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Room Q

Economic problems are a major issue for virtually all healthcare systems, confronted as they are by an exponential increase in demand for healthcare services against a background of limited resources with which to meet these levels of demand. The economic problem arises because there will never be enough resources to completely satisfy human desires. Because resources are scarce, choices have to be made about different ways of using them. In addition, despite the growth in evidence relating to effectiveness and ineffectiveness, there remain many areas in which there is a dearth of such evidence. Occasionally it is instructive to see how evidence is used in making decisions in scientific areas outside medicine.

**VALIDITY AND CAUSATION**

Suppose you had data which showed that there was a highly significant inverse correlation between central bank independence and inflation: low inflation occurred in countries with highly independent central banks. The obvious decision, if you wanted low inflation, would be to create an independent central bank, and that has been a major tenet of economic thinking for a decade or so.

James Forder's trashing of this theory [1] originates in the fact that measures of central bank independence were so poor and inconsistent as to deny any relationship. We can't measure independence, so can't pontificate as to causation. Health care decisions likewise require outcomes which make sense, and in whose measurements we can trust.

**FEEL THE WIDTH**

No matter how much information we have, making a decision is often hard. Derek Pooley, faced with decision-making on renewable energy sources, used the simple guide of cost per tonne as a way of sharpening the mind [2]. This is a bit like a cost per QALY (the quality-adjusted life year) used in health care. Many people think it is a crude measure, but since adequate measures are unavailable (and may be impossible to get anyway), it has to serve. Ceri Phillips gives a good explanation of QALYs and costs [3], and some illustrative costs per QALY are shown in Table 1.

**TABLE 1. COST PER QALY FOR HEALTHCARE INTERVENTIONS**

Intervention	£/QALY
Neurosurgical intervention for head injury	240
GP advice to stop smoking	270
Neurosurgical intervention for subarachnoid haemorrhage	490
Antihypertensive treatment to prevent stroke (45-69 years)	940
Pacemaker implant	1,100
Hip replacement	1,180
CABG (left main vessel disease, severe angina)	2,090
Kidney transplant	4,710
Heart transplant	7,840
Home dialysis	17,260
Hospital dialysis	21,970

## WHAT IS A QALY?

A QALY takes into account both quantity and the quality of life generated by healthcare interventions. It is the arithmetic product of life expectancy and a measure of the quality of the remaining life years. A year of perfect health is worth 1; a year of less than perfect health life expectancy is worth less than 1. Death is considered to be equivalent to 0, but some health states may be considered worse than death and have negative scores. QALY provides a common currency to assess the extent of the benefits gained from a variety of interventions in terms of health-related quality of life and survival for the patient. When combined with the costs of providing the interventions, **cost-utility ratios** result; these indicate the additional costs required to generate a year of perfect health (one QALY). Comparisons can be made between interventions, and priorities can be established based on those interventions that are relatively inexpensive (low cost per QALY) and those that are relatively expensive (high cost per QALY). A cost-utility ratio is the difference between the costs of two interventions divided by the difference in the QALYs they produce (Figure 1). An example of this is to be found in pre-operative smoking intervention on postoperative morbidity [4].

FIGURE 1

**Cost-utility ratio – an example**

$$\text{Cost-utility ratio} = \frac{\text{Cost of Intervention A} - \text{Cost of Intervention B}}{\text{No. of QALYs produced by Intervention A} - \text{No. of QALYs produced by Intervention B}}$$

## LIMITATIONS OF QALYS

While QALYs provide an indication of the benefits gained from a variety of medical procedures in terms of quality of life and survival for patients, they are far from perfect as a measure of outcome. For example, they suffer from a lack of sensitivity when comparing the efficacy of two competing but similar drugs and in the treatment of less severe health problems.

## QUICK AND CLEAN

Just how to use cost per QALY in health care decision-making is shown in a superb paper from Andrew Stevens and his colleagues from Wessex in 1995 [5]. This paper, which draws together all the themes in making decisions about new interventions, should be required reading for everyone involved in decision making in health care sectors. It provides guidance for ordering one's thoughts. The paper also introduces Buxton's Law: "it is always too early to evaluate a new technology until unfortunately suddenly it's too late". It sets out seven stages needed for assessing technology (loaded towards the new, but highly applicable to existing technologies), and emphasises the importance both of analysis - drawing together information from a wide range of sources to bolster evidence from systematic review and meta-analysis - and costs - which have to be dealt with pragmatically.

They give us a simple guide to making decisions based on levels of evidence and cost per QALY. Pragmatism is the name of the game. If, for instance, costs are lower than £3,000 per QALY, then the need for randomised trials may be relaxed (Figure 2). It is worth having a copy of this thoughtful and influential paper on your desk for re-reading at quiet moments.

