

Economic Evaluation in Health Care

Kaja Abbas

Learning objectives

- Describe the role of economic evaluation in health care.
- Differentiate between the different forms of economic evaluation.
- Explain how an incremental cost-effectiveness ratio is estimated and its meaning in relation to willingness-to-pay threshold.
- Identify the key steps in designing an economic evaluation.

Economic evaluation for health



What is economic evaluation (in health care)?

“The comparative analysis of alternative courses of action in terms of their costs and consequences.”

Drummond et al,
2005

“Based on the common sense notion that a decision to do or not to do something should depend weighing up the advantages (benefits) and disadvantages (costs).”

Morris et al, 2007

Economic evaluation in health care

- What is economic evaluation?
 - To evaluate the value of health
- Why conduct economic evaluation?
 - To determine cost-effectiveness of health care interventions/services
 - To assist decision-making in choosing to fund specific health care interventions
- Prioritisation of **limited resources** to maximise health gains

Private markets (vs) Public provision/financing of health care

- Private markets' focus
 - Maximisation of profits
 - Optimisation of health for sub-population
 - Provision of services based on individual's ability to pay
 - Asymmetry of information
 - Disadvantageous to individual decision-making
 - Negative externalities
 - Effectiveness + Efficiency
- Public health care focus
 - Maximisation of health
 - Optimisation of health for whole population
 - Provision of services based on state's willingness to pay
 - Pooling of information by state
 - Advantageous for population health decision-making
 - Positive externalities
 - Effectiveness + Efficiency + Equity

Types of economic evaluation

- Cost-**effectiveness** analysis
 - Cost (versus) **effectiveness** (health outcomes)
 - **Natural unit of health outcome**
 - cases, deaths averted, etc
 - Cost-**utility** analysis
 - Cost (versus) **utility** (health-related quality of life measures)
 - **DALYs** - disability-adjusted life-years
 - **QALYs** - quality-adjusted life-years
 - Cost-**benefit** analysis
 - Cost (versus) **benefits** (health outcomes)
 - **Monetary valuation of health benefits/outcomes**
- plus other related types of economic evaluation

Types of economic evaluation

- Cost-effectiveness analysis
- Cost-utility analysis
- Cost-benefit analysis

Economic Evaluation	Summary Measures
Cost-effectiveness analysis (CEA)	Cost-effectiveness ratio (Incremental costs per cases averted)
Cost-utility analysis (CUA)	Cost-utility ratio (Incremental costs per QALY)
Cost-benefit analysis (CBA)	Net benefits (Benefits – costs)

Economic analysis	Cost measure	Health benefit measure	Example in HIV context
Cost-effectiveness analysis	Monetary units	Natural units (Cases of disease or deaths averted)	The number of HIV cases averted by a female condom distribution program to sex workers (SWs) in South Africa.
Cost-utility analysis	Monetary units	QALY or DALY averted	Cost-utility of tuberculosis prevention among HIV-infected adults in Kampala, Uganda.
Cost-benefit analysis	Monetary units	Monetary units (US\$, Tanzania Shilling (TShs), etc.)	Cost-benefit analysis of female primary education as a means of reducing HIV/AIDS in Tanzania.

Cost-effectiveness analysis (CEA)

- Treatment A
 - Cost
 - £30,000
 - Effectiveness
 - 0.5 life-years gained
- Treatment B
 - Cost
 - £55,000
 - Effectiveness
 - 1.5 life-years gained

Incremental Cost-Effectiveness Ratio

$$\text{ICER} = \frac{(\text{cost B} - \text{cost A})}{(\text{effect B} - \text{effect A})}$$

Activity: Calculate ICER

Cost-effectiveness analysis (CEA)

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$$\text{ICER} = \frac{(\text{cost B} - \text{cost A})}{(\text{effect B} - \text{effect A})}$$
$$\frac{(\pounds 55,000 - \pounds 30,000)}{(1.5 - 0.5) \text{ life-years gained}}$$

