Introduction to
Health Economics

Second Edition

Edited by
Lorna Guinness & Virginia Wiseman

Introduction to Health Economics

Second edition

Understanding Public Health Series

Series editors: Ros Plowman and Nicki Thorogood, London School of Hygiene & Tropical Medicine.

Throughout the world, there is growing recognition of the importance of public health to sustainable, safe and healthy societies. The achievements of public health in nineteenth-century Europe were for much of the twentieth century overshadowed by advances in personal care, in particular in hospital care. Now, in the twenty-first century, there is increasing understanding of the inevitable limits of individual health care and of the need to complement such services with effective public health strategies. Major improvements in people's health will come from controlling communicable diseases, eradicating environmental hazards, improving people's diets and enhancing the availability and quality of effective health care. To achieve this, every country needs a cadre of knowledgeable public health practitioners with social, political and organizational skills to lead and bring about changes at international, national and local levels.

This is one of a series of books that provides a foundation for those wishing to join in and contribute to the regeneration of public health, helping to put the concerns and perspectives of public health at the heart of policy-making and service provision. While each book stands alone, together they provide a comprehensive account of the three main aims of public health: protecting the public from environmental hazards, improving the health of the public and ensuring high quality health services are available to all. Some of the books focus on methods, others on key topics. They have been written by staff at the London School of Hygiene & Tropical Medicine with considerable experience of teaching public health to students from low, middle and high income countries. Much of the material has been developed and tested with postgraduate students both in face-to-face teaching and through distance learning.

The books are designed for self-directed learning. Each chapter has explicit learning objectives, key terms are highlighted and the text contains many activities to enable the reader to test their own understanding of the ideas and material covered. Written in a clear and accessible style, the series is essential reading for students taking postgraduate courses in public health and will also be of interest to public health practitioners and policy-makers.

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Dedications

For John, Thomas and Theo

LG

I would like to dedicate this book to my parents, Kaye and Don, for their enduring support. I also dedicate it to my children, Franklin, Myrtle and Rose who have always reminded me of the importance of play as well as work. Finally, to my husband, Steve, who has the patience of a saint.

VW

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Contents

The editors

Lorna Guinness (PhD) is a lecturer in health economics at the London School of Hygiene & Tropical Medicine where she has worked in teaching and research since 2001. Prior to this she was working as an economist at UNAIDS in Geneva. She works on the economics of health care in low-income countries including contracting out health services and the economics of HIV/AIDS. She is currently also a visiting research fellow at the Australian Centre for Economics Research in Health at the Australian National University, Canberra.

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Acknowledgements

Introduction

Cigarette consumption among the young, access to anti-retroviral therapy for AIDS patients, the increasing prevalence of obesity, rising health care costs and international shortages of key health care workers are just some of the challenges facing public health policy-makers and practitioners at the start of the twenty-first century. Economics has a central role to play in helping resolve these problems.

This book will introduce you to economic techniques that can be used in public health. It will help you understand the specific features that distinguish demand for health care from demand for other goods and services. It will provide insight into the economic methods that are being used to promote public health policies, analyse health care delivery and shape health sector reforms. You will be better able to make use of information on the economic evaluation of health care interventions and you will better understand the strategic debates on the use of market elements to improve health service performance and the use of financial strategies to promote the health of the public.

As you read through this book, you will soon discover that economists like their jargon and that they do not always agree with each other! You will also discover that there is often a gap between theoretical concepts and political implementation. Moreover, economic policies that work in one country don't necessarily work in a different cultural context. This book does not shy away from such issues; instead emphasis is placed on evoking a critical understanding of issues by describing different views held on the subject, rather than imposing a single view. Throughout this book effort has been put into presenting relevant empirical evidence on each topic and providing case studies and examples that help to demonstrate how economic advice works in practice in low, middle and high income countries.

If you don't have a background in economics you may find the language economists use and the way they explain their theories challenging. Don't panic. This book tackles economic issues from first principles and has been designed for students who have no previous knowledge of economics. A certain amount of economic theory is indispensable to understanding the strength and limitations of economic concepts as applied to health and health care. Wherever possible, we have tried to visualize complex economic concepts by using graphs rather than equations and by giving examples from a wide range of regions and health care settings. Lists of key terms also help to clarify new concepts and terminology. If you don't understand something, don't worry. You may proceed and come back to the problem later. You will find plenty of case studies and some self-assessment exercises to guide you through difficult issues and allow you to compare and contrast what you have learned with your own experience.

Why study health economics?

You may ask yourself what economics has to do with health and health care. Should health and health care, as fundamental concerns, not have an absolute priority? You may,

however, already know the answer. Resources are inevitably scarce and choices have to be made about their allocation. Health economics, as you will see in this book, is about the optimization of health relative to other activities and making choices to employ resources in a way that improves health status and service delivery within the limited resources available. Although economics is a relatively old discipline, its systematic application to the health sector is fairly new. It is only during the last 30 or 40 years that health economics has established itself as a sub-discipline of economics and gained influence in the health sector.

Managers and policy-makers rely increasingly on economic analysis. Economic thinking has gained in its influence on decision-making and economic ideas have fuelled health sector reforms. These changes are part of a larger process of public sector reform since the 1980s, which has been shaped by economic ideas. In pursuit of these reforms, multilateral agencies, such as the World Bank, have been aiming to redefine the relationship between the state and the private sector, to promote slimmer government services and an increased engagement of the private sector. A growing number of countries are using economic techniques to prioritize health services and to evaluate new health care technologies. The pharmaceutical industry has started to provide information on cost-effectiveness as this may provide a competitive advantage in promoting their products. But you should be aware that for most health care interventions, information on effectiveness and efficiency is not available. Health economics is still a developing discipline which is increasingly gaining acceptance of its methods.

Equity is another important area of economic analysis because of its usual prominence as a policy objective, its comparison with efficiency objectives and the implications it has for the allocation of resources. For instance, economists (as well as others) have shown that while imposing user fees can address the problem of consumer moral hazard by deterring the frivolous use of health services, this often comes at a high price by imposing heavy burdens on poorer groups. Another example is the use of 'weightings' within resource allocation formulae to reflect the higher health needs of particular population groups such as indigenous people or rural vs. urban populations. Almost all the chapters of this book will have something to say about equity.

Structure of the book

This book follows the conceptual outline of the 'Introduction to health economics' module taught at the London School of Hygiene & Tropical Medicine. The original edition was based on the materials presented in the lectures and seminars of the taught course, which had been adapted for distance learning. This revised edition places a greater emphasis on the practical application of economic theories and concepts to the formulation of health policy and planning. This is principally achieved through the extended use of new examples, case studies and activities. For instance, in Chapter 17 ('Promoting equity and the role of government'), case studies are presented from South Africa and Cambodia to illustrate how policies have been designed to address vertical equity concerns in these countries. Similarly, in Chapter 16 ('Economic evaluation and decision-making), new examples show how the results of economic evaluations have been used by groups such as the National Institute for Health and Clinical Excellence (NICE) in the UK and by the Copenhagen Consensus Project to set priorities on health care spending. The book also provides an update in terms of current thinking. Some important policy shifts have taken place since

the first edition was published in 2005: the rise of performance-based funding in health care, increased evidence about the impact and cost of achieving universal health care coverage and the growing impact of globalization and international trade on the health sector are just a few examples. The book introduces some completely new chapters covering topics such as macroeconomics and health, provider payments and countering market failure.

The book is structured around a simple conceptual framework. It starts by introducing you to economics and goes on to consider the concepts of supply, demand and markets. You will then learn about how health systems can be financed. Next we consider how health care interventions can be evaluated using economic analysis and how such economic information can be used in policy-making. Finally, you will look at the issue of equity and the economic argument for the role of government in health services.

The six sections, and the 17 chapters within them, are shown on the book's contents page. Each chapter includes:

- an overview;
- a list of learning objectives;
- a list of key terms;
- a range of activities;
- feedback on the activities;
- a summary;
- references and a list of suggested further reading.

The following briefly summaraizes the book as a whole.

Economics and health economics

Chapter 1 defines economics as well as a range of key concepts commonly used by economists. Health economics is then introduced along with examples of the type of policy questions that this sub-discipline can help to address. In Chapter 2 you will learn about the macroeconomics of health and health care including the relationship between trade and health and health systems.

Demand and supply

This section provides the foundations for exploring how individual markets function, how market forces operate in health care and how they influence output and price for health services. It starts by considering the concept of demand in Chapter 3 and then goes on to explore the measurement of demand and the notion of price elasticity of demand in Chapter 4. You will start to explore the concept of supply in Chapter 5 by looking at production and the inputs to production. In Chapter 6 you will look at the costs of production.

Markets

Your attention will then turn to the interaction of demand and supply and the concept of markets in Chapter 7. This chapter focuses on markets and the conditions under

which markets operate well. You go on to learn the reasons for market failure in health care in Chapter 8.

Health care financing

Chapter 9 provides a framework for assessing health care financing systems. It looks at the different sources and uses of funds and provides a brief history behind health systems development. In Chapter 10 you will explore the different methods of paying health care providers and how these might influence health care delivery. You then go on to look at private health insurance (Chapter 11) and the topic of achieving universal coverage (Chapter 12).

Economic evaluation

The penultimate section starts with an exploration of the key concepts behind economic evaluation, the different possible economic evaluation techniques and their uses (Chapter 13). Methods to determine the costs of health care interventions are discussed in Chapter 14 and the methods to determine the benefits of health care interventions are explored in Chapter 15. The final chapter in this section provides an overview of how economic evaluation is applied in practice.

Equity and the role of government

The final chapter begins by describing the relationship between equity and equality and exploring a number of different ways in which equity has been conceptualized and applied in health care. Potential trade-offs between equity and efficiency are considered, along with the pros and cons of government intervention in the health care sector.

A variety of activities are employed to help your understanding and learning of the topics and ideas covered. These include:

• reflection on your own knowledge and experience;
• questions based on reading key articles or relevant research papers;
• analyses of quantitative and qualitative data;
• key terms for each topic defined at the beginning of each chapter for easy reference.

SECTION 5

Economic evaluation

What is economic evaluation and what questions can it help to answer?

Virginia Wiseman and Stephen Jan

Overview

So far we have learned that perfectly competitive markets provide the most efficient allocation of resources. We have also learned that markets in health care suffer from a number of 'failures' and for this reason (as well as equity concerns) governments intervene. Having no 'market' does not remove the central problem of allocating scarce resources. We will learn in this chapter and the subsequent three chapters that economic evaluation is one approach that can assist with resource allocation where markets do not exist.

