysis.⁵ However, economic evaluation in healthcare is most useful when certain other questions have already been answered and these include:

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).

The economic evaluation of healthcare shows certain important differences when compared with other commodities.⁶ Economics is concerned with choice and the assumption is made that choices are made after the consumer has been provided with full information. However, individuals who present within the healthcare sector are frequently unwilling or unable to collect the information required to make this choice. This is further complicated by the fact that the individual supplying the information is also the person supplying the treatment, something which does not generally happen in other fields. Other areas which make healthcare different include the fact that it is consumed on the assumption that benefits in health status will result and individuals are rarely voluntarily engaged in the use of healthcare programmes. This latter point is one where dentistry may differ from the rest of the healthcare field.

In brief

- Economic evaluation of healthcare programmes is now common-place in medicine and is becoming increasingly important in dentistry.
- Increased research in the field of economic evaluation in conjunction with clinical trials is required in dentistry in both primary care and hospital settings.
- This paper reviews the various methods of economic evaluation and also gives examples of some of the current research in the field of dentistry.

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REFEREED PAPER

Received 5.05.99; accepted 24.08.99

© British Dental Journal 2000; 188: 250–254

Allocation of resources

The allocation of healthcare resources has always been a controversial issue. Since the introduction of the National Health Service, there has been a basic problem that resources are limited and the demands can not be met. The questions which should always be asked are — is the allocation of healthcare resources efficient? and, is the allocation equitable?

Healthcare and government agencies must decide how to allocate their resources for a wide range of very different health care interventions. This involves making difficult judgments regarding the importance of certain health states. A number of arguments have been proposed in terms of 'need' for healthcare and/or 'right' to treatment. Goold proposed that the only fair way of resource allocation is to have two levels of organisation.⁷ The first, based on the existing government structure, should be responsible for making broad decisions, such as the amount of money allocated to health care. The second level, made up of community organisations with a membership which represents a wide range of health related interests, would be involved in the making of policy decisions and the development of guidelines.

Healthcare is limited by the total amount of resources available as well as through competition with other areas, such as housing and education and it is difficult to determine who should be responsible for the 'rationing' of healthcare. When rationing of resources becomes necessary, some procedure has to be set up to allow the most appropriate allocation. This was the basis for the introduction of cost-utility analysis (see later). There are three main theories which have been proposed to assist the allocation of resources, none of which is without faults.⁸ Although these theories are unlikely to be useful on an every day basis, they may aid the development of guidelines:

1. *The Utilitarian Theory* which argues that healthcare should be distributed so as to maximise the health of society (eg increase life expectancy; reduce infant mortality) without regard to how that good is actually distributed.

2. *The Egalitarian Theory* which is based on the concept that everyone has a claim to the amount of healthcare resources which gives them a level of health equal to that of others.

3. *The Rawlsian Theory*⁹ which proposes that each person has an equal right to the system and when making social and economic choices, those who are least advantaged should have maximum benefit.

Methods of economic evaluation

Robinson,¹⁰⁻¹⁵ Drummond *et al.*,² and Donaldson³ discussed a number of methods of economic evaluation currently in use: cost-minimisation analysis (CMA), cost-effectiveness analysis (CEA), cost-benefit analysis (CBA) and cost-utility analysis (CUA). These are terms which should be understood as they are likely to be seen more frequently in the literature in the future. It is, however, important to realise that these are only an adjunct to decision making.

Cost-minimisation analysis

This form of analysis is used when the outcomes of two procedures being compared are identical and it is important that the outcomes of the alternative programmes are proven to be the same if the method is used. The aim is usually to find the lowest cost programme and the unit of measurement is cost per intervention. There are few examples in dentistry which would fall into this type of analysis, except perhaps a situation where third molars could be removed as a day case or in-patient stay, with identical outcome. It would then be possible to calculate the costing for both methods and to select the lowest of the two.

Cost-effectiveness analysis

Cost-effectiveness was the most widely used method of economic analysis until the 1980s. It 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?' This method is used when the programmes may have differential success in outcome, as well as differential costs, but the outcome must be common to both programmes (eg life years gained; blood pres-

sure reduction). For example, a comparison of several different materials for dental restorations was published recently by the NHS Centre for Reviews and Dissemination.¹⁶ In any study such as this, it is not the cheapest programme *per se* which is of interest, the aim is to find the most efficient treatment option in terms of cost per unit effect (eg cost per tooth year gained).

The disadvantage of the cost-effectiveness approach is that it cannot be used to assess a single programme or to compare interventions which have several different clinical effects. It was this disadvantage which led to the development of cost-utility analysis (CUA). There are a number of similarities between CEA and CUA and the two terms are sometimes used synonymously.