ICER = £25,000 per life-year gained

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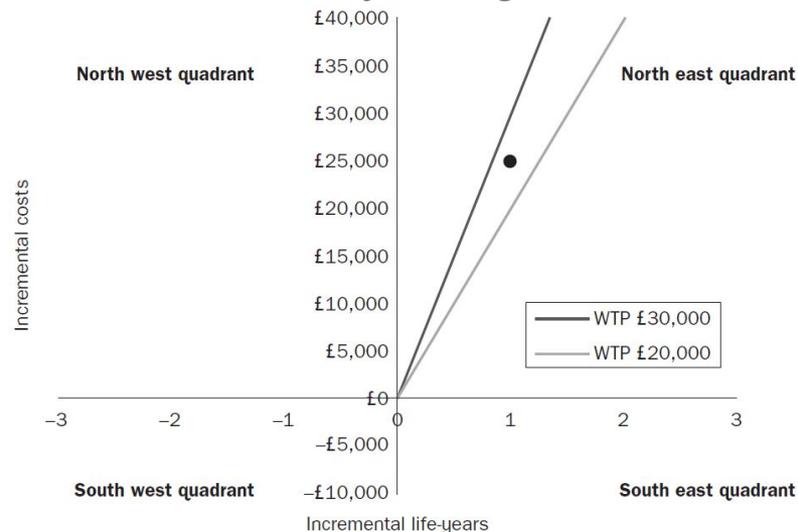
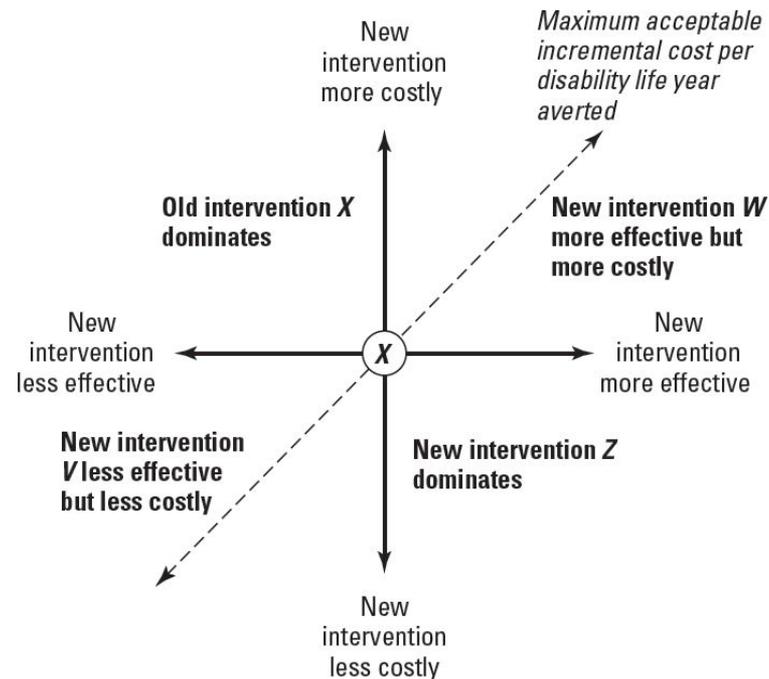
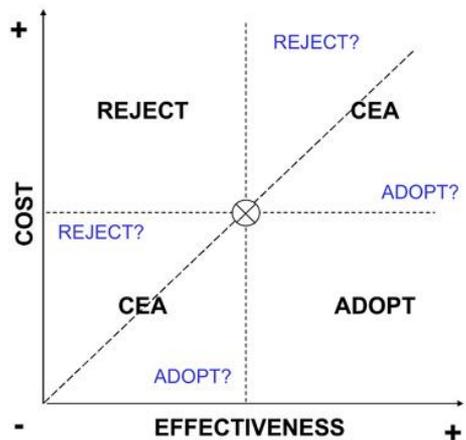
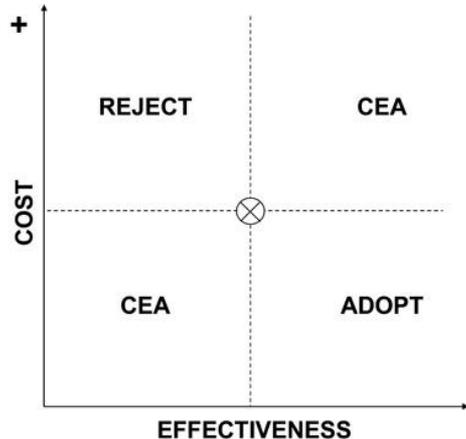


Figure 10.1 The cost-effectiveness plane.

Cost-effectiveness analysis (CEA)



Comparison of Cost and of Effectiveness between Interventions:
Conditions for Dominance

DALYs averted ~ QALYs gained

- DALY (disability-adjusted life year)
 - Healthy life year lost
- DALYs averted
 - Reduction of DALYs from new treatment of an early-onset disease

- QALY (quality-adjusted life year)
 - Healthy life year gained
- QALYs gained
 - Increase in QALYs from new treatment of an early-onset disease