We begin our exploration of economic evaluation by introducing some key concepts. You will encounter these concepts throughout the following three chapters so it is important that you understand them. This chapter will also give an overview of the types of economic evaluation and the sorts of policy questions they can address. Chapters 14 and 15 look at the *methods* for measuring and valuing costs and consequences while Chapter 16 discusses ways of *presenting and interpreting* information on costs and consequences to inform health care decision-making.

Learning objectives

After working through this chapter, you will be able to:

- define economic evaluation
- describe the different techniques of economic evaluation
- explain how economic evaluation helps to assess efficiency
- explain the main stages in economic evaluation
- describe how economic evaluation can contribute to answering policy questions

Key terms

Cost–benefit analysis. An economic evaluation technique in which outcomes are expressed in monetary terms.

> **Cost-effectiveness analysis.** An economic evaluation technique in which outcomes are expressed in health units such as life years saved.
>
> **Cost–utility analysis.** An economic evaluation technique where outcomes are expressed in health units that capture not just the quantity but quality of life.
>
> **Economic evaluation.** Compares the costs and consequences of alternative health care interventions to assess their value for money.
>
> **Sensitivity analysis.** The process of assessing the robustness of the findings of an economic evaluation by varying the assumptions used in the analysis.

A day in the life of a health minister

As free markets rarely exist in health care, decisions have to be made about which health services should be funded in the face of resource scarcity. These are difficult decisions to make especially when medical technologies are improving and expanding, real incomes are increasing and many countries have an ageing population.

A minister of health once remarked that 'the only thing a minister of health is ever destined to discuss with the medical profession is money'. There never seems to be enough money to do everything worth doing and ministries of health frequently encounter situations where each request for additional funding may be legitimate in that it will improve health but the budget often cannot cover all of the requests. For example, suppose a minister of health receives requests from two different programmes, one from the Tuberculosis Programme (TBP) and the other from the Expanded Programme on Immunization (EPI). The TBP wants additional funding for 'Directly observed therapy – short course' or DOTS. The EPI wants to add hepatitis B vaccine (HBV) to its routine programme. Without an increase in the overall budget, the new programmes could not be covered unless some other programmes are cut.

The question, then, is how can the minister decide which of the requests should be supported? Giving support for one, or possibly both, means that something else should be cut back – which programme should it be? Which interventions are 'worthwhile'? This is where economic evaluation comes into the picture.

Impact of health problems

A key priority of many societies around the world is the alleviation of health problems: disease, injury or a risk factor for one of these. The impact of such health problems can be manifested in different ways – physical disability, morbidity and mortality, emotional distress, social difficulties and isolation, and financial and economic losses. Each manifestation can be seen at the level of the individual, the family and household, the local community, and the rest of society. The impact of health problems can be measured as:

- the number of cases;
- the number of deaths;
- the amount of disability, pain or suffering;

- the number of people with a risk factor;
- the amount of money spent on a health problem;
- the amount of lost income due to a health problem.

For example, the death during childbirth of a mother who already has two children and who is the only schoolteacher in the village can be measured in various ways, such as:

- a 'case' of maternal mortality;
- the number of years of life she has lost by dying prematurely;
- the amount of her wages that her family will no longer receive;
- the effect of the loss of her wages, particularly on her school-age children who can't be educated because the money for school fees is no longer available;
- the loss to her husband who misses her company and her skills as a housekeeper and part-time farmer;
- the loss of her guidance and training for her young children;
- the loss of the investment her own parents made in training and educating her to be a teacher;
- the loss to the school system which now has to hire or train new teachers to replace her.

So, in economic evaluation the impact of health problems can be assessed using a variety of health measures such as the number of cases of illness, the number of deaths due to illness, the number of potential years of life lost due to illness or in monetary terms as the *cost of health problems* – the monetary value of resources spent or lost because of the health problem.

Resources needed for an intervention

You know in advance that you will never have enough money to do everything you would like – so knowing all the possible interventions available for a health problem is not enough. It means you also need to know what the interventions cost. Determining the cost of an intervention can sometimes be complicated. A first step is to know what specific resources are used to implement the intervention. Resources are the ingredients of health care interventions. They are also referred to as *inputs* or *resource inputs*. A useful approach is to divide the resources into seven categories:

- personnel;
- buildings and space;
- equipment;
- supplies and pharmaceuticals;
- transportation;
- training;
- social mobilization and publicity including information, education and communication.

Activity 13.1

Look at the photograph of a growth monitoring session in a low-income country. What resources are being used in the health intervention depicted?

Figure 13.1 A health intervention in a developing country
Source: Global Samaritans

Feedback

In the photo your attention was probably first drawn to the equipment, in particular the weighing scale. Then you will have noticed the staff – the nurse who is writing down the weights of the babies. She has been trained to carry out this activity. You may have forgotten the vehicle and driver – they are not in the picture. Other activities would include the maintenance of vehicles and equipment, the training of staff, the supervision by higher levels of staff at a health centre or wherever they are based. Another resource to keep in mind is the time of the mothers – they could be doing other activities instead of waiting for their babies to be weighed. And how did the mothers know that there would be a growth monitoring session in this place at this time? Resources have gone into informing and motivating the mothers to bring their babies.

Having identified the resources, you need to measure how much of each resource is used. This is what economists call production – how much of each resource or input is required to produce the growth monitoring service. Finally, you need to establish the value of each resource that you have used, so that you can calculate the cost of the intervention. The most straightforward way to value resources is to use money as the measure. Some costs will not be easy to determine – think of the time of the women who brought their children for the growth monitoring session. How would you estimate its value in monetary terms? For the moment it is enough that you begin to be aware that costing is not always a simple matter of collecting price information – it may require skill and judgement on the part of the economist. We will explore costs more closely in the next chapter.

Outcomes or consequences

The goal of an intervention is to reduce the impact of a health problem. For economic evaluations, you need to measure how much the impact is reduced. To figure out if the intervention has done enough good to justify its cost, you need to know how the health problem changes after the intervention. Specifically, you need to know what occurs *as a result of* the intervention, in other words, the outcome or consequences of the intervention.

You can assess this change by measuring the difference in the health problem in one of two ways. You can either measure the impact of the health problem before and after the intervention, or with and without the intervention. For this reason economic evaluations are often done alongside clinical trials or some other form of intervention evaluation where these impacts are being specifically assessed.

Since impact is assessed using either health measures (number of deaths, number of cases, etc.) or their monetary equivalent, and since outcome is merely the difference in impact, units used to measure outcome are identical to the units used to measure impact.

Take the example of the use of impregnated bed nets to prevent malaria. If you wanted to determine their impact, you could calculate the number of deaths in children aged 6 months to 5 years in a village where the nets were impregnated and compare this to the number of malaria deaths in villages of similar size and characteristics where the bed nets were not impregnated. Suppose that the results showed that:

- villages which did not receive the intervention had 73 deaths from malaria;
- villages where bed nets were impregnated (with the intervention) had 16 deaths from malaria.

As a result of the intervention, you could conclude that there were 57 fewer deaths from malaria. The *outcome* of the new malaria intervention then is a reduction of 57 deaths.

While health care's goal is to achieve as greater reduction in health problems as possible, your health care budget often won't allow you to implement all desirable interventions. This is exactly the same dilemma faced by the minister of health at the beginning of this chapter. He or she still faces the challenge of comparing the request for funding by the TBP for DOTS with the request for funding from the EPI to introduce HBV. Some decision must be made as regards the relative value of the interventions. This is how economics as a discipline can assist.

What is economic evaluation?

According to Drummond *et al.* (2005) two features characterize economic evaluation: it is a *comparative* analysis (i.e. it compares two or more different options), and it compares these options in terms of their *costs and their consequences*. Figure 13.2 illustrates this. Two alternatives are presented, A and B. When assessing programmes A and B, we compare the difference in costs with the difference in consequences. This is called an *incremental analysis*. Let us now begin thinking about comparing costs and consequences of different interventions in a practical way.
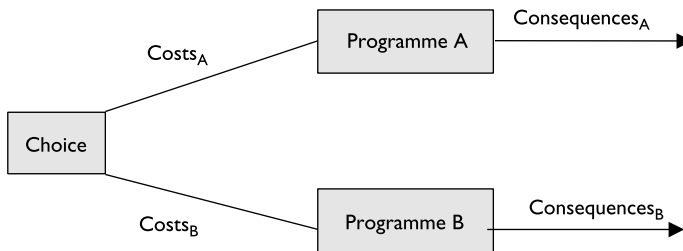
Figure 13.2 Costs and consequences

Source: Drummond *et al.* (2005)

Activity 13.2

Imagine that programme A is a community-wide programme distributing free insecticide-treated bed nets (ITNs) to control malaria. What alternative programmes might you want to compare this against?

Feedback

Here are some suggestions but you can probably think of others. We have concentrated on malaria but you might be interested in comparing your intervention with other infectious disease programmes or alternatively non-health programmes in the agricultural or education sectors.

- Do nothing (i.e. not implementing ITNs).
- Using ITNs only in target groups (i.e. pregnant women and children under 5).
- Social marketing of ITNs – social marketing projects encourage private sector distribution networks to make health products available to low-income people at subsidized prices. Products are sold, rather than given away free of charge.
- Distributing ITNs only in malaria endemic areas.
- Other forms of malaria control such as indoor residual spraying (IRS) or intermittent presumptive treatment (IPT) in pregnant women or infants.
- Treating malaria using different antimalarials.

Types of economic evaluation

Table 13.1 summarizes the different types of economic evaluation studies.

Cost–benefit analysis

Cost–benefit analysis (CBA) is a method of economic evaluation where the monetary value of the resources consumed by a health intervention (costs) is compared with the monetary value of the outcomes (benefits) achieved by the intervention. While the lay meaning of 'benefit' is 'something good', in CBA it means the 'monetary value of the outcomes' achieved by an intervention. CBA is appropriate when a decision-maker wants to know: is a single intervention policy or a number of intervention policies

Table 13.1 Types of economic evaluation

Type of analysis	Measurement/valuation of costs in both alternatives	Identification of consequences	Measurement/valuation of consequences
Cost–benefit analysis	Monetary units	Single or multiple effects, not necessarily common to both alternatives	Monetary units
Cost-effectiveness analysis	Monetary units	Single effect of interest, common to both alternatives, but achieved to different degrees	Natural units (e.g. life years gained, points of blood pressure reduction, etc.)
Cost–utility analysis	Monetary units	Single or multiple effects, not necessarily common to both alternatives	Healthy years (typically measured as quality adjusted life years)
Cost analysis	Monetary units	None	None

Source: Drummond et al. (2005)

worth implementing? (i.e. are benefits greater than the costs?) Two common cost–benefit indicators are:

- net present value (NPV): this result is expressed as a single number with monetary units;
- benefit–cost ratio (BCR): this result is expressed as a ratio of benefits to costs.

