

Review Article

Economic Evaluation for Health Interventions: Narrative Review

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Abstract

Costs and benefits should be considered alongside each other so that decisions can be made regarding the efficient delivery of scarce health care resources. So, if costs are high, benefit might also be large. Similarly, no health intervention can be efficient just because it is of low cost. An intervention may be of low cost and have no benefits. So, the important question when informing efficient decision making is how to compare costs and benefits associated with alternative interventions with each other. This is where economic evaluations are used. Types of economic evaluation are: (1) cost effectiveness analysis (CEA) which uses uni-dimensional measures of benefit (expressed in health units) and as such is generally used to address questions of technical efficiency; (2) Cost Minimization Analysis (CMA) which is considered to be a special case of CEA where alternative interventions are equivalent in terms of effectiveness and are compared only in terms of cost; (3) Cost-utility analysis (CUA) in which outcomes are considered in terms of changes in both quality and quantity of life. Here a cost per quality adjusted life years (QALY) ratio is estimated. The advantage of using this broader form of analysis is that it can address questions of both technical and allocative efficiency across various health producing programs; (4) Cost benefit analysis (CBA) expresses benefits and costs in monetary terms. By allowing costs to be compared directly to benefits, CBA is able to address questions of allocative efficiency (both within and beyond the health sector).

Keywords: Economic-evaluation, cost-benefit, cost-utility, cost-effectiveness, health-interventions

Available online at:
jhphalexu.journals.ekb.eg

Print ISSN: 2357-0601
Online ISSN: 2357-061X
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Suggested Citations: Mosallam RA. Economic Evaluation for Health Interventions: Narrative Review. JHIPH. 2023;53(3):126-132.

Economic Evaluation

There are many ways in which health might be improved today and, as technology improves, the opportunities will increase. However, there are limits to budgets as well as other resources so choices have to be made about what to spend money and time on. Economic evaluation can help set out the value of the costs and benefits from competing choices. Economic evaluations compare the costs and consequences of two (or more) health care interventions.¹

Economic analysis always involves a choice between ≥ 2 options. There must always be a comparison option, it may be explicit e.g. treatment B compared to treatment A or the comparator may be implicit e.g. current practice or “doing nothing”. All health economic analyses share two major ingredients; (1) Cost (what do we pay or save if we choose one course of action vs. another) and health outcomes (what do we get accordingly?) There are four techniques for economic evaluation of healthcare interventions; economic minimization analyses, cost-effectiveness

analysis, cost-utility analysis and cost-benefit analysis.²

1. Measuring Benefits:

1.1. Economic impact/ cost minimization analyses

Economic impact analyses are sometimes called “cost of illness estimates,” “impact analyses,” or “economic burden estimates.” These analyses estimate the total costs incurred by a disease or illness. It typically includes the costs of medical care required to treat or manage an illness. Often, these analyses also include estimates of lost productivity associated with the disease. The economic impact analysis is a “Pure” cost comparison. The cheapest intervention is preferred. Health outcomes are not explicitly assessed. They are implicitly assumed equivalent. If health outcomes are not equivalent, then the analysis should not be restricted to costs, and simple cost minimization is inappropriate.⁽³⁾

1.2. Cost-effectiveness analysis

Cost-effectiveness analysis must be conducted with

interventions or programs that impact the same health outcome. For example, we could compare two programs designed to prevent overweight or obesity, where one program focuses on physical activity and the other focuses on nutrition.

Outcomes are measured in natural units-for example, per life saved, per life year gained, per pain or symptom free day, cases of TB diagnosed, blood pressure lowered and cases cured. ⁽¹⁻³⁾ (Table 1)