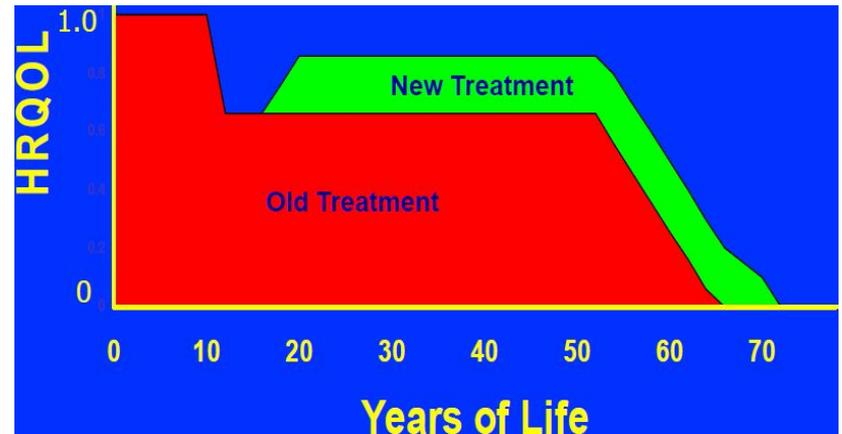
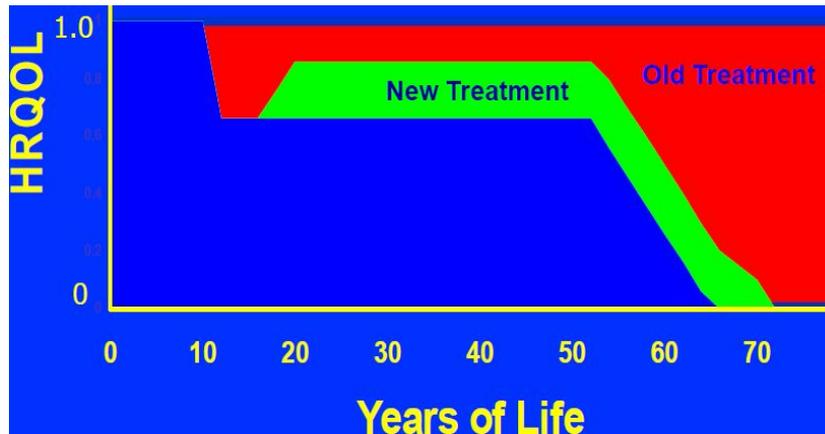


Table 15.4 International thresholds for cost-effectiveness

Organization/group	Cost-effectiveness thresholds	Reference
Australia*	Costs per LYG < AU \$ 42,000 – 76,000 (costs per LYG < AU \$ 42,000: reimbursement likely, costs per LYG > AU \$ 76,000 reimbursement unlikely)	George et al. (2001)
The Netherlands	Costs < € 20.000 per QALY or LYG: cost-effective* Costs < € 80.000 per QALY: cost-effective**	Welte et al. (2004c); Raad voor de Volksgezondheid & Zorg (2007)
UK National Institute of Clinical Evidence (NICE)*	Costs per QALY < £ 20,000–30,000: cost-effective Costs per QALY < £ 45,000: cost-effective	Devlin and Parkin (2004); Appleby and Devlin, Parkin (2007)
US Institute of Medicine (IOM)**	Saves money and QALYs: most favorable Costs per QALY < US \$ 10,000: more favorable Costs per QALY > US \$ 10,000 and < 100.000: favorable Costs per QALY > US \$ 100,000: less favorable	Institute of Medicine (2000)
World Health Organization (WHO)**	Costs per DALY < GDP per capita: highly cost-effective Costs per DALY = 1x – 3x GDP per capita: cost-effective Costs per DALY > 3x GDP per capita: not cost-effective	WHO (2008)
International and especially US decision analysts**	Costs per QALY or LYG < US \$ 50,000: cost-effective	Grosse (2008)
US and British health economists**	Costs per LYG < US \$ 60,000: cost-effective	Newhouse (1998)