NPV is calculated by subtracting the cost of an intervention from its benefits. When the benefit is bigger than the cost, the net benefit will be greater than zero. This says that the value of the outcomes is worth more than the value of resources used up by the intervention, so the intervention is worthwhile.

Another way of comparing cost and benefit is the BCR. This is simply the benefits *divided by* the costs. The higher the BCR, the more worthwhile the intervention – and some interventions can actually be cost-saving, in other words, implementing them can save money for health services or for a society as a whole.

From a societal perspective, as long as net benefits are greater than zero, or benefits exceed costs (the BCR is greater than 1), the intervention should be implemented. For now, it is important to recognize that CBA's greatest appeal lies in the fact that it can be used to compare interventions with a range of different outcomes. These interventions can even relate to different sectors of the economy. In practice, however, the monetary valuation of benefits in CBA is difficult. Placing a value on human life and health can be extremely hard. Decision-makers can also find a single amount representing costs and benefits of a programme 'disconcertingly impenetrable' (Fox-Rushby and Cairns 2005).

Cost-effectiveness analysis

Cost-effectiveness analysis (CEA) is the most commonly used form of economic evaluation in the health sector. Under this method, the value of the resources spent on an intervention is compared with the quantity of health gained as a result. Unlike CBA,

which compares monetary costs with monetary outcomes, CEA compares the cost of an intervention with the intervention's *health* outcomes.

Cost-effectiveness is typically expressed as a ratio of costs divided by health outcomes. The *cost-effectiveness ratio* (CER) of one intervention can then be compared with that of another. CERs typically come in the form of average cost-effectiveness ratios (ACERs) or incremental cost-effectiveness ratios (ICERs). ACERs relate to single interventions whereas ICERs compare relative costs and effects. ICERs are the ratio of the difference in cost between two alternatives to the difference in effectiveness between the same two alternatives. These two types of CER are shown in Figure 13.3.
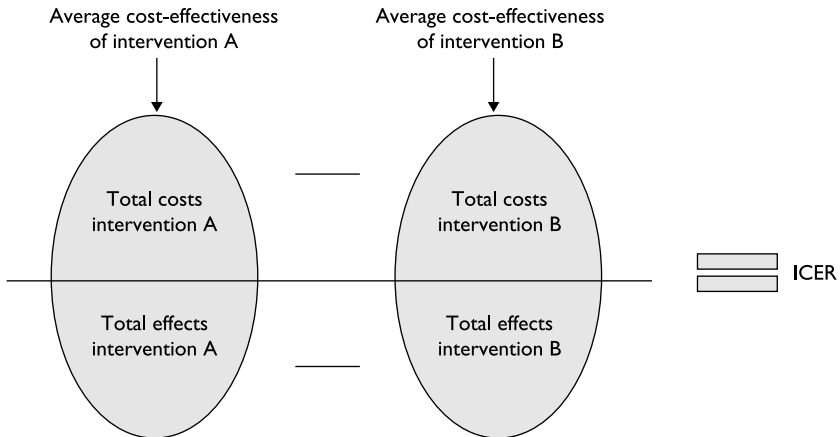
Figure 13.3 Comparative economic evaluation
Source: Fox-Rushby and Cairns (2005)

Where interventions are independent (i.e. the costs and effects of one intervention are not influenced by the introduction of another intervention(s)) then cost-effectiveness ratios can be calculated for each intervention and ranked giving those with a lower ACER higher priority. However, interventions are often not mutually exclusive, for example comparing two types of diagnostic testing for malaria. In this case we need to know what are the additional benefits to be gained from the new intervention and at what additional cost. This is where ICERs come into play. We will come back to CERs in Chapter 16.

CEA has been applied to many different types of health intervention. Its results – such as cost per life year gained – are often easily interpreted by planners and policy-makers. However, one of the key limitations of CEA is that it is restricted to comparisons of interventions that have a common single unit of effect.

Cost–utility analysis

Cost–utility analysis (CUA) is a broader form of analysis than CEA but a variant of that general approach (Drummond *et al.* 2005) and for that reason is often discussed under the heading of 'cost-effectiveness analysis'. Using CUA, one can assess the quality of, for example, life years gained, not just the crude number of years lived in a particular health

state. This is especially useful for those interventions that may extend life but at the expense of side-effects (e.g. treatment for certain types of cancer). The most common measures of consequences in CUA are the quality adjusted life year (QALY) and the disability adjusted life year (DALY).

CUA was developed to address the problem of conventional CEA, which did not allow decision-makers to compare the value of interventions for different health problems. While this is a definite strength of the approach, some have questioned the ability of CUA to capture all the valued characteristics associated with an intervention. For example, QALYs do not capture differences in the process characteristics of interventions (such as respect, autonomy, provision of information, etc.), despite substantial evidence that patients *do* attach value to these (Mooney 1994; Howard *et al.* 2008).

Cost analysis or cost minimization analysis

Cost-minimization analysis (CMA) is a narrow subset of CEA. It is used to measure and compare input costs across alternatives where there is good evidence that outcomes are identical. Thus, the types of intervention that can be evaluated with this method are rather limited.

Activity 13.3

Now that you have gained an understanding of the main types of economic evaluation it is important to also learn how these techniques can be used to address policy questions. For each of the policy questions listed below, identify which type of economic evaluation would be most appropriate to use and explain why. The idea for this exercise came from a similar activity used by Fox-Rushby and Cairns (2005).

1 The Ministry of Finance wants to know whether it is worth investing further resources into malaria control or building new primary schools?
2 The Ministry of Health wants to compare the costs of receiving intravenous antibiotics in a hospital with receiving the same antibiotics (at the same doses) at home via a home health care service.
3 The Ministry of Health wants to compare the costs and outcomes of two interventions for the treatment of early stage breast cancer: mastectomy without breast reconstruction compared to breast conserving surgery and radiotherapy (breast conservation).
4 A malaria control programme wants to use economic evaluation to compare two different diagnostic strategies for malaria treatment: microscopy and rapid diagnostic tests.

Feedback:

1 CBA, as here we are dealing with the size of the budget and comparing interventions across different sectors of the economy.
2 CMA, as outcomes *should* be the same.
3 CUA, as there are likely to be differences in mortality and morbidity.
4 CEA, as there is likely to be a common unit of effect – e.g. cost per case detected.

Efficiency and economic evaluation

It is important to recognize that economic evaluation is *not* about choosing the cheapest option. According to Maynard (1987), 'The pursuit of efficient practices is not merely about reducing costs. If it were, the most "efficient" procedure would be to do nothing as that pushes costs to zero'.

The main forms of economic evaluation (i.e. CEA, CUA and CBA) can be used to pursue two types of efficiency: economic and allocative. We learned in Chapter 7 that economic efficiency enables assessment of the relative value for money of interventions with directly comparable outcomes. Put differently, economic efficiency is concerned with 'what is the least costly way to *achieve* a particular goal?'. Allocative efficiency describes a situation where resources are allocated and goods distributed in a way that maximizes social welfare. Allocative efficiency judges whether the goal itself is worthwhile pursuing. This requires us to take a 'societal perspective' and consider costs and benefits within and outside the health sector.

CEA and CUA are based on the production function approach (see Chapter 5) which focuses on the least cost way of producing a good whether it be a car or a hip replacement. These techniques compute the ratio of input to output (or vice versa) with inputs valued in monetary terms and is therefore a measure of economic efficiency. CEA considers only one measure of effectiveness and as a result often omits important social costs and benefits.

CBA can be used to measure both economic and allocative efficiency questions. It can be measured either within the health care sector or across other sectors of the economy because in principle it assesses all relevant costs and benefits that result from an intervention. While in theory this provides the most comprehensive form of economic evaluation, its use in the health sector has been limited largely due to the practical problems of measuring and valuing these benefits. In addition to economic and allocative efficiency, CBA is based on Pareto welfare optimization. In other words, the aim of CBA is to provide a framework for assessing the ability of an intervention or policy to offer a potential Pareto improvement (see Chapter 7 for an explanation of Pareto efficiency).

Stages of economic evaluation

There are four broad steps in undertaking an economic evaluation:

- defining the decision problem (also known as 'framing the evaluation');
- identifying, quantifying and valuing the resources needed;
- identifying, quantifying and valuing the health consequences;
- presenting and interpreting the evidence for decision-making.

You will learn about the second step in the next chapter, the third step in Chapter 15 and the fourth step in Chapter 16. For now we will concentrate on defining the decision problem.

Defining the decision problem

When defining the decision problem you will need to include clear statements on the purpose of the evaluation, intended audience, time frame, perspective and interventions for comparison.

Purpose

It is important to be very clear about *why* you are carrying out the economic evaluation. The statement of purpose should include the following information:

- the intervention(s);
- the health problem addressed by the intervention;
- the reason for conducting the evaluation and its importance;
- the units of analysis.

In terms of the last point, you want your analysis to have an impact on policy. Therefore it is important that results should be easy to communicate in terms that are both useful and understandable to the target audience. People want to know what they are getting for their money and this is most easily communicated when costs and outcomes are simplified to units that people can understand.

Audience

The main audience should be those attempting to use the information.

Activity 13.4

Can you identify what groups might use the results of an economic evaluation in their decision-making?

Feedback

Audiences can include:
- government (e.g. Ministry of Health);
- international health organizations (e.g. World Health Organization);
- multilateral development banks (e.g. World Bank);
- bilateral aid agencies (e.g. Swedish International Development Cooperation Agency – SIDA);
- non-governmental organizations (NGOs) (e.g. Oxfam);
- drug companies;
- global health partnerships (e.g. Global Fund);
- advocacy or special interest groups (e.g. tobacco control advocacy groups).

The audience will have an important bearing on the perspective of the analysis and in turn the different options being compared. An economic evaluation designed to inform a large international donor, such as the World Bank, about the cost-effectiveness of scaling up malaria control in the Africa region will be different to an evaluation for an NGO that wants to compare mechanisms for delivering antenatal care to women living in a remote area of Nepal. The main differences will lie in the way results are presented and the types of costs and effects taken into account. We will come back to this last point under 'perspectives'.

