GLOSSARY

Health economic evaluation

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A glossary is presented on terms of health economic evaluation. Definitions are suggested for the more common concepts and terms.

It is well established that economics has an important part to play in the evaluation of health and health care interventions. Many books and papers have been written describing the methods of health economic evaluation.[1 2] Despite this, controversies remain about issues such as the definition, purposes and limitations of the different evaluative techniques, whether or not to discount future health benefits, and the usefulness of "league tables" that rank health interventions according to their cost per unit of effectiveness.[3–5]

To help steer potential users of economic evidence through some of these issues, we seek here to define the more common economic concepts and terms. Firstly, we offer a general definition of what health economics is and of what the discipline of economics seeks to achieve. We then outline the basic criteria and concepts underlying economic evaluation before going on to define some of the methods used on the "cost side" and on the "benefit side" of such evaluations. More extensive definitions and discussion of these terms and concepts can be found in Kielhorn and Graf von der Schulenburg.[6]

WHAT IS (HEALTH) ECONOMICS?

Economics: economics has been described in various ways, but most commonly as "the study of choice", "the study of resource use", "the scarcity discipline" or, more depressingly, "the dismal science". Of course, all of these definitions are related. It is because of resource *scarcity* that we have to make choices about different ways of using resources. If one accepts this premise, then a dismal realisation follows: that by choosing to use resources in one way, those same resources will not be available for other potentially beneficial pursuits (see *opportunity cost*).

The following quotation from the Nobel Prize winning economist, Paul Samuelson, aptly illustrates the above points. Samuelson, defined economics as:

> "The study of how men and society end up choosing, with or without the use of money, to employ scarce productive resources that could have alternative uses, to produce various commodities and distribute them for consumption, now or in the future, among various people and groups in society. It analyses the costs and benefits of improving patterns of resource allocation."[7]

Health economics: one role of health economics is to provide a set of analytical techniques to assist decision making, usually in the health care sector, to promote *efficiency* and *equity*. Another role, however, is simply to provide a way of thinking about health and health care resource use; introducing a thought process that recognises *scarcity*, the need to make choices and, thus, that more is not always better if other things can be done with the same resources. Ultimately, health economics is about maximising social benefits obtained from constrained health producing resources.

ECONOMIC EVALUATION CRITERIA

Technical efficiency: with technical efficiency, an objective such as the provision of tonsillectomy for children in need of this procedure is taken as given. Technical efficiency is about *how best* to achieve that objective. Strictly, technical efficiency is about ensuring the production of the same level of output with less of one input and no more of other inputs or, equivalently, maximising the output that one gets from given quantities of inputs.[8] Technical efficiency is linked to *cost effectiveness*. The combination of technically efficient inputs that minimises the *cost* of achieving a given level of output is that which is cost effective.

Allocative efficiency: with allocative efficiency, all objectives compete with each other for implementation. For example, "should we allocate more resources to the prevention of childhood injury or improve clinics for children with chronic disease such as asthma?" is a question of allocative efficiency. Allocative efficiency is about *whether* to do something, or how *much* of it to do, rather than *how* to do it. Allocative efficiency in health care is achieved when it is not possible to increase the overall benefits produced by the health system by reallocating resources between programmes. This occurs where the ratio of marginal benefits to *marginal costs* is equal across all health care programmes in the system.

Equity: equity is about "fairness". It is often confused with equality, or "the state of being equal". Fairness and being equal are not necessarily the same things. Inequality can be fair if there are differences in need, or differences in contribution, effort or deserve. The reason we are interested in equity is the same as for efficiency—that is, *scarcity*. If resources were not scarce, it would be fair for people to consume as much as they want or need of any particular commodity, including health care. However, because of scarcity, we have to judge what a fair allocation might be. In health care, there are two

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general equity concepts to consider, both dating from the time of Aristotle, namely *horizontal equity* and *vertical equity*.

Horizontal equity: refers to the "equal treatment of equals". This is embodied in health care objectives such as "equal access for equal need"[9] and is reflected in efforts to use population-based formulas to allocate health resources to geographical regions.[10]

Vertical equity: refers to the "unequal treatment of unequals".[11] This is a more problematic concept because it is difficult to decide how unequal people should be in terms of the amounts of resources devoted to them or how much more access we should provide for some over others. For example, one may think that we should devote more health resources to those who are more socially deprived, but how do we decide how much more? What if people in more deprived groups do not gain as much health from interventions as those in better off groups? Judgements about what to do when faced with such questions will always be subjective.