* Thresholds derived from past decisions

** Officially stated thresholds

LYG = Life year gained

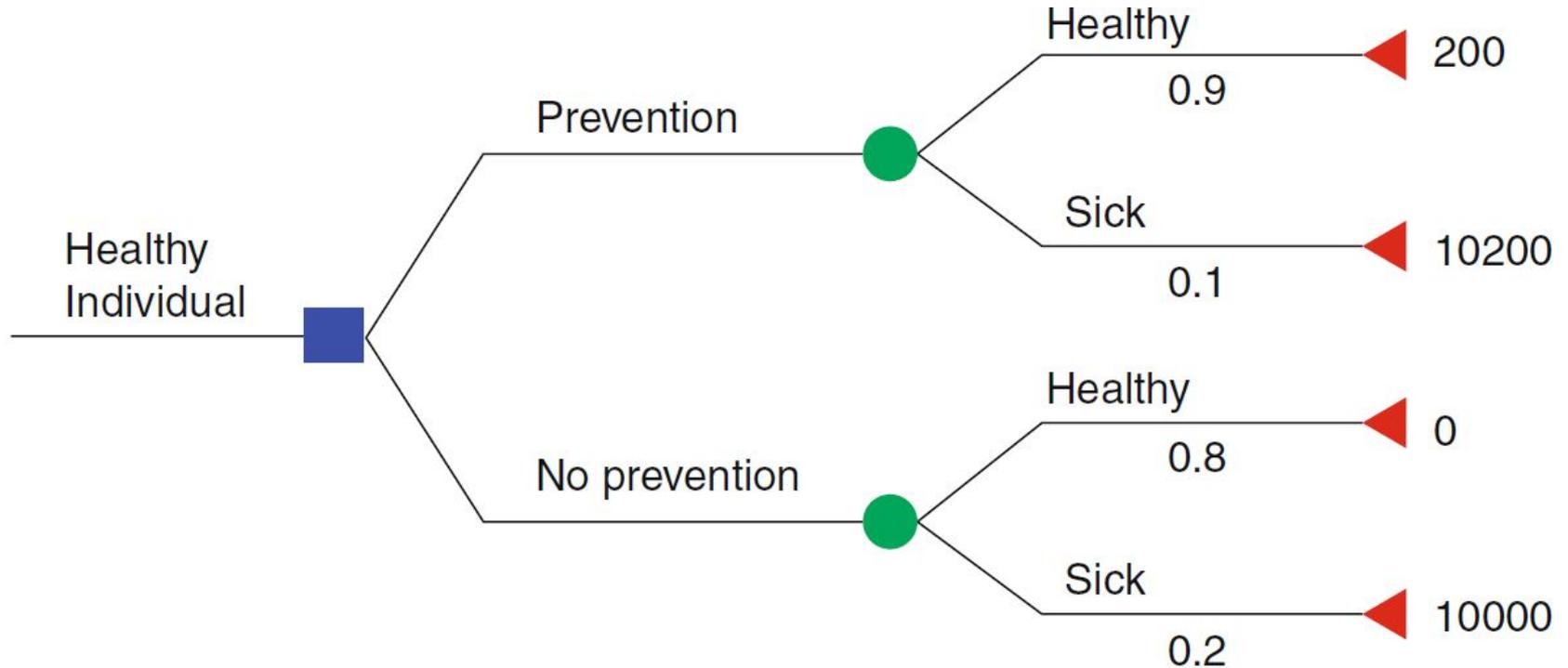
QALY = Quality-adjusted life year

GDP = Gross domestic product

Willingness to pay thresholds

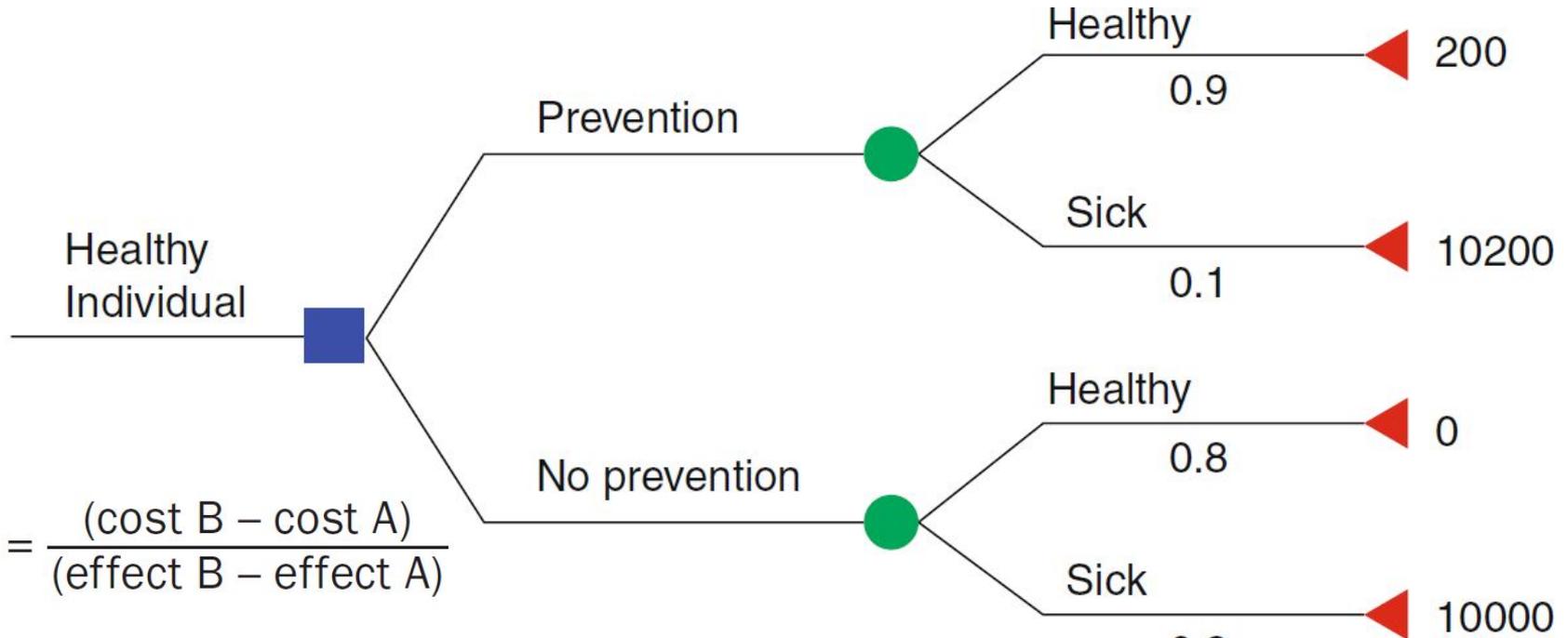
Activity:

Calculate incremental-cost-effectiveness ratio (ICER)



Activity:

Calculate incremental-cost-effectiveness ratio (ICER)



$$ICER = \frac{(\text{cost B} - \text{cost A})}{(\text{effect B} - \text{effect A})}$$

$$ICER = ((0.9 * 200) + (0.1 * 10200)) - ((0.8 * 0) + (0.2 * 10000)) / (0.9 - 0.8)$$

= - \$8000 / case averted (cost saving)

Significance of incremental approach

- Incremental cost-effectiveness ratios (vs) average cost-effectiveness ratios
 - ICERS (vs) ACERs
- Activity: Calculate ICER and ACER for one or two sequential tests within a screening programme for a health condition.