Time frame

Interventions often have different time patterns for their costs and outcomes; costs and outcomes are usually spread out over time (often a number of years) and, frequently, costs and outcomes change over time. It is quite common that the costs of the intervention are incurred at the beginning, while the benefits occur far in the future – an example would be an immunization programme for hepatitis B. A cost analysis must therefore consider the time course of interventions and outcomes separately and adjust for changes over time. *Discounting* is a procedure economists use to relate costs and outcomes occurring at different times to a common basis. We will learn more about this technique in the next chapter.

To understand how and why the costs of an intervention vary, think about dividing an intervention into start-up costs (those needed to set up the intervention) and maintenance costs (those needed to keep it going). If you do the cost analysis when beginning the intervention, it would be a mistake to assume that start-up costs (such as building a new clinic) are representative of the costs you will incur in later years. Conversely, if you begin the cost analysis after the intervention has begun, you cannot assume that everything put in place at the beginning of the project no longer has to be paid for and therefore has a value of zero.

Perspectives: whose costs and whose outcomes?

It is important to realize that health interventions frequently have costs and outcomes that affect different parts of a society. The perspective or viewpoint is like the lens through which costs and consequences are examined. It can be broad or narrow. Commonly used perspectives include:

- *Societal* – the broadest viewpoint possible which takes into account all the costs and all the outcomes of a health intervention, regardless of who incurs them or who gains from them. A societal perspective requires a vast range of micro and macro data and would be highly unlikely to address a specific audience;
- *Health system* – obviously a narrower point of view, this includes the costs borne and the outcomes received by the health sector.

Correctly thinking through the perspective can save large amounts of time and effort in performing the analysis because, depending on the perspective taken, some hard-to-measure costs and outcomes may not have to be considered.

The simplest example is the expenditure for a prescription drug. If the patient must pay 100 per cent of the cost of the drug, then the cost might not be important to the health service. On the other hand, if the health system must bear all of the costs of the drug, then this will directly reduce the funds available for other interventions and the health system might be very concerned with the drug costs – as the example below will show.

Should expensive drugs be provided free?
Consider a disease for which there is a drug treatment but the drugs are very expensive – e.g. they cost £10,000 to £12,000 per year for each patient. Citizens'

groups representing those affected by the disease are requesting that the Ministry of Health provide this medication free of charge to everyone with the disease. Now consider two contrasting perspectives: that of the Ministry and that of a group of citizens.

From the perspective of the Ministry, providing this drug will indeed help patients with the disease but the opportunity cost of these drugs is significant in terms of what could be provided for other patients. The budget is limited – what is the best use of available resources?

In contrast, the citizens' group will focus on the positive impact the drug is likely to have on people with the disease: they will be able to lead more normal lives of higher quality, perform their household duties and remain productive members of society, and their need to use the health services over any given period of time will be reduced. In contrast, if they do not get the drug they may not be able to work and consequently will be unable to support themselves or their families financially. From this perspective, supplying the drug will lessen the burden on the family and society.

You can see from the above example that the perspective you choose will dictate how you look at costs and outcomes.

Specifying the interventions/options for comparison

All the relevant interventions directly related to the health problem being evaluated should be included in the analysis. Interventions need to be described in enough detail that will allow all relevant costs and outcomes to be identified. For costs, this means asking who does what, to whom, where and how often (Drummond et al. 2005). For outcomes or consequences, it is important to examine which ones are measurable and in turn how they can be valued (Fox-Rushby and Cairns 2005). As you have learnt, the choice of outcome will dictate the type of economic evaluation undertaken (i.e. CEA, CUA or CBA).

Sensitivity analysis

For each stage of an economic evaluation it is important to document any assumptions made. You will have gathered by now that conducting an economic evaluation is far from an exact science. Lots of difficult questions are raised that do not always have clear-cut answers. Many of the procedures to estimate costs and benefits require estimates of data and preferences that are not known with certainty. For example, medical professionals are uncertain about the value of many preventive measures and their views can change as new evidence becomes available. There also tends to be considerable speculation over future drug costs. *Sensitivity analysis* is the process of deliberately varying these uncertain factors to examine their effect on the findings of a study. These type of assumptions will need to be tested under the final stage of an economic evaluation (i.e. 'presentation and interpretation of the evidence' (discussed in Chapter 16).

Summary

You have learned in this chapter that economic evaluation generates information on efficiency in non-market situations by comparing the costs and consequences of alternatives. There are three main forms of economic evaluation (CBA, CUA and CEA) and it is the way outcomes are expressed which distinguishes them. Under CBA outcomes are expressed in monetary terms, under CEA they are expressed in single health effects such as life years saved and for CUA multiple effects can be captured under measures such as QALYs. Establishing the purpose, audience, perspective, time frame and interventions for comparison are all important first steps in economic evaluation regardless of the type of tool being used.

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Further reading

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Counting the costs

Lorna Guinness

14

Overview

In Chapter 13, you learned that there are three steps in determining the cost of an intervention, once the decision problem has been identified: identification of the resources needed; quantification of the amount of each resource; and valuation of each resource. In this chapter you will focus on the third step: the valuation of resources to generate costs. You will learn about defining, calculating and comparing costs, known as cost analysis. In particular, you will learn about marginal costs – the cost of providing one additional unit of service.

Learning objectives

After working through this chapter, you will be able to:

- define and set up a cost analysis
- define and give examples of financial and economic costs
- define and give examples of capital and recurrent costs, fixed and variable costs
- calculate the following as they relate to an intervention: total costs, annual and annualized costs, average costs and marginal costs
- explain why discounting may be necessary

Key terms

Annual cost. The cost of an intervention, calculated on a yearly basis, including all the capital and recurrent costs.

Annualized costs. The annual share of the initial cost of capital equipment or investments, spread over the life of the project – usually modified to take account of depreciation.

Average cost. Total cost divided by quantity.

Capital cost. The value of capital resources which have useful lives greater than one year.

Direct cost. Resources used in the design, implementation, receipt and continuation of a health care intervention.

Discount rate.   The rate at which future costs and outcomes are discounted to account for time preference.

Discounting.   A method for adjusting the value of costs and outcomes which occur in different time periods into a common time period, usually the present.

Financial (budgetary) cost.   The accounting cost of a good or service, usually representing the actual (historical) amount paid – distinct from the economic (opportunity) cost.

Indirect cost.   The value of resources expended by patients and their carers to enable individuals to receive an intervention.

Intangible cost.   The costs of discomfort, pain, anxiety or inconvenience.

Marginal cost.   The change in the total cost if one additional unit of output is produced.

Overhead cost.   A cost that is not incurred directly from providing patient care but is necessary to support the organization overall (e.g. personnel functions).

Recurrent cost.   The value of resources with useful lives of less than one year that have to be purchased at least once a year.

Shadow price.   The true economic price of a good that reflects its value to society.

Time preference.   People's preference for consumption (or use of resources) now rather than later because they value present consumption more than the same consumption in the future.

Total (economic) cost.   The sum of all the costs of an intervention or health problem.

Costing – not as simple as it may look

It is important to know the cost of things you buy in the health sector. Every time a decision is made to implement one intervention instead of another, it is the same as making a purchase. The cost of the intervention becomes a very important part of the decision to use one intervention rather than another. But figuring out the cost of an intervention is often not easy. First you need to establish an inventory of costs based on a clear description of the intervention, identification of the resources used and organisation by type of resource. Next there is valuation and calculation of the costs. Finally you will need to carry out a sensitivity analysis. This chapter will take you through issues to consider at each of these steps.

Drummond *et al.* (2005) provide a list of questions that need to be answered when specifying interventions. They suggest that to identify costs you need to ask:

- Who are the people providing care (e.g. doctors, nurses, village health workers, volunteers, etc.)?

- What are the different activities of the intervention (e.g. training, drug distribution, etc.)?
- To whom is the intervention directed (e.g. different age groups, socioeconomic groups, ethnic groups or gender)?
- Where is each part of the intervention delivered (e.g. inpatient and outpatient care)?
- How long will the intervention run (e.g. weight loss programme for six months versus HIV prevention monitoring sexual behaviour over a 10-year period)? How often will individuals or populations be seen (e.g. monthly antenatal check-ups)?

Once the intervention is specified and resources identified (as described in Chapter 13) we turn to the valuation of those resources to generate costs. When economists talk about cost, they are referring to the opportunity cost of producing a good or, in this case, a health service. In perfectly competitive markets price will equate to opportunity cost (remember that you learned in Chapter 6 that the supply curve is equivalent to the marginal cost curve). Consequently price is often used as a proxy for costs. If this is the case, once you know the quantity of resources required, costing sounds easy: many types of resource have a readily obtainable price. However, given that most markets are not perfectly competitive, price may not be a good proxy. Think of the resource which is most scarce for some people – their time. How would you value the time of individuals? Or the difference in the prices of goods purchased on the black market from those purchased through official channels? In addition, the price of a resource may not be easily available. It may be that there are no records about what was paid, the purchase was made long ago and the resources have declined in value or the people who have the information are not willing to share it. This means costing requires both skill and judgement on behalf of the economist in valuing or estimating the price of a resource.

Financial and economic costs

Let's look at the case when the price is available, but it does not reflect the true value of the resource to society. If a resource is donated, the price paid is zero but the value of the equipment is not zero. Similarly, taxes or subsidies result in the price paid for a resource differing from its opportunity cost. Remember that opportunity cost is the level of benefit we would receive in the next best alternative option. When valuing resources economists use this definition to obtain the value of the resource to society. Where price does not reflect opportunity cost, the inputs are valued using a *shadow price*, reflecting the true value to society. Opportunity costs are also referred to as *economic costs*. They are used in economic evaluation and the weighing up of alternatives in health service delivery.

Financial costs are defined as the actual money spent on resources. They are used in programme planning and budgeting, as revenues must be generated to cover these financial outlays if a programme is to be sustained. Examples of financial costs include the price paid for supplies, maintenance, personnel, electricity and rent. The following activity will give you an idea of why the distinction between financial and economic costs might be important.

Activity 14.1

You are costing a primary health care project and have been asking around for the prices of resources which include imported vaccines. From a well-informed local source,

you find out that the official prices of some resources do not seem to reflect their real value. Specifically, you are given the following information (Creese and Parker 1994):

- wages paid in the private sector for nurses and nurse assistants are US$1,350 and US$1,050, respectively;
- the driver is paid the national minimum wage, but in the informal sector, drivers are paid only US$300;
- although the project is able to buy fuel at official prices, there is always a shortage of fuel and in the black market the price is four times the official price;
- the official exchange rate is 50 shillings = US$1, but on the black market the average rate is 250 shillings;
- space which is given free would rent for US$300 on the private market;
- some community women have volunteered their time – most of them are house-wives and earn extra money by cooking for the market for which they would normally earn about US$300 in a month.