Table (1): Measures of effectiveness in cost-effectiveness studies

Study	Country	Health Intervention and comparator	Measure of Effectiveness	Result
Fuller et al, 2013 ⁴	Australia, the United Kingdom and Germany	either standard care, or a commercial provider (Weight Watchers)	Cost per kilogram of weight loss	\$ 122, 90 and 180 for the CP in Australia, the United Kingdom and Germany, respectively For the standard care, the cost was USD138, 151 and 133, in Australia, the United Kingdom and Germany, respectively.
Ward et al, 2023 ⁵	UK	Patiromer treatment in regulating potassium levels in patients with advanced chronic kidney disease compared with standard care	Cost per life gained	£2973 per 0.264 life years gained
Sintonen, et al, 1990 ⁶	Finland	Drug regimens based on omeprazole, ranitidine and sucralfate in the treatment of duodenal ulcers	Cost per healthy days period after starting treatment	With a sacrifice of 100 Finnish Marks, 15.5 healthy days in the omeprazole regimen, compared with 13.7-14.9 and about 10 days in the sucralfate and ranitidine regimens, are obtained, respectively.
Khan et al, 2002 ⁷	Pakistan	<u>Intervention</u> DOTS with direct observation by health workers (at health centers or by community health workers) <u>Comparator</u> DOTS without direct observation	Tuberculosis cases cured	310 US dollars per case cured in direct observation by health centre-based health workers 172 dollars per case cured in direct observation by community health worker
Jinshuo et al, 2018 ⁸	UK	Web-based self-management program for people with type 2 diabetes (HeLP-Diabetes) compared to usual care	Cost per improvement on the Problem Areas in Diabetes (PAID) Scale	164 US dollars per case cured in self-administered group £58 per unit improvement on PAID scale
Vassall at al, 2002 ⁹	Egypt and Syria	DOTS applied through primary care system compared to its application through specialized health clinics	Tuberculosis cases cured	\$258 and \$243 per patient cured through primary healthcare system in Egypt and Syria, respectively \$585 per patient cured through specialized clinics in Egypt
Sullivan, 2002 ¹⁰	USA	social worker-based education program and environmental control in children with asthma compared to the usual care	Asthma symptom-free day gained Asthma related hospitalizations Asthma related Unscheduled doctor visits	30.71 and -2.92 (cost saving) US dollars per symptom-free day gained in mild and severe cases, respectively. 14.35 and -21.20 (cost saving) US dollars for no hospitalization and ≥ 1 hospitalization in the previous 2 month 18.56 and -10.85 (cost saving) US dollars for 0-1 unscheduled doctor visits and ≥2 visits in the previous 2 months, respectively

A major drawback in conducting cost-effectiveness analysis is that outcomes in natural units cannot be combined and must be considered separately. For example, a physical activity program may have two intended effects: lowering blood pressure and decreasing body mass index. Because these two effects can't be combined in a cost-effectiveness analysis, the summary measure for the analysis would be cost per 1 percent reduction in blood pressure and cost per 1 percent decrease in body mass index. However, the cost in these two summary measures is the same, so the ratios are somewhat misleading. This makes cost-effectiveness ratios using natural units difficult for policy-makers to translate. ⁽¹⁻³⁾ A counter argument is that the variations across a number of dimensions are made clear to decision makers rather than being concealed within an aggregate measure. This can sometimes permit more informed decision making. ⁽¹¹⁾

1.3. Cost-utility analysis

In Cost utility analysis (CUA) health effects are expressed in units of quality- or disability-adjusted

survival (QALYs and DALYs, respectively). It Compares costs and benefits, where benefits = number of life years saved, adjusted for loss of quality, thus combining length and quality of life. CUA is considered one method for dealing with the problem of multiple outcomes. In this case outcomes are expressed as a health index. This combines all health outcomes associated with an intervention in terms of increase in length of life and quality of life. As it is not specific to any particular disease or condition, quality-adjusted survival can be used to compare the health impacts of interventions that target different illnesses, for example, when comparing interventions that affect obesity, nutritional outcomes, and cardiovascular disease. ¹⁻³

In calculation of QALYs, "quality" of a particular state of health is captured on a scale ranging from 0 (death) to 1 (perfect health), which is then used to adjust survival. For example, 0.5 QALY could be six months spent in perfect health. One year spent in poor health, valued as halfway between death and perfect health (Figure 1). ⁽²⁾