ECONOMIC CONCEPTS

Scarcity: provides the raison d'etre for economics because if there were no scarcity then there would be no need to make difficult resource allocation decisions. Scarcity is a relative concept. Resources may be plentiful in absolute terms but appear scarce when our ability to promote health exceeds our resource capacity to do so.[12] That is, scarcity exists when the claims on resources (that is, wants or needs) outstrip the resources available.

Priority setting/rationing: rationing is an unavoidable consequence of *scarcity*. If there are not sufficient resources to meet all "needs" then some needs must be left unmet and priority should be given to services that best meet one's objectives. Priority setting refers to the process of deciding which needs should be met and which needs cannot be met, at least not immediately.

Opportunity cost: the value of a resource in its most favoured alternative use. Because of *scarcity*, choices among competing claims on the limited resources must be made. As the example of *allocative efficiency* shows, the opportunity cost of additional investment in preventing childhood accidents could be the potential health gains forgone by children with asthma. It follows that an *economic evaluation* is a method of comparing the benefits of alternative allocations of resources.[13]

The margin: refers to the *consequences* of changes in the scale of service provision. The *marginal cost*/benefit is the change in cost/benefit arising from (strictly a one unit) increase or decrease in service provision. It does not mean small or insignificant and its meaning is best illustrated by contrasting it with the average. The marginal savings associated with a one day reduction in the length of a hospital stay for example are typically much lower than the *average cost* per hospital bed day because of the existence of *fixed costs*.[14]

Incremental analysis: refers to the process of estimating the additional cost per unit of outcome achieved when comparing one treatment modality to another (typically more expensive and more effective) form of treatment. Where the *margin* refers strictly to differences in scale within a treatment modality (such as increased throughput in an operating theatre), incremental change occurs when one compares different programmes such as one view versus two view mammography. Incremental cost effectiveness refers to the difference in cost between the programmes divided by the difference in outcome.

METHODS OF ECONOMIC EVALUATION

Economic evaluation: a "comparative analysis of alternative courses of action in terms of both their costs and consequences".[1] Two essential features of this definition are worth noting. Firstly, economic evaluation involves a comparison between alternative courses of action. Secondly, the options are evaluated in terms of both their costs and their benefits. Such analyses can be set within the context of a randomised control trial or other health research study design, or can be undertaken through decision analysis modelling approaches.[15]

Cost effectiveness analysis: a form of economic evaluation applicable strictly only when outcomes are one dimensional and measured in naturally occurring units, such as changes in blood pressure or mortality. Within a given budget, a lower cost effectiveness ratio is better as more health can be produced by implementing that alternative.[16] Where one programme is both more expensive and more effective than its comparator, an *incremental* ratio can be calculated that depicts the extra cost per unit of outcome obtained, in comparing one treatment option to another. In this case, a value judgement will be required to assess whether the extra unit of outcome is *worthwhile* (see *cost-benefit analysis*).

Cost minimisation analysis: a specific type of cost effectiveness analysis in which the outcomes of the two (or more) comparators are assumed equal, thereby resulting in an assessment based solely on comparative cost. Making the assumption of equal outcomes can be risky, as such assumptions rarely hold in practice.[17]

Cost utility analysis: a form of economic evaluation that, compared with cost effectiveness or cost minimisation analysis, enables broader comparisons to be made between treatments for different disease groups.[18] Multi-dimensional health outcomes are reduced to a single index using *health utilities* and expressed as *quality adjusted life years* (QALYs), disability adjusted life years (DALYs) or healthy years equivalents (HYEs). Cost per unit of outcome ratios can then be derived that depict the costs required to obtain one QALY

Cost-benefit analysis: a form of economic evaluation through which questions primarily of *allocative efficiency* are addressed. Costs and outcomes are valued in a commensurate unit, often money, through techniques such as *contingent valuation*. This allows one to assess whether an intervention is *worthwhile*. Cost-benefit analysis provides a broader comparison between alternative claims on limited (societal) resources, enabling such comparisons to be made between treatment options within health care and even with options in other public sectors.[19] Even if not everything can be valued in monetary terms, a cost-benefit framework is still useful as all impacts on costs and benefits can be laid out in a "balance sheet" to highlight where trade offs can be, or are being, made between tangible items (usually costs) and some intangibles.[20]

Programme budgeting and marginal analysis: an economic framework that can aid decision makers in *priority setting* and allocating resources. The programme budget is a map of the current use of resources usually, though not necessarily, within a health region. Through marginal analysis, changes in the amount or the mix of services provided for a given population are identified. The aim is to maximise benefit and minimise *opportunity cost*, while considering other important principles such as *equity*.[21]

Discounting: refers to the process of adjusting the value of costs or benefits that occur at different points of time in the future so that they may all be compared as if they had occurred at the same time. Discounting is necessary if there is a preference to defer costs until tomorrow or to enjoy benefits today (positive time preference).[4] The *discount rate* describes the "interest rate" with which the present value of future costs and benefits is estimated. There is little agreement over what discount rate to use, but to ensure comparability Gold *et al*[2] recommend using 3% in the base case and 5% in a sensitivity analysis.