Cost-benefit analysis

If the outcome of two health programmes differs, then a common denominator must be established to allow comparisons of outcome. One way of doing this is in monetary terms and cost-benefit analysis aims to measure the costs and the consequences in terms of pounds, dollars etc. CBA differs from cost-effectiveness and cost-utility analyses in that costs and benefits of healthcare are expressed in the same units. It is a difficult concept because placing a monetary value on life or relief of suffering is a concept which many find difficult. When assessing a programme in this way, there is usually an assumption that the alternative is to do nothing and this itself may have costs associated with it. It is worth noting that many studies which call themselves 'cost-benefit analyses' are not true CBAs and, in fact, compare the costs of treatment with cost savings.

CBA has a solid foundation in welfare economics and it is one of the most comprehensive methods of economic evaluation which is available. Two main approaches are used. The first is the human capital approach, which values health improvement on the basis of the individual's future 'worth' to society in terms of future earnings. The second method is the so-called 'willingness to pay' approach where respondents are asked how much they would be prepared to pay for a certain form of health

intervention (or alternatively, how much they would be 'willing to accept' to forego this intervention). It is a technique which has been used widely in environmental issues but has only been used relatively recently in healthcare.¹⁷⁻¹⁹ Both methods have problems associated with them, particularly the use of the willingness-to-pay method in a society which is not used to paying for healthcare. However, this method may prove useful in analysis of certain forms of dental intervention. For example, comparing the willingness to pay for implant retained prostheses against conventional dentures.

Cost-utility analysis

Utility refers to the value or worth of a particular health state or an improvement in that health state. Utility values lie between 0 and 1, where 0 is equivalent to death and 1 is equivalent to perfect health. CUA should be the method of choice when quality of life is an important outcome. It is also the ideal method when interventions affect both morbidity and mortality or when treatments have a wide range of different outcomes and a common unit is required. Utility values may be estimated using values quoted in the literature or they may be measured directly using a number of techniques such as the Standard Gamble²⁰ or the Time Trade-Off.²¹⁻²³ In CUA only final data (eg lives saved; days of illness avoided) can be used. Intermediate data, such as cases found, cannot be used as they cannot be converted into QALYs gained.

Utility based measures are usually expressed in terms of quality adjusted life years (QALYs) gained, which are calculated by multiplying the change in utility value as a result of medical intervention by the years of life remaining. The cost per QALY is then calculated and this can be used to produce 'league tables' which list interventions in order of cost per QALY. This in turn may be used to guide resource allocation although there is still a great deal of controversy associated with their use.²⁴ For example, the well known Oregon Study, which aimed to develop a priority list for proposed rationing for individuals on Medicaid,

found that the use of splints for temporomandibular joint dysfunction came out higher than appendectomy. The major surprise here being that treatment for TMD was not only ranked higher than a life saving procedure but that it was also a relatively cheap life saving procedure.²⁵ It therefore becomes obvious that the information should be handled carefully before making decisions.

The principle behind CUA is that a QALY gained is considered to be worth the same no matter who receives it. Recent papers have suggested that QALYs could be valued differently depending on how seriously ill the individual is. This approach has important implications in the field of dentistry as patients are not seriously ill and treatment may be considered less worthwhile under this system of equity weights.²⁶

CUA may be seen as an improvement on CEA as it attempts to combine more than one outcome measure. It may also be seen as an improvement on CBA as it permits ranking of programmes without the need to place monetary values on the benefits. This is a useful method of economic analysis when looking at dental interventions which produce changes in quality of life, for example, improvements following orthodontic treatment or following the placement of implant retained prostheses rather than conventional dentures.

Economic evaluation in dentistry

'When alternative therapies are available, patients want the choice of treatment to be based on processes that are cost-effective and have proven outcomes.'²⁷

It is likely there will be an increased demand for economic analyses of dental interventions by the public and by those funding healthcare and the National Institute for Clinical Excellence (NICE) may play an important role in this area in the future. Both the NHS and private companies are likely to demand increased evidence of value for money in the future. This is particularly important in areas which may be perceived as 'cosmetic'.

Economic evaluation is still used less frequently in dentistry than in medicine. However, this is beginning to change. A recent

computerised literature search showed the following:

- 'Cost effectiveness and dentistry' produced 388 papers published between 1971 and 1999 with 67 of those in 1997/98
- 'Cost benefit and dentistry' produced a total of 370 papers published between 1971 and 1999 with 66 of those in 1997/98
- 'Cost utility and dentistry' produced only 18 papers, all of which were published between 1980 and 1998 with 5 of those in 1997/98
- 'Cost minimisation and dentistry' produced no papers at all.

It is, however, worth noting that a number of papers were listed under both cost benefit and cost effectiveness. This stresses the importance that papers must be read carefully to determine which method of analysis was actually used. It is also worth noting that a large number of the papers which were listed, had not undertaken any form of economic analysis and merely mentioned that economic evaluation would be a useful next step in research. A relatively small number of the papers had undertaken carefully controlled economic evaluation.