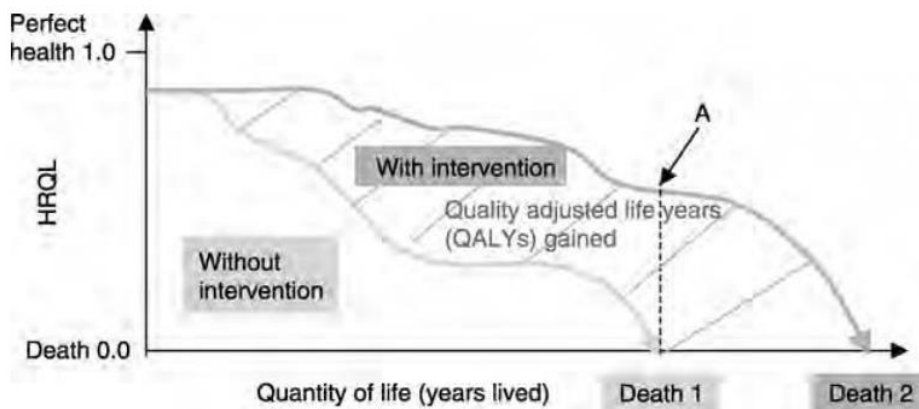


Figure 1: QALYs gained from intervention
Source: Adapted from Drummond et al. (1997) ²

Disability-adjusted life years were developed in the international community primarily to measure disease and injury burden and to allow comparable estimates of these burden measures across countries. The disability-adjusted life year weights are slightly different from the quality-adjusted life year weights, with an inverted scale of 0 referring to perfect health, or no disabilities, and 1 referring to death, or 100 percent disabled. DALYs for a disease or health condition are calculated as the sum of the Years of Life Lost (YLL) due to premature mortality in the population and the Years Lost due to Disability (YLD) for people living with the health condition or its consequences $DALY = YLL + YLD$. ⁽¹⁾

QALY Calculation

Pre-scored questionnaires are used. Examples included

the Quality of Well Being Index (QWB), the Health Utilities Index (HUI) and the Euro-Qol Group's EQ-5D. These are based on multi-attribute classifications of health status with each possible health state having an assigned value or utility. The assigned values have been developed amongst a general population using either the Visual Analogue Scale (VAS) and Time Trade off (TTO) approaches. ¹

Visual Analogue Scale (VAS)

A VAS usually consists of a single line on a page with verbal and numerical descriptors at each end. Scale markers are often added to the line, and these are sometimes also numbered. The endpoints are labelled 'best imaginable health state possible' and 'worst imaginable health state possible', denoted as 100 and 0 respectively (Figure2) ⁽¹⁾

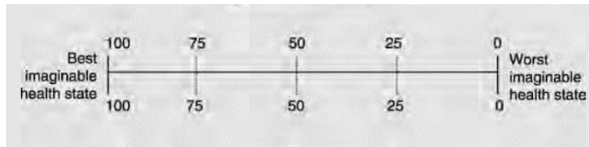


Figure 2: Visual Analogue Scale (VAS)
 Source: Adapted from Rushby J et al, 2005¹

The time trade-off approach

The time trade-off (TTO) is a choice-based method of eliciting health state utility, which reflects the length of remaining life expectancy that a person may be prepared to trade-off in order to avoid remaining in a sub-perfect health state. The TTO method usually involves asking the respondent to consider remaining in full health for 10 years. Then he is asked how many years he would need to stay in a certain health status (described by a clinical scenario) to make this option exactly as desirable as being in full Health for 10 years. The preference score is calculated by x/t (where x is the time spent in perfect health and t is the time spent in the health state in the scenario).^{1,12}

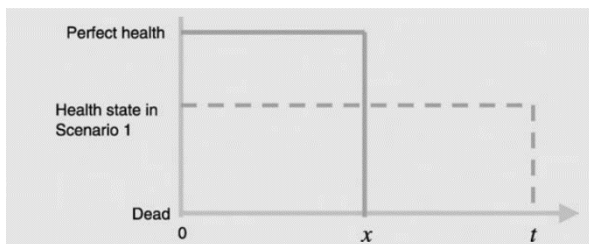


Figure 2: The choice offered by the TTO approach
 Source: Adapted from Drummond et al. (1997)²