Sensitivity analysis: describes the process of assessing the robustness of an *economic evaluation* by considering the effects of uncertainty.[22] All evaluations are characterised by some degree of uncertainty or ignorance about the future course of events. In a sensitivity analysis, the results of the evaluation

are re-worked after systematically substituting high and low values for each of the variables of interest (the discount rate or the expected loss to follow up, for example). If the conclusions remain unchanged after the re-analysis, then the results can be said to be robust. If the results are not robust, then sensitivity analysis can show where better information will be most useful.

COSTS

Resource costs: resource costs of a health intervention or programme include: capital costs (new and existing buildings or equipment); staffing costs (physicians, nurses, physiotherapists, etc); consumable costs (drugs, dressings, etc); non-patient related costs (administration and overhead costs); costs incurred in non-health care sectors (social services, etc); and costs incurred by patients and their families (transportation, parking, child care, etc). Each of these components must be identified, measured and valued. The range of costs (and benefits) included in a particular economic evaluation depends upon the perspective taken, which could be that of the individual patient or provider, hospital, health authority, health insurer or society.

Resource costs and opportunity costs: the definition of costs for inclusion in an economic evaluation is linked to resource impact, because it is the use of resources that have opportunity costs. Once the resource cost components are valued, one must then ascertain whether alternative uses of those resources would yield greater benefits than the current use in order to link the use of resources to their opportunity cost.

Fixed costs: the costs associated with operating a particular programme or intervention that do not vary with the scale of provision such as the number of patients treated or the number of tests performed. Fixed costs are only "fixed" in the short-term. For example, the building in which a programme is housed would be regarded as a fixed cost initially because small changes in the number of patients treated could be accommodated within the existing space. As the time frame increased, so it would be possible to increase capacity by new construction or reduce it by selling assets or finding alternative uses for them, at which point the cost would become *variable*.

Variable cost: the cost associated with a programme or intervention that varies with the size of the programme or the number of patients treated with the intervention. Cost items such as consumables would be variable costs.

Total cost: the sum of all the fixed and variable costs associated with a particular scale of provision of a programme or intervention. The greater the scale of provision, the larger will be the total costs.

Average cost: the cost per unit of output. Each of the three cost concepts discussed above can be expressed as an average cost: average fixed costs, average variable costs and average total costs, by dividing cost by the measure of output (patient days, hospital admissions, diagnostic tests performed, etc).

Marginal cost: the additional cost associated with producing one more unit of output. As pointed out earlier, in considering the optimal level of service provision, it is this cost concept that is crucial in economics.

VALUING OUTCOMES

Health utility: is a measure of strength of preference that people have for particular health states.[23] A year in full health is arbitrarily assigned a value of 1: a state that is considered equivalent to death is assigned a value of zero. Health states that lie somewhere between these two anchor points will have a utility value that lies somewhere between zero and one. States considered worse than death will have a negative value. The health utility is used to weight years of life in order to estimate *quality adjusted life years*.

Quality adjusted life years (QALYs): a summary measure of health gain that combines (changes in) life expectancy and quality of life. It uses *health utilities* to weight improvements in life expectancy according to the quality of life experienced. Thus, a given state of health (say living with chronic pain) may be assigned a utility of (say) 0.75. Living for 20 years in this state of health would then be considered equivalent to 15 QALYs (20×0.75) and an intervention that prevented people from entering this state would lead to a health gain of five QALYs.

Standard gamble: a method of establishing the *utility* of a specified health state. For chronic health states, people are asked to choose between the certainty of the specified health state for a given period of time or a gamble that involves a probability (p) of restoration to full health and a complementary probability (1–p) of immediate death. The value of p is changed until the respondent regards the two options as equivalent to each other. The utility of the specified health state is then given by p. A slightly modified method is needed for temporary health states[24] or states regarded as worse than death.

Time trade off: an alternative, and supposedly simpler, approach to establishing health utilities. Here, the respondent faces a choice between living for a given period of time (t) in the specified health state or a shorter period of time (x) in full health. The duration in full health is altered until the respondent regards the two options as equivalent to each other. The value of the health state is then given by (x/t). As with the standard gamble technique, the method described here needs to be adjusted for short-term conditions.