In Table 14.1 you will find the financial costs already calculated. Use the information above and, if necessary, the financial costs in the table to calculate the economic costs in the last column. What is their total? And which are the 'big ticket' items? Which resources are undervalued in terms of their financial costs, and which are overvalued?

Table 14.1 Monthly financial costs of an identified primary health care project

Resource	Financial cost (US$)	Economic cost (US$)
Staff:		
• nurse	900	
• nurse assistant	700	
• driver	600	
• volunteer helpers	0	
Vaccine	5,000	
Vehicle fuel	3,000	
Building space	0	
Total cost		

Source: Creese and Parker (1994)

Feedback

Check the economic costs you calculated by comparing them with those shown in Table 14.2.

You can see that the actual value to the economy and society of many of these resources is greater than their financial price – especially in the case of nursing staff, who are paid relatively poorly compared to the private sector. The driver, by contrast, is overpaid. The fuel and vaccines are also undervalued by comparison with their scarcity value in the economy.

Table 14.2 Financial and economic costs of an identified primary health care project (solution)

Resource	Financial cost (US$)	Economic cost (US$)
Staff:		
• nurse	900	1,350
• nurse assistant	700	1,050
• driver	600	300
• volunteer helpers	0	300
Vaccine	5,000	25,000
Vehicle fuel	3,000	12,000
Building space	0	300
Total cost	10,200	40,300

Source: Creese and Parker (1994)

Types of cost

Direct costs

Direct costs are resources used in the design, implementation, accessing or continuation of the intervention(s) being evaluated and are usually the main focus of a cost analysis. They are the costs of providing or accessing health services and can be incurred by either the provider or patient. Both should be included unless the study perspective dictates otherwise. Direct costs can be further classified as direct health care and direct non-health care costs.

- Direct health care costs are those costs essential to the implementation, receipt and continuation of the health service. They are the resources spent on health care;
- Direct non-health care costs are resources used in connection with the health service but are not health sector costs. Examples include the cost of transport to and from the facility or catering in hospitals.

Activity 14.2

Imagine that the minister of health has proposed that seven primary health care centres (PHCs) be built to decrease demands on a regional hospital. In Table 14.3 you will

Table 14.3 Resources used to establish and run seven new PHCs

Resource	Type of cost
Building the seven PHCs	
Education of parents on how to prevent exacerbation of asthma	
Laboratory equipment for PHCs	
Lunch while waiting at PHCs	
PHC health education to prevent smoking	
Salaries of intervention personnel	
Soap for hand washing in PHCs	
Training PHC teams	
Transportation to PHCs	
Vehicles to carry vaccines for PHCs	

see a list of the resources identified as necessary for this project. Consider the resources listed and, in the right-hand column, write down whether each is a health care or a non-health care cost.

Feedback

The classification of costs would be as shown in Table 14.4.

Table 14.4 Cost classification of resources used in setting up and running seven new PHCs

Resource	Type of cost
Building the seven PHCs	Direct health care
Education of parents on how to prevent exacerbation of asthma	Direct health care
Laboratory equipment for PHCs	Direct health care
Lunch while waiting at PHCs	Direct non-health care
PHC health education to prevent smoking	Direct health care
Salaries of intervention personnel	Direct health care
Soap for hand washing in PHCs	Direct health care
Training PHC teams	Direct health care
Transportation to PHCs	Direct non-health care
Vehicles to carry vaccines for PHCs	Direct health care

Indirect costs

In addition to direct costs, other resources might be used as a result of the health intervention. Indirect costs refer to resources like the patient's time that is taken up going to the hospital, rather than working. Similarly, other family members may also have to change their work schedules to take over some of the jobs that would have been done by the patient, or to accompany the patient to receive care. The time of other family members used for these reasons is also counted as an indirect cost.

Indirect costs are commonly measured using wages and earnings lost. If wages and earnings are not available or the person is not working, alternative methods can be used to find the value of their time – you will read more about different techniques for valuing people's time in Chapter 15.

Intangible costs

Some interventions may themselves cause pain and suffering such as side-effects from treatment or anxiety about whether the treatment will be effective. The value of pain and suffering is termed an intangible cost. Because measuring intangible costs is a difficult task, most economic evaluations do not calculate them. However, you should bear in mind that intangible costs could be major factors affecting the patient's and society's decision regarding treatment options.

Activity 14.3

Consider the following aspects of the problems posed by polio in a society. Classify the items in Table 14.5 as direct health care, direct non-health care, indirect or intangible costs of the health problem or intervention, noting your classification in the right-hand column.

Table 14.5 The costs of polio

Resource	Type of cost
Polio vaccine	
Salary of physical therapist who treats polio victims	
Loss of wages due to polio	
Loss of wages due to vaccine-induced polio	
Bus fare for family members visiting child at hospital	
Pain and suffering following a case of polio	
Cost of care of siblings to enable mother to take ill child for rehabilitation	
Time lost taking child to clinic for immunization	
Salary of nurse who runs immunization clinic	
Hospital cost for child with vaccine side-effects	

Feedback

The classification of the resources devoted to the problem of polio could be described as shown in Table 14.6.

Table 14.6 The costs of polio classified

Resource	Type of cost
Polio vaccine	Direct health care
Salary of physical therapist who treats polio victims	Direct health care
Loss of wages due to polio	Indirect
Loss of wages due to vaccine-induced polio	Indirect
Bus fare for family members visiting child at hospital	Direct non-health care
Pain and suffering following a case of polio	Intangible
Cost of care of siblings to enable mother to take ill child for rehabilitation	Indirect
Time lost taking child to clinic for immunization	Indirect
Salary of nurse who runs immunization clinic	Direct health care
Hospital cost for child with vaccine side-effects	Direct health care

Schemes for classifying costs

Classifying costs into different schemes helps ensure that you include everything necessary in the cost analysis. Different schemes serve different purposes and there are three main schemes for thinking about costs.

The most commonly used system for classifying direct health care costs is the functional classification scheme you learned about in Chapter 13. In this, resources are classified according to their use or function within a health programme (e.g. buildings, personnel and equipment). Alternatively, resources can be classified according to the activity for which they are used (e.g. training, outreach, treatment and administration). The two remaining schemes most commonly used and that you will read about here are capital and recurrent costs, and fixed and variable costs.

Capital and recurrent costs

An important way to classify costs, that can help determine the sustainability of a programme, is to classify according to the time period over which the resource will be used. Capital costs are generally defined as the costs of those resources such as equipment, vehicles, buildings and one-off training programmes that have a useful life of more than one year. Capital costs are often equated with start-up costs because they are paid for at the beginning of a programme but these resources are defined according to their useful life, not when they are purchased.

In contrast, recurrent resources are those with useful lives of less than one year and have to be purchased at least once a year – yearly, monthly, weekly, daily or irregularly but frequently. *Recurrent costs* are the value of recurrent resources. Any given capital investment will require some recurrent funds to keep it running. The sustainability of a health service depends heavily on whether funds are available to cover these recurrent costs. The recurrent cost coefficient (r-coefficient) is used to estimate the approximate amount a given capital investment will require to run adequately. Typically, r-coefficients in the health field run from about 0.25 for a basic clinic to 0.33 for a more high-technology referral hospital.

In economic evaluation, it is normal to calculate the annual cost of a health service. Capital costs are included in this calculation by converting them into a recurrent cost by spreading them out over time in a process called *annualization*. This is just like when you obtain a loan from a bank. When you obtain the loan you spread a one-time cost over years and your annual payment to the bank is a recurrent cost. The simplest method to obtain an annualized cost is straight-line depreciation, which simply divides the initial cost by the number of years of useful life. For example, a £10,000 X-ray machine which has a useful life of 10 years has an *annualized cost* of £1,000 per year.

Most economists prefer a slightly more complex method that takes account of the opportunity cost of money – the interest that would be earned if it were invested in the bank. This is called the *annualization method*. Banks calculate payment schedules by the annualization method.

Activity 14.4

Suppose you were calculating the annual costs of a family planning clinic. Calculate the annual cost of the resources in this example, using straight-line depreciation. The expected useful lives of the different resources are shown in Table 14.7.

Table 14.7 The costs and expected length of life of resources used in a family planning clinic

Resource	Useful life (years)	Total cost (£)	Annual cost (£)
Equipment	5	8,650	
Buildings	30	54,080	
Land	50	31,150	
Vehicles	5	8,165	
Initial training (nurses and midwives)	30	48,321	

Feedback

The annual costs of these items, using straight-line depreciation are shown in the right-hand column in Table 14.8.

Table 14.8 The annual cost of resources for a family planning clinic (solution)

Resource	Useful life (years)	Total cost (£)	Annual cost (£)
Equipment	5	8,650	1,730
Buildings	30	54,080	1,803
Land	50	31,150	623
Vehicles	5	8,165	1,633
Initial training (nurses and midwives)	30	48,321	1,611

Fixed and variable costs

Take a look at Chapters 5 and 6 to remind yourself about the classification of resources and costs by fixed and variable. This scheme is most often used when looking at issues of scale and how costs might vary with different levels of output, as described in Chapter 6.

Some items have both a fixed and variable cost component. These are termed semi-variable costs. A good example is a telephone. You will have to pay the monthly line rental whether or not anyone makes any calls – this part is fixed. A variable amount is payable depending on the amount that it is used.

Allocating shared costs

In many situations, a resource will be used for a number of purposes. This is particularly true for overhead costs. For example, a hospital administrator works on all the different activities of the hospital. One aspect of a cost analysis will be to determine a fair allocation of shared resources among the different activities which use the resource. One method is to attribute to a specific intervention the percentage of the resource which is used by the intervention. Typically, the following are used for calculations:

- *buildings* – the percentage of floor space used for activities related to the intervention;
- *staff* – the percentage of their time that staff spend on the intervention;
- *equipment* – the percentage of time the item of equipment is used for the intervention;
- *utilities (water, electricity, gas)* – the percentage of floor space used by the intervention;
- *maintenance* – the percentage of floor space used by the intervention.

However, using the percentage of floor space may be misleading. A storeroom and an operating theatre in a hospital may occupy the same floor area but the latter would consume much more in the way of utilities and maintenance. An alternative is to use the number of staff as a proxy for the percentage use – in this case it would be many times greater for the theatre. This would be a more realistic reflection of the resources used in the theatre.