Table 10.1 Incremental cost-effectiveness calculations

<i>Number of tests</i>	<i>Costs (£)</i>	<i>Cases detected</i>	<i>ACER (£)</i>	<i>ICER (£)</i>
None	0	0		
One	100,000	10		
Sequential	180,000	12		

Source: Adapted from Morris et al. (2007).

Significance of incremental approach

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- Activity: Calculate ICER and ACER for one or two sequential tests within a screening programme for a health condition.

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None	0	0	—	
One	100,000	10	10,000	10,000
Sequential	180,000	12	15,000	40,000

Source: Adapted from Morris et al. (2007).

Economic evaluation approaches

- Alongside a randomised controlled trial
- Using decision modelling techniques
 - Static model
 - Decision tree
 - Markov model
 - Dynamic model
 - Transmission dynamic modelling for infectious diseases
- Combination of RCT and decision modelling

Perspective & Time horizon

- Perspective
 - Societal
 - Others
 - health care payer
 - health department
 - hospital
 - health insurance
 - employer
 - pharmaceutical
- Time horizon
 - Timeline of new intervention
 - costs
 - effects
 - choice of timeline
 - current intervention remains same?
 - longer horizon
 - uncertainty increases

Discounting

$$\text{Present value} = (\text{Future cost at year } t) / (1 + \text{discount rate})^t$$

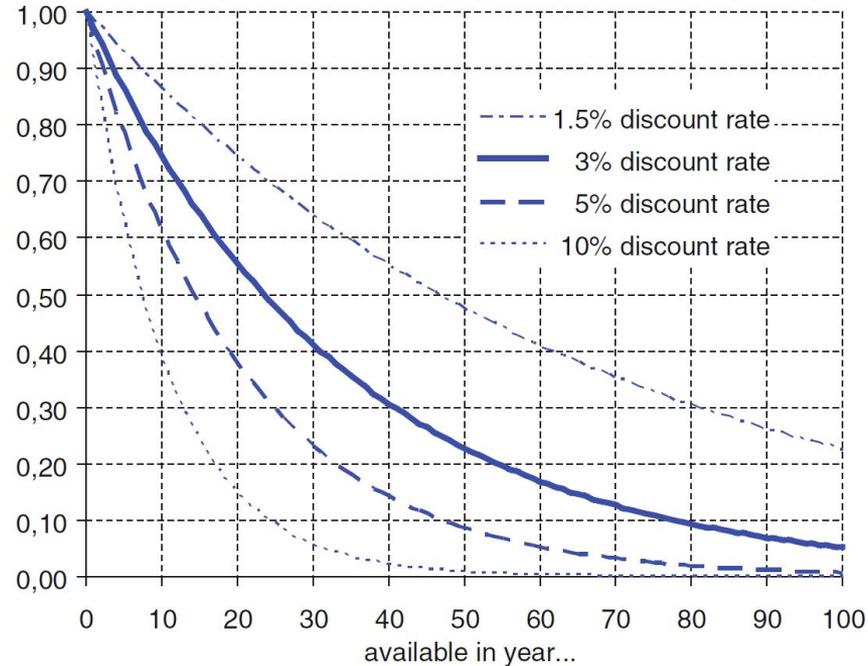
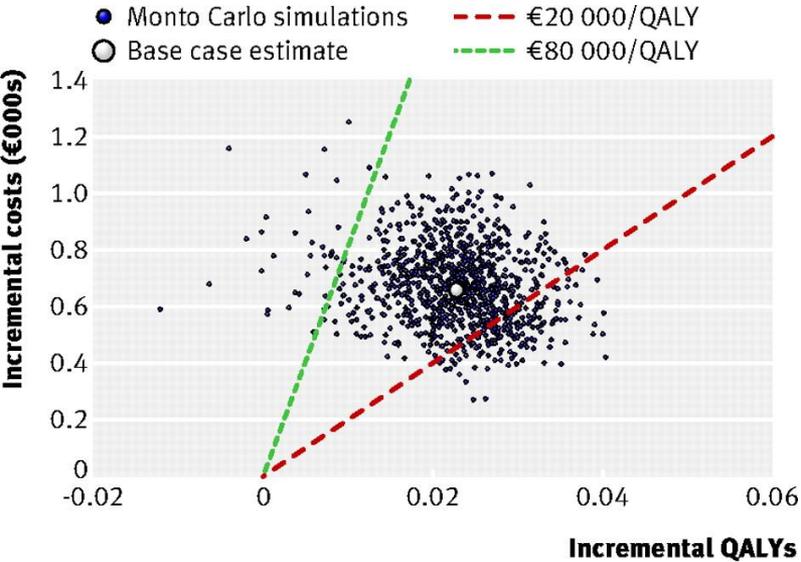
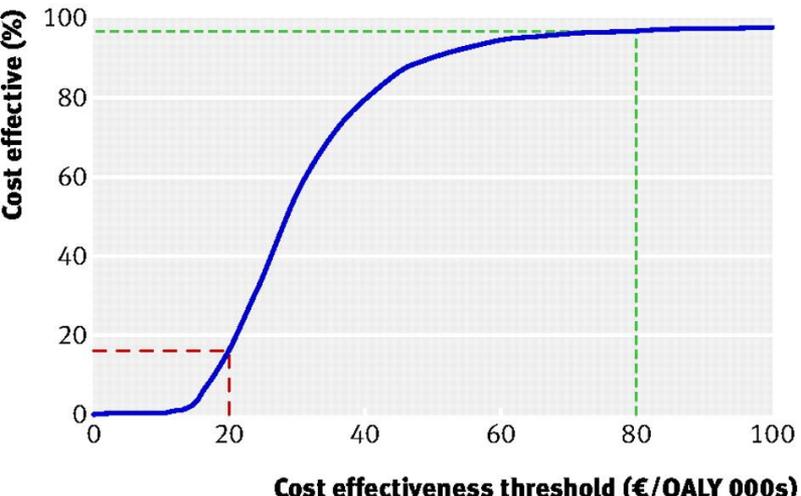