Cost effectiveness and cost benefit studies are therefore carried out much more frequently than cost utility studies, which probably reflects the increased difficulty and time consuming nature of cost utility type studies. However, the cost utility method would be 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 some method of comparing dental interventions with other forms of medicine.

Cost effectiveness and cost benefit studies have focused largely on comparison of restorative materials²⁸⁻³⁰ and cost implications of fluoride, fissure sealants and caries prevention.³¹⁻³⁴ Recent years have also seen a number of papers undertaking economic analysis of implants.³⁵⁻³⁷

The following examples of economic evaluation in dentistry have been selected to illustrate the issues described in the previous sections. It is not intended to be an exhaustive list.

A good example of clinical trials and economic evaluation being undertaken concurrently is that by Severens *et al.* who assessed the short-term cost effectiveness of pre-surgical orthopaedics in babies with a complete unilateral cleft of the lip and palate.³⁸ There was a significant difference in both medical and indirect costs for the two groups with the pre-surgical orthopaedic group being higher. However, there was no significant difference in outcome (which was assessed in terms of operating time) between the two groups. Thus concluding that pre-surgical orthopaedics was not cost-effective in terms of reduced operating time. Obviously, other important outcome measures such as appearance and function must be assessed but these were not reported in this paper.

Klock looked at CBA and CEA of a preventive programme (including oral hygiene, fluoride application and fissure sealants) and found that in spite of a reduction in caries activity, the programme was uneconomic compared with traditional dental care.³² In contrast, Morgan *et al.*³³ assessed the cost-effectiveness of a preventive programme in two non-fluoridated regions of Australia and concluded that the introduction of a preventive programme was an efficient use of resources. They also stressed the need for systematic evaluation of a full range of dental prevention and treatment programmes.

A number of cost-effectiveness studies in dentistry have looked at different restorative materials. Mjör studied the cost-effectiveness of restorative materials for two and three surface restorations undertaken in Norway and found amalgam to be the most cost-effective, followed by composite and then gold.²⁸ A similar analysis of cost-effectiveness in the UK also found amalgam to be the most cost-effective material.³⁰ It was proposed that the cost-effectiveness of composites in particular was lower due to the shorter longevity and the higher cost of these restorations. A recent paper reported a systematic review of intra-coronal dental restorations in terms of their longevity and cost-effectiveness.¹⁶ It was noted that of the 30 economic studies identified, the majority were generally of poor quality, and the paper

called for improved research in this area.

A more recent area of interest is that of implant retained prostheses. MacEntee and Walton looked at the costs associated with implant retained prostheses and conventional dentures.³⁵ Jacobson *et al.* undertook one of the few utility based dental investigations in which implant retained prostheses and conventional dentures were compared using a rating scale method.³⁶ They concluded that this was a reliable measure of patients' preferences and the implant group rated a successful implant-supported prosthesis as higher than a functional, fitting, aesthetic conventional denture, in spite of higher costs and longer periods of non-function.

There are relatively few cost-utility studies in the field of dentistry. A study in 1992 by Fyffe and Kay assessed the average utility values for four different 'tooth states' which it was hypothesised would have different values.³⁹ They found that the highest mean utility values were for the restored tooth and lowest values for the decayed and painful posterior tooth. Values were obtained from both dentists and members of the general public and, perhaps not surprisingly, dentists gave higher utility values when compared with members of the general public. Downer and Moles also studied the influence of relevant factors on health gain from restorative treatment.⁴⁰ O'Brien *et al.* undertook the only example which was found of utility analysis in orthodontics.⁴¹ They developed a TTO scale questionnaire using the aesthetic component of the Index of Treatment Need and found that patients seeking treatment gave lower utility values than those not wanting treatment. However, with the visual analogue scale there was no significant difference. It was proposed that this method could also be used as a method for predicting patient compliance.

In the field of oral medicine/oral pathology, Downer *et al.*⁴² used the Standard Gamble method to elicit the public's perceptions of different oral cancer states — precancer, small cancer and large cancer and found utility values of 0.92 for precancer, 0.88 for stage 1 cancer and 0.68 for stage 2

cancer. These values then allow the QALYs gained and the cost per QALY involved in the treatment of such lesions to be calculated.

The future

Only by improving research in economic evaluation and by improving planning and management systems will the health service progress. It is becoming increasingly obvious that demands for treatment can not be met and that choices need to be made. Alongside this, governments and third party payers have intensified their search for better value for money.

As more papers involving economic evaluation are seen in the literature, it is important that all those involved in the provision and purchasing of healthcare have a full understanding of the methods in current use. Also, an increasing number of clinicians are likely to be involved in this field of research and will be required to have a knowledge of the techniques.

There are many areas in dentistry which would benefit from clinical studies also incorporating some form of economic evaluation. Developments including new restorative materials, increased use of implants, aesthetic type dentistry (for example, complex crown and bridge work) and comparisons of adult and adolescent orthodontic treatment are all areas which could be studied.

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