Obtaining estimates of personnel time may be difficult. In some cases it is possible for an administrator to make a list of who works where and for how many hours per week. In other cases, staff can keep a log of where they work. If estimates of personnel time are not available, you could perform time and motion studies, which entail the use of a trained observer to determine the amount of time personnel actually spend performing tasks related to the intervention.

Activity 14.5

A new roof at a hospital costs £1 million and is expected to last 20 years. The TB ward occupies one floor in this 10-storey hospital. What is the share of the total annual cost of the roof which should be attributed to the TB ward?

Feedback

First, the total cost of the roof of £1 million should be annualized. With straight-line depreciation, the annual cost is £50,000 (£1 million/20 years = £50,000). There are 10 floors, so the percentage use of the shared input (the roof overhead) for the TB ward is 10 per cent – only 10 per cent of the annualized cost of the roof should be attributed to the TB programme. So £5,000 is the annualized cost of roof for the TB programme (10 per cent of £50,000 = $5,000).

Calculating costs

So far you have learned about framing the study and making an inventory of the costs. Finally you have reached the last of the three main steps – calculating the costs.

Activity 14.6

Explain each one of these four commonly used measures of costs:

1 Total cost
2 Annual cost
3 Average cost
4 Marginal cost

Feedback

1 Total cost is the sum of all costs. This gives an indication as to how much the intervention costs overall – taking account of the value of all the resources used.
2 Annual cost is the cost of the intervention calculated on a yearly basis – including all the annualized costs of capital expenditures as well as the yearly recurrent costs. Annual costs will vary from one year to another – in the first year, the start-up costs will be greater whereas after the intervention has been in operation for a while, the recurrent costs may form a higher part of the annual cost.
3 Average cost is the total cost divided by the total units of activity or outcome. Average cost gives an indication of how efficiently, on average, different providers are functioning.
4 Marginal cost is the change in the total cost if one extra unit of output is produced. Marginal cost can also be used to calculate how much would be saved by contracting a service. In practice you can see that often it is more than a change of only one unit of output which is of concern but rather a group of 10 or 100 extra units. In this case the correct term for the cost of the change is *incremental cost*. You may see some applications where the term incremental cost is used, rather than marginal cost.

The following activity is drawn from a real-life situation and shows an application of the incremental cost (and incremental benefit) concept to decision-making.

Activity 14.7

An evaluation of a sexually transmitted disease (STD) clinic found that while the service was much appreciated by the clients who were using it, quite a few people with STDs were not able to come during its opening hours, from 9.00 a.m. to 5.30 p.m, because they worked or were in school. A decision was made, therefore, to extend the opening hours to 7.30 p.m. on Monday and Thursday nights on a trial basis. This meant that staff would have to be paid more for the overtime and the managers were interested to know what the impact would be on the overall attendances at the clinic. The costs per week of the clinic *before* the extension of the hours are shown in Table 14.9.
The number of clients seen on average each week was 20 per day, or 100 per week.

Table 14.9 Costs per week of the clinic before the extension of the hours

Cost	£
Rental of premises	200
Staff:	
• receptionist	300
• practice nurse	385
• doctor	595
Medicines, etc.	270
Electricity, gas, etc.	55
Other operating costs	580
Total	**2,385**

Option 1: evening hours

After opening for an extra two hours on Monday and Thursday evenings each week, the following additional costs were incurred: staff £115, medicines £80, electricity £25 and other items £130. During the trial period, the clinic was very busy in the evenings, and an additional 15 patients were seen on Monday evenings and 12 on Thursdays.

1 What was the average cost per patient seen in the clinic?
2 What was the incremental (or marginal) cost per patient seen in the evenings?
3 What was the new average cost per patient of the clinic?
4 What recommendation would you make to the health authority about whether to maintain these new evening opening hours of the clinic?

Feedback

1 The average cost per patient at the beginning of the period was £23.85.
2 The incremental cost of the patients seen in the evening was £12.96 (£350 marginal costs/27 extra patients).
3 The total costs now (including evening hours, Option 1) are £2,735 (£2,385 + £350), the number of patients now attending is 127, so the new average cost is £21.54 (£2,735/127).
4 The evening hours seem to be a success – the incremental cost is below the average cost so the costs are still going down. Keep the new hours.

Option 2: Saturday hours

The clinic management held a meeting and decided that perhaps it would be good to open on Saturday mornings from 8.00 a.m. to 12 noon as well, to serve especially young people who come from outlying areas. The additional costs of opening on Saturdays were £250 for staff, £27 for medicines and £120 for other costs. The clinic was not as popular as predicted, with only five people coming on average on Saturdays.

5 What was the total incremental cost of this option?
6 What was the incremental cost per client of this additional group of clients?
7 What was the overall average cost per client (with options 1 and 2)?
8 Overall, with the information you now have about the opening hours (options 1 and 2) what recommendation would you make to the management regarding the best combination of opening hours of the clinic?
9 Now consider this: if the costs of opening on Saturday afternoons are the same as Saturday morning (£397), how many patients would you estimate are needed to make it worthwhile?

Feedback

5 The new incremental costs of Saturday opening (option 2) are £397.
6 The new incremental cost per patient is £79.40 (£397/5 patients).
7 The new total cost of the original clinic hours plus options 1 and 2 is £3,132, and the new average cost per patient is £23.72 (£3,132/132 total patients).

8 Evening hours were a success but the incremental costs of £79.40 per Saturday patient are high. Either give up on Saturdays altogether – or try Saturday afternoons!

9 It seems unlikely that the same incremental cost could be obtained for the Saturday hours as for the evening hours. The evening hours cost only around £13 per patient so ideally Saturday hours would give the same result – this would require about 30 patients (£397/13). If the average cost per patient could be kept at or near the average with option 1, this would mean that the clinic was still operating efficiently and therefore 17 patients would make this worthwhile (£397/21.54 = 16.7). This seems attainable if the clinic is well situated, user-friendly and the Saturday opening hours are made known to the teenage target group.

Some practical considerations

Until now the discussion has assumed that you are doing 'bottom-up' costing – starting from scratch and building up the costs, in the same way as you build up a budget. But sometimes you are faced with a situation of retrospective costing, whereby you have information on total expenditures by line item and most of the costs are joint costs – used by several activities. If it is not possible to go back to get the information on individual units of resources that were used or the costs of those resources, you can use the aggregated information and break this down by activity or 'cost centre'.

By now you may be wondering where you will find all the information you need. There are a number of sources, depending on what exactly you are trying to cost.

Health services costs

If you are costing the activities of a health facility such as a hospital, there is probably an accountant or financial officer who can provide much of the financial information you need, although you will still need to estimate the economic cost which may differ from the financial cost. Information on personnel allocation can often be obtained from the nursing manager or sister, from the medical director and from the administrator who is responsible for the non-medical and non-nursing staff of the facility. Information on supplies and drugs can be found either on invoices or from catalogues of equipment and drugs; if the drugs, for example, were donated, you will probably need to refer to an international source of information to find out the international market price. Vehicles and vehicle costs can often be obtained from the person responsible for managing the fleet of vehicles.

A handy hint in doing costing is to concentrate on the more expensive items and those which constitute the biggest fraction of the total – the 'big ticket' items, usually vehicles and vehicle running costs, personnel, drugs and supplies. Often half or more of the total cost will be spent on personnel, so getting good information on the wages and benefits and the allocation of staff will be a good start in getting an overall cost. Vehicles and drugs may be another major expenditure category, and time spent getting precise measures here may enhance the accuracy of your overall estimates.

Don't spend too much time chasing a detailed piece of information when the decision will not be affected by it. It is unlikely that time spent getting precise estimates of the allocation of electricity and cleaning supplies, for example, will make much of a difference in the overall total.

Patient and family costs

The time of patients and their families is an essential input into the delivery of health services. For example, in order to receive treatment a patient and family members will:

- spend time and money getting to the service;
- spend time in activities other than the ones they would normally be doing, in order for them or their household member to be able to use the service.

There are a number of ways to estimate these costs and it can be complex, involving the estimation of shadow prices for work and leisure time (Posnett and Jan 1996). The best way is to carry out a survey of the patients. However, you may not have enough time to carry out a full survey, and if this is the case you could ask a small sample of patients and make some estimates of their expenditure, the time they have spent, and of their lost wages.

Calculating the value of wages lost can prove problematic – should you use the minimum wage, the average wage or some estimate of the wage of the actual patients? There is also seasonal variation in the value of time in many agricultural areas. The important thing is to include patient costs if appropriate – too often the difficulty of calculating patients' costs has meant that they have simply been left out of the analysis altogether and this clearly leads to a misleading result – effectively costing the patients' costs as zero.

Which price should you use?

One issue which you may face is which price to use – say, for example, you are costing a project which used a vehicle. If the vehicle was purchased five years ago and the market price then was £10,000 but a new one now has a market price of £15,000, which price should you use to estimate the opportunity cost? This depends on the purpose of your analysis. Here are three possibilities.

- If you are looking 'for historical purposes' at the past cost of an intervention which will not be repeated, you could safely use the original price of £10,000.
- If you wanted to know the annual cost of running the programme for the past five years, you would use the annualized cost of the original expenditure: £2,000 per year.
- But if you wanted to know the cost of replicating the programme in another location, you should use the present replacement price of £15,000. The annual cost of running the project in the future would use the annualized cost of £3,000 per year, assuming you expect it to last five years.

Time preference and discounting

In general, individuals have a preference for utility (from consumption) that happens now as opposed to in the future and they value consumption-derived utility less as it occurs further into the future. Why? People live for today and the future is uncertain. In addition, as someone's earning potential increases over time, the value of a single unit of currency will be worth less to them in 10 years' time than it is now. In the same way we might value our health today more than being healthy in 10 years' time. Let's

look at the example of a trainee nurse with approaching exams: a trainee nurse might be happy to pay £50 now to know that they are going to be healthy all of June because they have an exam during that time. However they are less likely to be willing to pay £50 now to know that they will be healthy for all of June in 10 years' time. This is because they actually value their health in the future less. Similarly, although the nurse is willing to pay £50 to be healthy in June this year, they might be willing to agree to pay $100 in 10 years' time so that they will be healthy in June in 10 years' time. This is because they value the utility that would be derived from the consumption that money would enable in the future less.