Fig. 15.2 Present value of € 1 or 1 life year



Uncertainty & sensitivity analysis

- Deterministic sensitivity analysis
- Probabilistic sensitivity analysis



Economic Evaluation Process:

Planning, Implementation/Analysis & Presentation/Advocacy

Steps to Performing an Economic Evaluation

1.
Planning

Step 1: Planning

- Define the problem
- Define the options
- Define the audience
- Define the perspective
- Define the time frame
- Define the analytic horizon

2.
Implementation
/Analysis

3.
Presentation
/Advocacy

Steps to Performing an Economic Evaluation

1.
Planning

2.
Implementation
/Analysis

3.
Presentation
/Advocacy

Step 2: Implementation/Analysis

- Choose a research design
- Estimate costs
- Estimate outcomes/benefits
- Conduct a sensitivity analysis

Steps to Performing an Economic Evaluation

1.
Planning

2.
Implementation
/Analysis

3.
Presentation
/Advocacy

Step 3: Presentation/Advocacy

- Determine methods of presentation of findings
- Present findings from evaluation
- Advocate for evidence-based decision-making as a result of the findings

Activity 10.1

Assume that a single hypothetical randomized controlled trial (RCT) has recently reported on the clinical effectiveness of two drug regimens, drug A on its own and a regimen consisting of drugs A and Y, for the treatment of chronic hepatitis C infection (HCV). The main RCT outcomes after a 52-week follow-up period are reported in Table 10.2.

Table 10.2 RCT results at one year

	<i>Drug A</i>	<i>Drugs A+Y</i>
Annual mean cost of Drug A	£2500	—
Annual mean cost of Drugs A + Y	—	£6438
Annual mean cost of all other health care resources related to HCV infection	£764	£650
Mean utility over months 1 to 6 inclusive	0.80	0.81
Mean utility over months 7 to 8 inclusive	0.80	0.90
Mean utility over months 9 to 12 inclusive	0.805	0.95
Percentage of patients alive at study end	100%	100%
Percentage of patients achieving a sustained virological response at study end	87%	90%

Note that the aim of treating people with chronic HCV is to completely eradicate detectable levels of the virus – this is known as having a ‘sustained virological response’ (SVR). Assume that if people achieve a SVR, they are no longer likely to develop any longer-term problems associated with the infection. Assume that all costs are to the health service. Your task is to calculate the ICER per additional QALY.

Costs over a year for A = £2500 + £764 = £3264

Costs over a year for A + Y = £6438 + £650 = £7088

QALYs for A = $((6/12)*0.8) + ((2/12)*0.8) + ((4/12)*0.805) = 0.8017$

QALYs for A + Y = $((6/12)*0.81) + ((2/12)*0.9) + ((4/12)*0.95) = 0.8717$

ICER = $(£7,088 - £3,264) / (0.8717 - 0.8017) \approx £54,629$ per additional QALY

In other words, for every year of perfect health that is generated (1 QALY being 1 year of perfect health), it costs an additional £54,629 if treatment A + Y is used instead of A alone.

Note: The 6/12 (or 0.5) is used here because the time period is 6 months (or 0.5 of a year). Similar adjustments are made for the other time periods to standardize them to a year period.

Activity 10.2

Given the answer to Activity 10.1, is the introduction of $A + Y$ a cost-effective use of resources? What other information would you (ideally) need to answer this question?

To answer this question, the most critical piece of missing information is an idea about the willingness to pay for an additional QALY. In the UK, NICE suggests a value of up to £30,000 per additional QALY (in most circumstances at least). Thus, as the ICER is above this level, A + Y is not a cost-effective use of resources – more QALYs would be lost than gained if money were taken from elsewhere in the health economy to fund it.

Other information, however, would also be useful. For example, no confidence intervals are presented in Table 10.2, meaning we have no idea as to how certain or not these results are, although sensitivity analysis would help somewhat in addressing this issue. Moreover, the benefits of treatment if a SVR is achieved are likely to extend beyond the one year period. Thus there is a strong argument that the treatment benefits, as they stand, have been underestimated and that decision modelling should be undertaken. Finally, treatment A is defined as the comparator – it would be useful to know how frequently it is used to treat HCV in the UK. If, for example, it too is an experimental drug, then the ICER becomes difficult to interpret, as it is unclear whether it is clinically- and cost-effective in the first instance.