FIGURE 2. DECISION MAKING ON EVIDENCE AND COST

		<b>Cost per QALY (£,000)</b>			
<b>Evidence</b>		<b>&lt;3</b>	<b>3-20</b>	<b>&gt;20</b>	<b>Negative</b>
<b>I</b>		<b>Strongly support</b>	<b>Strongly support</b>	<b>Limited support</b>	<b>Not supported</b>
<b>II</b>		<b>Strongly support</b>	<b>Supported</b>	<b>Limited support</b>	<b>Not supported</b>
<b>III</b>		<b>Supported</b>	<b>Limited support</b>	<b>Limited support</b>	<b>Not supported</b>
<b>IV</b>		<b>Not proven</b>	<b>Not proven</b>	<b>Not proven</b>	<b>Not proven</b>

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The values of evidence are ranked according to the following classification in descending order of credibility: **I.** Strong evidence from at least one systematic review of multiple well-designed randomised controlled trials, **II.** Strong evidence from at least one properly designed randomised controlled trial of appropriate size, **III.** Evidence from well-designed trials such as non-randomised trials, cohort studies, time series or matched case-controlled studies, **IV.** Evidence from well-designed non-experimental studies from more than one centre or research group, opinions of respected authorities, based on clinical evidence, descriptive studies or reports of expert committees.

## WHAT IS COST-EFFECTIVENESS ANALYSIS?

Cost-effectiveness analysis (CEA) is a technique of economic evaluation designed to compare the costs and benefits of a healthcare intervention to assess whether it is worth implementing. The choice of technique depends on the nature of the benefits specified. In CEA the benefits are expressed in non-monetary terms related to health effects, such as life-years gained or symptom-free days, whereas in cost-utility analysis they are expressed as quality-adjusted life-years (QALYs) and in cost-benefit analysis in monetary terms. As with all economic evaluation techniques, the aim of CEA is to maximise the level of benefits – health effects – relative to the resources available.

## WHAT IDENTIFIES COSTS AND BENEFITS?

The identification of costs and benefits involves placing them in certain categories.

Costs are seen differently from different points of view. In economics the notion of cost is based on the value that would be gained from using resources elsewhere – referred to as the opportunity cost. In other words, resources used in one programme are not available for use in other programmes, and, as a result, the benefits that would have been derived have been sacrificed. It is usual, in practice, to assume that the price paid reflects the opportunity cost and to adopt a pragmatic approach to costing and use market prices wherever possible. In CEA it is conventional to distinguish between the direct costs and the indirect costs associated with the intervention, together with what are termed intangibles, which, although they may be difficult to quantify, are often consequences of the intervention and should be included in the cost profile:

- Direct costs: *Medical*: drugs; staff time; equipment. *Patient*: transport; out-of pocket expenses.
- Indirect costs: Production losses; other uses of time.
- Intangibles: Pain; suffering; adverse effects.

It is essential to specify which costs are included in a CEA and which are not, to ensure that the findings are not subject to misinterpretation.

## CATEGORIES OF EFFECTS/BENEFIT

- *Disease-specific effects*: specific outcomes resulting from anaesthesia, such as recovery time, improvements in pain scores, and return to normal functioning.
- *Utility effects*: measures that can be used to compare health status across all healthcare interventions, such as healthy days quality-adjusted life year (QALY).
- *Economic effects*: resources released, and expressed in monetary terms, by improvement in recovery and discharge times and the treatment of emesis rather than prophylaxis.

## HOW TO USE A COST-EFFECTIVENESS ANALYSIS?

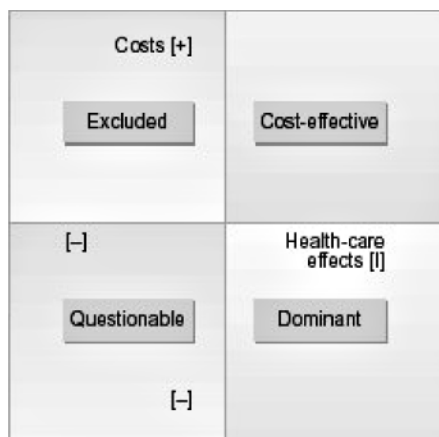
A distinction must be made between those interventions that are completely independent – i.e., where the costs and effects of one intervention are not affected by the introduction or otherwise of other interventions – and those that are mutually exclusive – i.e., where implementing one intervention means that another cannot be implemented, or where the implementation of one intervention results in changes to the costs and effects of another.