Because people do not place equal value on costs or outcomes that occur this year with those that occur in later years, economic evaluations must give different weight to costs and health outcomes that occur at different periods in time. While there are theoretical and practical problems in doing so, many economic evaluations are performed using some sort of adjustment for the occurrence over time, or *discounting*, both for the costs and for outcomes. Discounting is used to convert a value in the future (either costs or health outcomes) to today's equivalent or present value using a *discount rate*. National and international guidelines recommend using a 3 per cent discount rate, after controlling for inflation. In some countries, such as the UK, central government imposes a specific real discount rate for economic evaluations of publicly funded projects. In other countries where no specific rate is imposed, economists frequently choose one rate and then perform a sensitivity analysis to ensure the conclusions are stable with respect to the assumption about discount rates.

Sensitivity analysis

Cost estimates calculated using the methods described in this chapter should be seen as mean (average) values. As with most parameters in an economic evaluation, costs are also subject to uncertainty and we should explore the way cost uncertainty affects the result of the economic evaluation in a sensitivity analysis.

Summary

In this chapter you have learned about different ways of defining costs and why costing is rarely a straightforward and simple exercise. In addition you have gained an understanding of how to calculate the different cost measures: total cost, annual cost, average cost and marginal cost. You have learned about the difference between financial and economic costs and when it is appropriate to use each of these. Next you read about the different types of costs that might be considered for inclusion in a cost analysis: direct, indirect and intangible costs; and the ways in which these might be classified: by function or activity, recurrent and capital, and fixed and variable. Finally, some practical difficulties were discussed concerning obtaining data, allocating shared costs among different activities, identifying which costs to use and people's time preferences.

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Further reading

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Identifying, measuring and valuing consequences

<div style="text-align:right">**15**</div>

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Overview

This chapter starts with a brief review of the different consequences or outcomes that arise from health interventions and their suitability for economic evaluation. This is followed by a detailed exploration of the different non-monetary and monetary methods for measuring and valuing consequences. Some pros and cons of these methods are also considered.

Learning objectives

After working through this chapter, you will be able to:

- recognize the wide range of outcomes that arise from health interventions (both health and non-health)
- explain which type of outcome measure is most suitable for use in each type of economic evaluation
- identify different ways of *measuring* health in economic evaluation
- compare different approaches for *valuing* health and non-health outcomes
- define and give examples of health outcomes in monetary terms

Key terms

Disability adjusted life year (DALY). A measure of health based on the length of a person's life weighted by the level of disability they experience.

Human capital approach. An approach that uses market wage rates to measure the value of productivity lost through illness.

Quality adjusted life years (QALY). A health outcome measure based on survival weighted by quality of life, where quality of life is scored between 1.0 for full health and zero for death.

Willingness to pay (WTP). The monetary value, representing the maximum amount an individual would be prepared to pay out of his or her own income, to gain an improvement in health.

Defining and measuring health consequences

You will recall from Chapter 13 that there are three main types of economic evaluation: cost-effectiveness analysis (CEA), cost–utility analysis (CUA) and cost–benefit analysis (CBA). Each of these involves the comparison of different alternatives in terms of both their costs and consequences (Drummond *et al.* 2005). However, they differ in terms of the type of consequences they attempt to measure and value. In this chapter we explore these different methods, starting with those used to measure health consequences in CEA and CUA. Some outcomes of health interventions are more obvious than others. Immunizing a baby against diphtheria, pertussis and tetanus protects him or her from these potentially life-threatening diseases. In this case, outcomes might include: cases prevented, life years saved, number of vaccines delivered. Using radiotherapy as part of a treatment package to cure a woman of breast cancer potentially increases her life span, and a patient's poor adherence to anti-TB chemotherapy may result in treatment failure. These examples are all fairly obvious. However, there are many less obvious outcomes – intended and non-intended – and potentially negative as well as positive. For example, the positive externality derived from immunizing a baby (i.e. the herd immunity); the fact that the radiotherapy used as part of many cancer regimens is associated with negative adverse effects (intangible costs); and the negative externality of the risk of developing drug resistance due to poor adherence to anti-TB chemotherapy. Some of these outcomes may result in the need for additional expensive treatments.

Activity 15.1

For each of the interventions below, list any positive and negative outcomes that you can think of:

1 Improving access to clean water and sanitation in a rural village.
2 Screening pregnant women for HIV infection.
3 Neonatal intensive care for extremely pre-term infants.

Feedback

1 Decreased incidence of diarrhoeal disease, less time taken to fetch water (and therefore more time available to do other things).
2 For those found to be HIV positive, early treatment for the mother and decreasing risk of transmission to the infant. Potential negative consequences include psychological stress in considering the test and especially, in rare cases, false positive tests.
3 Increased survival but high risk of short- and long-term complications including neurological disability.

It is perhaps worth bearing in mind that the most useful measures for economic evaluation will be those that are 'tangible' and allow any changes to be quantified and compared across interventions and diseases.

Measures of health consequences

Health can be measured in a number of different ways.

Mortality

Mortality can be measured as the 'number of deaths averted' or 'number of life years gained'. This is a tangible and quantifiable measure that can be used across diseases and interventions. It is useful for preventative and curative interventions which impact on potentially life-threatening injury and disease but not for those which may cause significant morbidity but rarely death.

Morbidity

Several measures can be used here, as outlined below.

- *Number of cases cured or disease incidence*: these measures are particularly useful in measuring acute illnesses (e.g. malaria or acute respiratory infections). They indicate presence or absence of disease but not duration or impact and are therefore not good for chronic or disabling conditions such as diabetes or arthritis. In addition they can only be used to compare interventions where the type of outcome is identical;
- *Disease-specific indices:* for a number of chronic conditions, there are disease-specific indices or profiles which aim to capture severity of disease and/or impact on quality of life (e.g. an arthritis impact measurement scale). The advantage of these measures is that they are tangible, however, as above, they can only be used to compare interventions where the type of outcome is identical;
- *Generic health measures (indices and profiles):* these are designed to be broadly applicable across different types of disease and interventions and to summarize core concepts of health and quality of life. Profiles like the Nottingham Health Profile (Hunt *et al.* 1985) present different dimensions of health separately (e.g. mobility, pain, emotional well-being). Health indices such as the Sickness Impact Profile (Gilson *et al.* 1975) provide a single summary index score. The advantage of an index is that it allows for the possibility of comparing health across interventions, diseases and populations. Aggregating scores to produce a single value can be done with or without taking into account people's preferences. Taking people's preferences into account allows the calculation of measures of utility such as the quality adjusted life year (QALY) or disability adjusted life year (DALY), used in CUA.

Intermediate measures

Sometimes it is not possible to measure actual health outcomes, especially in preventative interventions when the health outcome may be significantly 'downstream'. For example, if the intervention results in the reduced risk of an individual developing a certain illness. In this case an intermediate measure may be used. For example, the relationship between blood pressure (BP) and the risk of cardiovascular disease (CVD) is well described. Therefore, in measuring the impact of BP-lowering treatment on CVD, BP can be used as an intermediate measure of the risk of CVD. Intermediate measures are only useful when comparing similar interventions.

Process measures

This refers to activities which are known to or are believed to have a direct bearing on the outcomes achieved by the intervention – e.g. length of hospital stay or correct diagnosis.

Money

Monetary values can also be assigned to health outcomes. This is explored further later in this chapter.

Activity 15.2

1 For each outcome below decide what kind it is, and consider how useful the outcome is for economic evaluation.
  a) Number of patients that quit smoking as a result of a health education campaign.
  b) Number of (i) deaths averted and (ii) disability adjusted life years (DALYs) averted by treating severe malaria with the drug artesunate instead of quinine.
  c) The average blood flow density lipoprotein (LDL) cholesterol level after treatment with cholesterol-lowering drugs.
2 Now apply this thinking to a more practical situation. Assume you are a civil servant working in the Ministry of Health and one day you are called to the minister's office. You are informed that you must conduct an economic evaluation of several interventions including the distribution of free insecticide-treated bed nets (ITNs) to pregnant women. The finance department has already provided estimates of the costs to the public health care sector of running an ITN programme. It will be your duty to provide estimates of the outcomes of such a programme. Fortunately, a recent randomized controlled trial in your country captured data on health outcomes over two years among a group of pregnant women given an ITN and another group of pregnant women not normally sleeping under a net. Health outcomes registered include the number of maternal deaths, anaemia cases, low birth weight (LBW) babies born, infant deaths and malaria episodes among mothers and their newborns. The minister suggests to you that reduction in maternal deaths could be used as an outcome measure of the ITN programme. What will you reply?

Feedback

1 a) This is an intermediate measure. It can be directly linked to a final health outcome (i.e. lung cancer cases prevented).
  b) (i) This is a measure of mortality. It is a good measure in that it is tangible and can be used to measure across other acute injuries and deaths. (ii) This is a general health index. It fulfils all the criteria for a good outcome measure for economic evaluation.
  c) This is an intermediate measure. The ultimate goal is to reduce mortality from CVD. It is only useful for comparing with other cholesterol-lowering drugs or interventions.
2 You may reply that reduction in maternal mortality is too narrow a measure since there are other adverse health outcomes worth avoiding such as malaria episodes and LBW babies. You may suggest choosing a health measure which can incorporate different adverse health states in addition to premature maternal death, such as QALYs or DALYs. In addition, a broader health measure will be needed if the costs and consequences of an ITN programme must be compared to interventions aimed at other diseases.

Valuing changes in health using non-monetary approaches

At first glance the distinction between *measuring* and *valuing* benefits may appear pedantic, but as the following extract from Richardson *et al.* (1998) illustrates, it is actually quite important.

The measurement of benefits in economic evaluation involves two steps that are conceptually distinct and normally distinct in practice. The first is the measurement of the consequences of a health-related intervention as measured in natural units such as additional years of life, change in blood pressure, etc. Second, there is the determination of the *value* of these changes. Economics is concerned with the second of these steps and it is the role of epidemiologists or clinical researchers to determine outcome (consequence) in natural units. This implies that economic evaluation does not compete with or intrude upon clinical or epidemiological research. Rather the two forms of evaluation are complementary.

(Richardson *et al.* 1998)

All of the valuation techniques to be discussed in this section are designed to elicit 'utility weights' or, simply, 'utilities', that reflect an individual's preferences for different health states. In health economics, utility weights are most commonly used to generate QALYs and DALYs for use in CUAs of health care interventions. They allow the different characteristics of health (such as symptoms or ability to do activities) to be valued on a single scale and compared. There are two broad ways of estimating values for health states: those estimated from patients using *direct* valuation methods, and those estimated *indirectly* using 'off-the-shelf' values from the literature. We describe the different elicitation techniques for valuing health states a little later but first let's look at how QALYs and DALYs are constructed.