The incremental cost-effectiveness ratio

The “incremental cost-effectiveness ratio,” or ICER is the additional cost of the more expensive treatment, per additional gain in QALY, i.e. $\Delta \text{ cost} \div \Delta \text{ QALY}$. For example, program A costs \$50,000 per 5 QALY and program B costs \$200,000 per 10 QALY. Then the $\text{ICER} = \Delta \text{ cost} \div \Delta \text{ QALY} = (\$200,000 - \$50,000) / (10 - 5) = 150,000$ per 5 QALYs or 30,000 per 1 QALY. The decision to adopt B depends whether we consider \$18,000/additional case cured a reasonable figure and the existence of alternatives to spend the money.^(1,13)

Incremental Cost Effectiveness Ratio Threshold

Cost-effectiveness thresholds allow cost-effectiveness ratios that represent good or very good value for money to be identified. With some reference strategy occupying the origin of the graph, a cost-effectiveness (CE) study can plot the incremental costs (y-axis) and benefits (x-axis) of alternative strategies, relative to this reference, in 2-dimensional space. The area above the horizontal is cost-increasing, and to the right of the vertical, clinically beneficial. When a new strategy

adds both benefits and costs (upper right-hand quadrant) or reduces both (lower left-hand quadrant), a CE ratio must be calculated to judge benefits relative to costs.⁽¹³⁾ ICER thresholds are set by many countries to evaluate the value for money and to rank different interventions. ICER is mostly set based on the Gross Domestic Product of different countries (GDP).^(14,15)

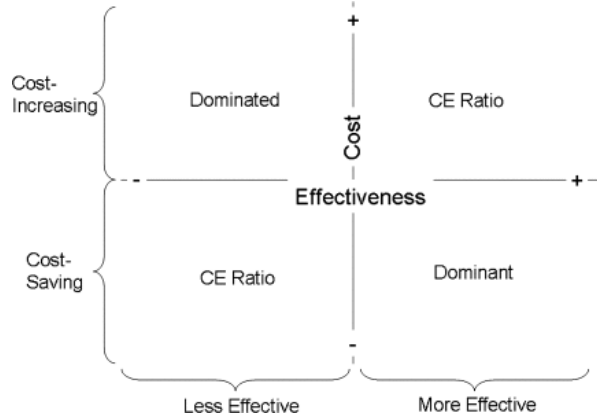


Figure 4: Cost Effectiveness Plane
 Source: Adapted from Cohen DJ, Reynolds MR. 2008⁽¹³⁾

1.4. Cost-benefit analysis

Cost-benefit analysis (CBA) is a type of economic evaluation that compares the costs of a program, policy, or intervention to its outcomes where all costs and outcomes are converted into dollar terms. Debates in the 1990s extended the definition of what constitutes benefits to consider dimensions beyond health outcomes e.g. ‘non-health outcomes’ (information, reassurance, etc.) and ‘process factors’ (waiting time, location of treatment, continuity of care etc). Such factors are currently being referred to as patient experience factors. It was recognized that the QALY approach to valuing benefits would not be sensitive to such patient experience factors. This led to the re-introduction of stated preferences methods which are contingent valuation and discrete choice experiments (DCEs) in health economics. Both these techniques have the advantage that they can value dimensions of benefit beyond health outcomes, thereby deriving a more holistic measure of value. In addition, they derive willingness to pay, a monetary measure of benefit that can be used in cost-benefit analysis.¹⁻³

In stated preferences methods people, an opportunity to give direct values or providing them hypothetical market scenarios to document their responses. This is particularly of value when no market exists as in governmental settings where patient preferences cannot be elicited by the revealed preferences (actual purchase behavior) as in the private sector. The relevance of stated preference studies (which

incorporates WTP to measure monetary benefits) is also demonstrated in countries which greatly rely on private health services where the patients pay out of pocket to receive those services. In such case, measuring the demand side lever is as important as supply side lever (measured using the QALY in cost utility studies). Cost benefit analysis utilizing stated preferences techniques aims to capture allocative efficiency ensuring that sum of all health gains is distributed in an equitable fashion.¹⁶

Contingent Valuation (Willingness to Pay Survey)