Learning outcomes

- Describe the role of economic evaluation in health care.
- Differentiate between the different forms of economic evaluation.
- Explain how an incremental cost-effectiveness ratio is estimated and its meaning in relation to willingness-to-pay threshold.
- Identify the key steps in designing an economic evaluation.

Additional resources

Cost-effectiveness analysis: Recommendations & Checklist

Recommendations for Conduct, Methodological Practices, and Reporting of Cost-effectiveness Analyses Second Panel on Cost-Effectiveness in Health and Medicine

Gillian D. Sanders, PhD; Peter J. Neumann, ScD; Anirban Basu, PhD; Dan W. Brock, PhD; David Feeny, PhD;
Murray Krahn, MD, MSc; Karen M. Kuntz, ScD; David O. Meltzer, MD, PhD; Douglas K. Owens, MD, MS;
Lisa A. Prosser, PhD; Joshua A. Salomon, PhD; Mark J. Sculpher, PhD; Thomas A. Trikalinos, MD;
Louise B. Russell, PhD; Joanna E. Siegel, ScD; Theodore G. Ganiats, MD

JAMA 2016;316(10):1093-1103. <http://doi.org/10.1001/jama.2016.12195>

Consolidated Health Economic Evaluation Reporting Standards (CHEERS) statement

 OPEN ACCESS

Don Husereau *senior associate; adjunct professor of medicine; senior scientist*^{1,2,3}, Michael Drummond *co-editor-in-chief, Value in Health; professor of health economics*⁴, Stavros Petrou *professor of health economics*⁵, Chris Carswell *editor*⁶, David Moher *senior scientist*⁷, Dan Greenberg *associate professor and chairman; visiting assistant professor*^{8,9}, Federico Augustovski *director; professor of public health*^{10,11}, Andrew H Briggs *William R Lindsay chair of health economics, health economics and health technology assessment*¹², Josephine Mauskopf *vice president of health economics*¹³, Elizabeth Loder *chief of division; clinical epidemiology editor, BMJ*¹⁴, on behalf of the CHEERS Task Force

BMJ 2013;346:f1049. <http://doi.org/10.1136/bmj.f1049>

Cost-effectiveness analysis (CEA) & Budget impact analysis (BIA)

When cost-effective interventions are unaffordable: Integrating cost-effectiveness and budget impact in priority setting for global health programs

Alyssa Bilinski^{1*}, Peter Neumann², Joshua Cohen², Teja Thorat², Katherine McDaniel³, Joshua A. Salomon^{4,5}

1 Interfaculty Initiative in Health Policy, Harvard University, Cambridge, Massachusetts, United States of America, **2** Center for Evaluation and Risk in Health, Tufts Medical Center, Boston, Massachusetts, United States of America, **3** School of Social and Political Science, University of Edinburgh, Edinburgh, Scotland, United Kingdom, **4** Center for Health Policy and the Center for Primary Care and Outcomes Research, Stanford University, Stanford, California, United States of America, **5** Department of Global Health and Population, Harvard T.H. Chan School of Public Health, Boston, Massachusetts, United States of America

Global Health Economics Centre

<https://www.lshtm.ac.uk/research/centres/global-health-economics-centre>

- Economic evaluation and priority setting theme



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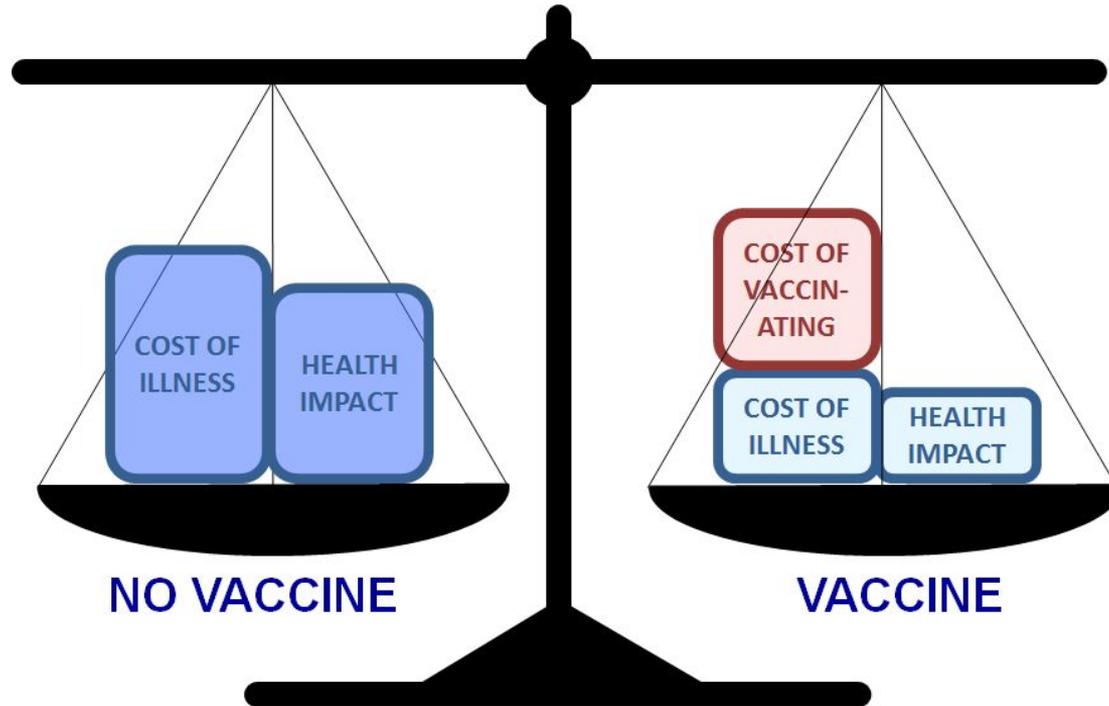
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Modelling and Economic Evaluation of Vaccines