## VALUATION OF COSTS AND BENEFITS

There are two main techniques that can be used here – *conjoint analysis* and *willingness-to-pay*. Conjoint analysis assumes that the attributes of a service determine the satisfaction (utility) that individuals receive from that service, whereas willingness-to-pay is based on the premise that the maximum amount of money an individual is willing to pay for a commodity is an indicator of the value to them of that commodity. For example, in one study the median willingness-to-pay for a reduction to reduce the risk of PONV from a 1-in-3 chance to a 1-in-10 chance was £50.

The process of calculating the cost-effectiveness ratio should take into account the context of the decision. If a new treatment is being considered it is unlikely that it will replace all existing therapies. Instead, some patients are switched to the new treatment, whereas others will remain on existing treatments. In comparing new therapies with placebo or existing alternatives, the question is whether the additional costs of the new therapy justify the additional benefits to gain. The *incremental cost-effectiveness ratio (ICER)* (difference in costs divided by the difference in benefits) is used to address this issue. The ICER can be placed on a cost-effectiveness plane, as shown in Figure 3.

**FIGURE 3. THE COST-EFFECTIVENESS PLANE FOR NEW AND EXISTING THERAPIES.**



Interventions with ICERs in the north-east quadrant require some consideration. They improve health but cost more than the alternative. The decision whether or not to choose them should be based on the level of additional resources available, or by viewing the ICER in the light of a specific acceptable threshold. For example, interventions with cost-QALY ratios of between 3000 and 20 000 are adjusted to be cost-effective when there is evidence of their effectiveness.

### **PRACTICAL EXAMPLE OF COST-EFFECTIVENESS OF GENERAL ANAESTHETIC AGENTS**

A study of Elliott et al. [6] compared the cost-effectiveness of general anaesthetic agents in adult and paediatric day surgery populations. They randomly assigned 1063 adult and 322 paediatric elective patients to one of four (adult) or two (paediatric) anaesthesia groups. Total costs were calculated from individual patient resource use to 7 days post discharge. Incremental cost-effectiveness ratios were expressed as cost per episode of postoperative nausea and vomiting (PONV) avoided. In adults, variable secondary care costs were higher for propofol induction and propofol maintenance (propofol / propofol) than other groups and lower in propofol induction and isoflurane maintenance (propofol / isoflurane). In both studies, pre-discharge PONV was higher if sevoflurane. Sevoflurane was used compared with use of propofol for induction. In both studies, there was no difference in post-discharge outcomes at Day 7. Sevoflurane / sevoflurane was more costly with higher PONV rates in both studies. In adults, the cost per extra episode of PONV avoided was £296 (propofol / propofol vs. propofol / sevoflurane) and £333 (propofol / sevoflurane vs. propofol / isoflurane).

Important results from this study for decision-makers are that there are differences in variable costs between inhalational arms, indicating that choice of different anaesthetic agents will translate into secondary care budget differences. Claims that the newer anaesthetic agents cancel out their increased acquisition costs by a reduced incidence of side effects are not supported by this study. Also, claims that shorter recovery times with different anaesthetic agents increase patient turnover are not supported, as this study shows no difference in length of stay between anaesthetic agents. Indeed, work carried out in this area suggests that the organisation of day surgery services (such as optimising operating theatre efficiency, reduction of late cancellations and non-attendance) and integration into the remainder of surgical services are the main factors influencing patient turnover, rather than choice of anaesthetic [7]. Finally, at these two sites, discharge policies seem to be appropriate due to low post-discharge costs. Until now there has been uncertainty and conflicting opinions among anaesthetists about the impact of different anaesthetic regimens on PONV and the associated effect on costs.

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This large multicentre study integrated individual patient clinical and economic data, where resource use was based on observation, and real price data were used. The main conclusions are that sevoflurane / sevoflurane is not a cost-effective regimen for day case surgery in adults or children, when pre-discharge PONV is used as the primary outcome measure. In adults, propofol / isoflurane provided the lowest cost, without significantly higher PONV rates. In children, the use of propofol with halothane provided the lower cost, with a significantly lower PONV rate. PONV was low despite no patients receiving prophylactic anti-emetics.

The choice of anaesthetic will have an increasing impact upon hospital budgets around the country. This study shows considerable differences in the anaesthetic costs and short-term impact on pre-discharge PONV, of different regimens, but no differences in post-discharge outcomes or costs. Furthermore, our study suggests that the use of different anaesthetics does not affect length of stay and so cannot affect throughput of patients.

## CONCLUSION

This lecture has aimed to show how the utilisation of economic techniques alongside evidence-based practice can enhance the quality of decision making in anaesthesia. The healthcare dilemma means that choices will always have to be made regarding the level of resources allocated to health care and, within health care, which areas receive a greater share and which areas receive less. The development of evidence-based practice, and an awareness of the need for fairness in resource allocation and service provision, are major steps along the road to answering the question of how much resources should be put into anaesthesia services and into health care in general.

## REFERENCES

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