The contingent valuation method (CVM) is a survey-based, hypothetical and direct method to determine monetary valuations of effects of health technologies.^(17,18) WTP studies have been reported globally addressing issues such as; public sector healthcare programs, health financing schemes, measuring health state improvement, health insurance retention, cross border health insurance, implementing preventive public health interventions, social health insurance of informal sector workers, WTP to lessen waiting times for health procedures, WTP for child survival and health related safety strategies.⁽¹⁶⁾ Preventive interventions can also be planned and prioritized by utilizing WTP to target high risk groups and choose between competing health programs. WTP can be estimated for one additional QALY gained to determine the threshold of the incremental cost-effectiveness ratio. In a study conducted by Bobinac et al in Netherlands, respondents first valued two health states on a visual analog scale (VAS) and expressed their WTP for avoiding a decline in health from the better health state to the worse, using a payment scale followed by a bounded open contingent valuation question. Mean WTP per QALY was €12,900 based on VAS valuations, and €24,500 based on the Dutch EuroQoL tariffs.⁽¹⁹⁾

Contingent valuation questions may be asked through conducting surveys by providing hypothetical market scenarios and framing the answer in one of the following formats; (1) an open-ended question. In this technique, respondents are directly asked, 'what is the maximum amount of money they would be prepared to pay for a commodity'? (2) closed-ended approach (also known as the referendum, dichotomous choice, and take-it-or-leave-it approach) the individual is asked whether or not they would pay a specified amount, with possible responses being 'yes' or 'no'. In this case the dichotomous choice is single bounded, (3) bidding game approach bid amount is varied across respondents and the only information obtained from each individual is whether their maximum WTP is above or below the bid offered to them, (4) the payment card technique where respondents are presented with a range of bids and asked to circle the amount that represents the most, they would be willing to pay.⁽¹⁶⁻¹⁸⁾

In their study, Al-Hanawi et al assessed willingness to pay for improved public health care services in Saudi Arabia. They surveyed heads of households in Jeddah. The objective of the study was to elicit the citizen's willingness to contribute to the national insurance scheme in Saudi Arabia to improve quality of services in the public sector. Insurance premium was specified as the payment vehicle in the scenario and questions. In this study, double-bounded dichotomous choice was used as a valuation technique where the interviewee ask the respondent if they are willing to pay. If they responded by 'yes' then they will be offered an initial bid (monetary value) in. If they accepted the initial bid then the following question is to state whether they would be willing to pay twice the initial bid; if the respondent rejected the first offered bid, then they would be presented with an offer of half of the initial bid. Participants who accepted any of the offered bids were asked to state the maximum amount that they would be willing to pay per household member to benefit from ensuring access to a better quality of health care services for some or all of the attributes. This question allowed respondents to state a WTP out of the range of bids specified in the double-bounded dichotomous choice questions.⁽²⁰⁾

Mataria et al surveyed 499 patients seeking care in primary health care centers, in Palestine, reveal their willingness to pay values for specified improvements in the quality of delivered medical care. Improvements over seven quality attributes were separately assessed. In this method a single bound dichotomous question was used (closed ended question). If the respondent replied by 'yes', then he was offered a payment scale to specify the maximum amount of money he would be willing to pay.⁽²¹⁾

Discrete Choice Experiment

The other method to elicit the stated preferences of respondents is discrete choice experiments (DCE). This technique is based on the assumption that any good or service can be described by its constituting characteristics (hereinafter called "attributes") and that the extent to which an individual values a good or service is determined by the levels of these attributes. In DCEs, respondents are presented different stimuli consisting of attributes with different levels and asked to state their preferences. The holistic assessments are then traced back to the contributions of the individual characteristics. DCE involves asking individuals to state their preference over hypothetical alternative scenarios. Each alternative is described by several attributes (e.g. convenience, quality of service, waiting time, accessibility, etc). Price is treated as one of these attributes and therefore WTP for an attribute can be derived.⁽²²⁻²⁴⁾

In a study conducted in Scotland to determine the relative importance of factors that influence decision making in the management of minor illness. Three

attributes were identified as important to participants: type of management, availability, and cost of managing symptoms. Trade-offs between these attributes were examined. For each attribute, different levels were specified. For example, the attribute availability (waiting time) was into 6 levels (0 hours, 1 hour, 5 hours...etc) The respondents were offered a scenario. The scenario described a set of flu-like symptoms associated with analgesic use. The symptoms described are likely to have been experienced by most people and are frequently managed by self-care. In each choice set, participants were asked to select from three options their preferred choice for managing the symptoms, one of which was a 'do nothing' option. Based on the three attributes and their corresponding levels, 72 separate choice sets were generated, each comprising two alternative profiles. These 72 choice sets were allocated by SAS into eight separate blocks (nine sets per block), each of which was incorporated into a separate questionnaire (blocked design). Each participant received one of the eight versions randomly.⁽²⁵⁾