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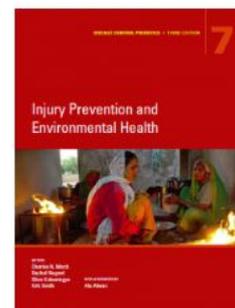
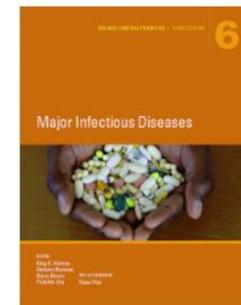
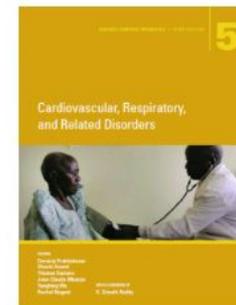
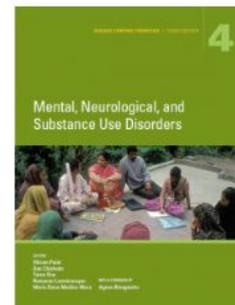
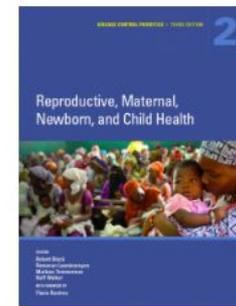
WHO guide for standardization of economic evaluations of immunization programmes

**EDITION II
October 2019**

<https://apps.who.int/iris/bitstream/handle/10665/329389/WHO-IVB-19.10-eng.pdf>

Economic evaluation for health

- Disease control priorities project
 - <http://www.dcp-3.org>



WHO-CHOICE (CHOosing Interventions that are Cost Effective)

<https://www.who.int/choice/en/>

Cost effectiveness and strategic planning (WHO-CHOICE)

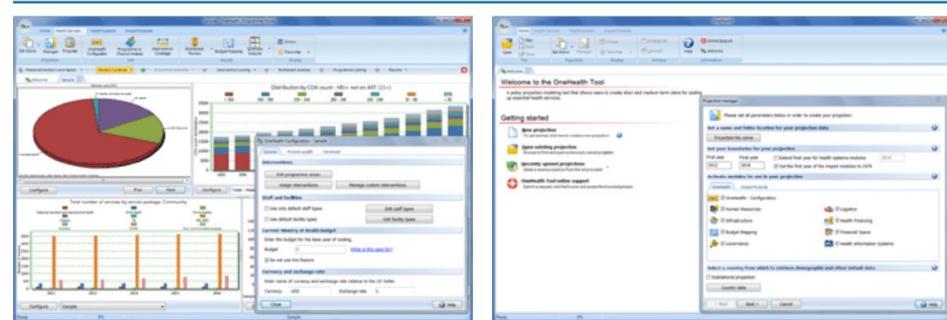


The WHO-CHOICE team works with policy makers at the country level, providing information on cost-effectiveness, costs and strategic planning which can help guide policy decisions. We assist countries to ensure that money spent on health is allocated in a way that the greatest possible health outcomes are achieved in the most feasible manner. We also collaborate with international agencies contributing to resource allocation decisions.

Member States, countries and organizations use the CHOICE tools to undertake cost-effectiveness analysis, whilst the OneHealth Tool assists in costing and measuring the feasibility of strategic plans.

<https://www.avenirhealth.org/software-onehealth>

OHT OneHealth Tool



The OneHealth Tool is a model to be used for supporting national strategic health planning in low- and middle-income countries. The tool facilitates an assessment of resource needs associated with key strategic activities and their associated costs, with a focus on integrated planning and strengthening health systems.

Health Technology Assessment (HTA)

- International Network of Agencies for Health Technology Assessment
 - <http://www.inahta.org/>



Decision support for priority setting in health

- International Decision Support Initiative
 - <https://www.idsihealth.org/>

Better decisions. Better health.

iDSI is a global network working to increase the value and impact of health spending. We believe everyone should have fair access to health, receiving the right treatment and the right medicines at the right time.



<https://www.youtube.com/watch?v=pxHdTVfLlxE>