Contingent valuation: is a method of valuing the benefits of health services based on estimates of the maximum amount that people would be willing to pay for the availability of a service or the minimum amount that they would accept as compensation for not having the service available.[25 26]

Conjoint analysis: a method of "estimating the relative importance of different aspects of (health) care, the trade-offs between these aspects, and the total satisfaction or utility that respondents derive from health care services".[27] The most common method entails asking respondents to choose between a series of paired descriptions of alternative service configurations, from which the importance of the different attributes of each service can be estimated. The technique is now referred to as discrete choice experimentation.

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REFERENCES

1 **Drummond MF**, O'Brien B, Stoddart GL, *et al. Methods for the economic evaluation of health care programmes*. Oxford: Oxford University Press, 1997.
2 **Gold MR**, Siegel JE, Russell LB, *et al. Cost-effectiveness in health and medicine*. New York: Oxford University Press, 1996.
3 **Donaldson C**. The (near) equivalence of cost-effectiveness and cost-benefit analysis: Fact or fallacy. *Pharmaco-Economics* 1998;**13**:389–96.
4 **Cairns J**. Discounting and health benefits: another perspective. *Health Econ* 1992;**1**:76–9.
5 **Gerard K**, Mooney G. QALY league tables: handle with care. *Health Econ* 1993;**2**:59-64.
6 **Kielhorn A**, Graf von der Schulenburg J-M. *The health economics handbook*. Chester: Adis International, 2000.
7 **Samuelson P**. *Economics*. Columbus, OH: McGraw-Hill, 1948.
8 **Gravelle H**, Rees R. *Microeconomics*. London: Longman, 1992.
9 **Mooney GH**. *Economics, medicine and health care*. Brighton: Wheatsheaf, 1992.
10 **Eyles J**, Birch S, Chambers S, *et al*. A needs-based methodology for allocating health care resources in Ontario, Canada: development and an application. *Soc Sci Med* 1991;**33**:489–500.

11 **Mooney G**. And now for vertical equity? Some concerns arising from Aboriginal health in Australia. *Health Econ* 1996;**5**:99–103.
12 **Smee CH**. Bridging the gap between public expectations and public willingness to pay. *Health Econ* 1997;**6**:1–10.
13 **Auld P**, Donaldson C, Mitton C, *et al*. Economic evaluation. In: Detels R, Holland W, McEwan J, *et al*, eds. *Oxford textbook of public health*. Oxford: Oxford University Press, 2000.
14 **Mooney G**, Russell E, Weir R. *Choices for health care: a practical introduction to the economics of health provision*. London: Macmillan, 1986.
15 **Detsky AS**, Naglie G, Krahn M, *et al*. Primer on medical decision analysis: part 1 – getting started. *Med Decis Making* 1997;**17**:123–5.
16 **Robinson R**. Cost-effectiveness analysis. *BMJ* 1993a;**307**:793–5.
17 **Robinson R**. Costs and cost-minimisation analysis. *BMJ* 1993;**307**:726–8.
18 **Robinson R**. Cost-utility analysis. *BMJ* 1993;**307**:859–62.
19 **Robinson R**. Cost benefit analysis. *BMJ* 1993;**307**:924–6.
20 **McIntosh E**, Donaldson C, Ryan M. Methodologies and analysis in cost-benefit analysis in health care: Does the state of the art reflect the state of the science? *Pharmaco-Economics* 1999;**15**:357–67.
21 **Donaldson C**, Farrar S. Needs assessment: developing an economic approach. *Health Policy* 1993;**25**:95–108.
22 **Briggs A**, Schulpher M, Buxton MJ. Uncertainty in the economic evaluation of health care technologies: the role of sensitivity analysis. *Health Econ* 1994;**3**:95–104.
23 **Torrance GW**. Measurement of health state utilities for economic appraisal. *Journal of Health Economics* 1986;**5**:1–30.
24 **Johnston K**, Brown J, Gerard K, *et al*. Valuing temporary and chronic health states associated with breast screening. *Soc Sci Med* 1998;**47**:213–22.
25 **Donaldson C**. Willingness to pay for publicly provided goods: a possible measure of benefit. *Journal of Health Economics* 1990;**9**:13–18.
26 **Klose T**. The contingent valuation method in health care. *Health Policy* 1999;**47**:97–123.
27 **Ryan M**, Farrar S. Using conjoint analysis to elicit preferences for health care. *BMJ* 2000;**320**:1530–3.

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