2. Calculating the costs:

2.1. Identifying cost categories in an intervention

Items to be included on the cost side of an economic evaluation are any 'resources', which have an alternative use and so can be utilized somewhere else. For example, we would not include the costs of building a new hospital in an economic evaluation. Costing methodology and principles are similar across the different types of economic evaluations. Health-related costs have been disentangled in three main components, namely; direct, indirect and intangible. Direct costs correspond to the costs for caring the patient. They can be disentangled in two subgroups: direct medical costs and direct non-medical costs. Direct medical costs include many different cost shares, For example visits to the physician, imaging or pathological work-ups, drug treatments, inpatient care..etc. Direct non-medical costs include costs as additional health interventions such as alternative and complementary medicine, transportation costs, cost of overnight stay of patients or caregivers outside the hospital and nutritional cost outside the hospital. Indirect costs correspond to costs related to productivity loss. The definition of productivity in health economics is definitely not limited to the impact of a health condition on paid activities. A person is 'productive' from the societal perspective if this person is useful to society, either due to her/his work and the production of goods related to it, or due to its involvement in non-paid activities such as volunteer work, involvement in non-for-profit organization or even household or familial duties. Intangible costs are a more conceptual cost compound trying to input a cost on pain, suffering and globally

on the fact that a person is not in perfect health. Intangible costs are used by specific insurance when they have to compensate a person for an adverse life event (a car accident, eg) but less rarely in health technology assessment and health economics.⁽²⁵⁾

2.2. Measuring costs of a health intervention

This is collecting data on different types of resource use in each cost category. Two principal sources of information can be used: administrative databases of health organizations or information reported by patients or medical staff themselves through standardized self-questionnaires. In some countries, there is a large access to hospital, healthcare system or health insurance databases. When possible, it provides all the medical visits, biological or imaging workups and medication deliverance. When the access to such data is not feasible, data collected through questionnaires is filled in by medical staff and/or patients.⁽²⁵⁾ Examples for database for cost questionnaires used in economic evaluation is Database of Instruments for Resource Use Measurement and Stanford Health Assessment Questionnaire, which has a section for measuring patient cost.^(26,27)

2.3. Valuing costs of a health intervention

Valuation is assigning costs on health resource use and productivity losses incurred by the patients. When valuing the resources included in an economic evaluation for national decision makers, it is important, wherever possible to include national average values of unit cost. Economic evaluations conducted within a hospital or specific area may be best informed by using local level unit costs if available. For the valuation of indirect cost, the costs associated to days of work can be derived from the patient wage if this information is known or from the average daily wage of the country population. For the non-paid workers as house wives, the majority of studies uses 'replacement' costs, that is, the average wage of a household employee who could perform the same tasks in replacement of the sick household member.^(28,29)

CONCLUSION AND RECOMMENDATIONS

Selecting the type of economic evaluation depends on the decision to be taken. In case of selecting the best way to achieve a health objective, the policy maker is concerned with technical efficiency (i.e. outputs are maximized from the resources available and also produced at minimum cost), so cost minimization and cost effectiveness should be selected. For example, comparing bariatric operations to nutritional counselling and exercise to achieve a normal body mass index. If the policy maker is to select between different health programs to achieve different health objectives (nutritional counselling for obese patients,

screening for breast cancer, treatment of hepatitis C etc.), then cost utility analysis should be conducted. If the choice was between programs inside the healthcare and others outside the healthcare (building schools, reducing air pollution, improving housing conditions etc.), then the effect should be unified in all programs through converting the benefit to monetary units. This is the case in cost benefit analysis. If the demand side of benefit is the major concern of the policy maker (patient and public preferences, rather than the supply side represented in the health outcomes only), then cost benefit analysis should be selected.

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