QALYs

By now you will be aware that QALYs are a health indicator which measures the amount of years of life lived, taking into consideration that some of those life years are lived in less than perfect health. An individual will have more QALYs the longer he or she lives and the better health he or she enjoys during those years. QALYs are therefore a measure of health gain, which is a 'good' of which an individual wishes to have as much as possible. Levels of health are described using a scale with anchor points of 0 (death) and 1 (full health) and the principle of combining the quantity and quality of life years. The example below illustrates how the calculation is made.

Utility weights and QALYs

Let us assume that there are two treatments for an illness. Both treatments extend the life expectancy of an individual by 10 years. However, treatment A results in the individual surviving the years in full health (represented by a utility score of 1 on a *cardinal scale** while death is shown by zero) compared to treatment B which results in the individual surviving the years in a state that only has a utility score of 0.5.

Treatment A has led to a gain in QALYs of 10 (10 × 1), twice that of treatment B which has led to a gain in QALYs of 5 (10 × 0.5).

Note that similar calculations are made under the DALY approach. Each state of health is assigned a disability weighting on a scale from 0 (perfect health) to 1 (death). To calculate the burden of a certain disease, the disability weighting is multiplied by the number of years lived in that health state and is added to the number of years lost due to that disease.

*A cardinal scale is a specific form of an interval scale with '0' reflecting states of health equivalent to death and '1' reflecting perfect health. This means that an interval from 0.2 to 0.3 has the same meaning to the individual as the interval from 0.7 to 0.8. (see page 176 of Drummond *et al*. 2005 for further explanation of cardinal scales).

Being able to measure *differences* in preferences in this way is fundamental to economic evaluation (in particular CUA) which is, as we have already learned, a *comparative* analysis. We are purely interested in differences between alternative interventions. Once the difference in preferences has been measured, these are combined with utility weights to calculate QALYs.

Discounting can also be important in the calculation of QALYs. In a CUA using QALYs, an analyst may decide to discount future life years (in full or compromised health), in a similar way to discounting costs, to incorporate the observation that most individuals prefer to experience good things sooner rather than years into the future. This means that a life year will be considered to be of a progressively lower value the further into the future this life year is experienced.

DALYs

DALYs were developed as part of the Global Burden of Diseases (GBD) study which was aimed at comparing disease burdens across all regions of the world (Murray and Lopez 1996). DALYs are a measure of healthy time lost caused by diseases in an individual or a population. This indicator combines the life years lost due to premature death with years lived in a health state less than full health. An individual will suffer a larger burden of DALYs lost the shorter he or she lives and the worse health he or she experiences. DALYs are therefore a measure of the health gap between actual health and a defined ideal for health achievement. This gap is a 'bad' which an individual or population would strive to minimize. DALYs in the original GBD study were characterized by four explicit value choices:

1 Premature death defined relative to a model life table corresponding to the highest observed life expectancies globally.
2 An unequal age weighting applied with relatively higher values attached to the middle years of an individual's life span, compared to early childhood and old age. The rationale for this is that because of the different social roles an individual plays during life, it is particularly important to be healthy in the middle years with many dependants in the form of young children and older family members.
3 Discounting of future life years whether in full or compromised health using an annual discount rate of 3 per cent.
4 Disability weights attached to diseases reflecting their severity using an inverted scale between 0 for full health and 1 for death. Disability weights were derived for

specific health problems, such as blindness or watery diarrhoea, from a group of international public health experts using the 'person trade-off technique' (you will read more about this technique later).

The value choices around disability and age weighting in the original DALY calculations have been the subject of much debate. Updates to the DALY calculations use equal age weights and are moving away from the expert panel approach for obtaining disability weights to one using a combination of community and expert-based assessments (World Health Organization 2004; Harvard University *et al.* 2009). Analysts wishing to use DALYs and QALYs as part of a CUA should subject their estimates to sensitivity analysis. In the case of DALYs the value choices might be varied, for example: using life expectancies from an analyst's own country rather than the standard life expectancies chosen for the DALY approach; equal rather than unequal age weights; and discount rates other than 3 per cent. In the case of QALYs, the assumptions underlying the calculations can also be varied.

Direct methods for valuing health states

Direct valuation can be a resource-intensive endeavour requiring the development of relevant health state descriptions and experienced interviewers. Direct valuation also requires high levels of respondent concentration and sound cognitive functioning (Rashidi *et al.* 2006). Participants in these types of valuation exercise have been members of the general population, patients suffering from the diseases under study or health sector personnel. To assess an individual's level of utility, they are asked to rank their preferences, making trade-offs between health states and alternatives (Sinnott *et al.* 2007). The *standard gamble* (SG), *time trade-off* (TTO), *person trade-off* and *visual analogue scale* (VAS) are direct methods widely used to estimate utility weights for economic evaluation.

Standard gamble

The SG method is a way of measuring preferences that is most consistent with conventional economic theory. It presents respondents with a choice between health outcomes involving uncertainty. A respondent is asked to imagine living in a compromised health state for a number years, for example 30 years. This compromised health state is carefully described to the participant to enable him or her to picture living in this way. The participant is then presented with a treatment option which will restore a patient to full health with probability P or immediate death with probability 1-P, as described in Figure 15.1. The probability of treatment success versus death is subsequently varied until the respondent is unable to say whether living in the compromised health state or having a treatment with P chance of full health is the better option. This specific P is interpreted as the respondent's valuation of the compromised health state. The more undesirable a health state is, the more willing a respondent is likely to accept a treatment option with a low chance of success. A key obstacle to utilizing the SG is that the concept of 'probability' is often difficult for respondents to understand. Despite this, the SG arguably mimics best the choices people face in 'real' clinical situations because it factors the uncertainty around events into respondents' choices.
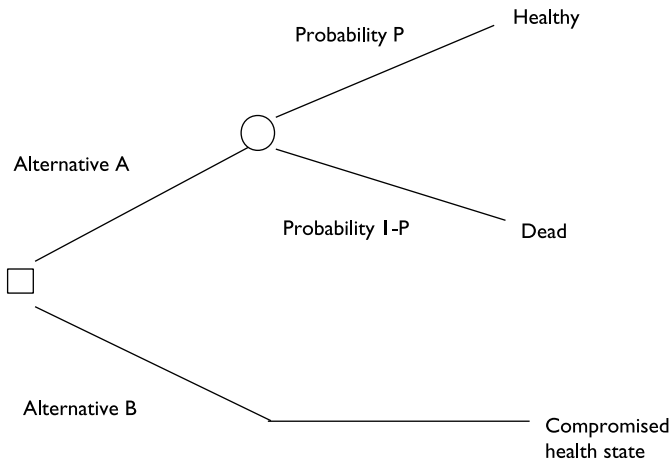
Figure 15.1 The standard gamble

Time trade-off

In the TTO technique, the respondent must indicate their preferred choice between two alternative health scenarios where alternative A is living in a specific compromised health state for X years followed by death and alternative B is living for a shorter amount of years, T, in full health followed by death (see Figure 15.2). The length of time, T, in full health is then varied until the respondent judges the two alternatives to be equally desirable. This particular duration, T, is then used to estimate this respondent's valuation of the compromised health state as T/X. For example, if an individual deems living 30 years in a specific compromised health state as equal to living 20 years in full health, the value of living one year in the compromised health state is 20/30 = 0.67.
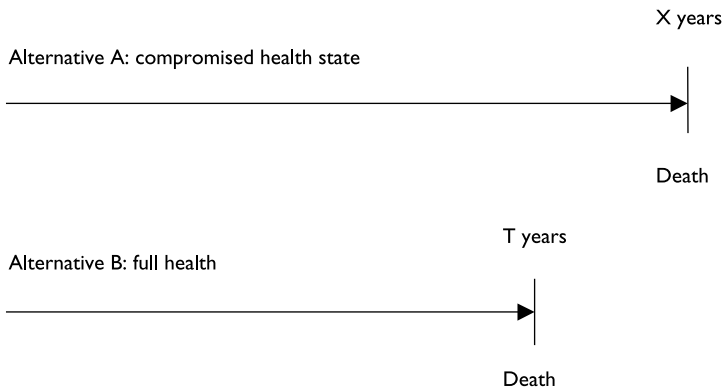
Figure 15.2 The time trade-off

Visual analogue scale

The VAS method utilizes a thermometer-type instrument such as that shown in Figure 15.3 to help respondents attach values to different health states. A number of different health states are described to respondents who are then asked to place these on the scale with mild health problems near the top of scale and severe health states near the bottom. Endpoints of the scale are typically framed as 'best imaginable health state' and 'worst imaginable health state' or 'full health' and 'death'. While the VAS has often been used for direct measurement of health states, it has some limitations. Many respondents have difficulty assigning interval scale values to health states and tend instead to merely rank them. Moreover, the method does not give the respondent a choice between two alternatives and therefore does not reflect the strength of preference necessary for economic evaluation. There is also a concern that rating scales are subject to measurement biases such as end-of-scale bias, where respondents tend to avoid the extremes (e.g. 0 or 100) (Sinnott *et al.* 2007).

Compromised health state

Death   Full health

0.00   0.25   0.50   0.75   1.00
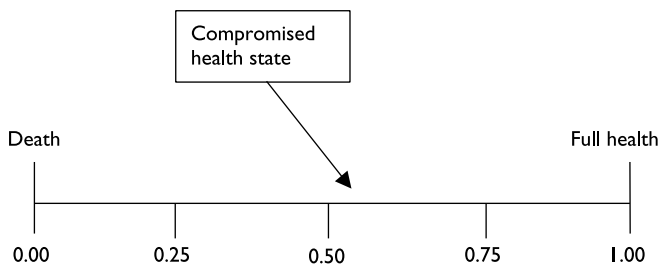
Figure 15.3 The visual analogue scale

Person trade-off

A respondent exposed to this technique is asked to imagine that he or she is a decision-maker who has been allocated a budget which is only enough to offer one of two mutually exclusive health care interventions, each improving the health of a certain group of patients. The choice is therefore effectively between two groups of individuals. A specific version of this approach was used to elicit disability weights for DALYs in the GBD study, as mentioned earlier, and the example below is based on this (Murray 1996).

> *Intervention A* will extend the lives of 1,000 healthy individuals for exactly one year, at which point they will all die. If you do not choose this intervention, they will all die today.

Or alternatively:

> *Intervention B* will extend the lives of n (≤ 1,000) blind individuals for exactly one year. If you do not choose this intervention, they will all die today.

If a respondent is presented with the choice between intervention A and intervention B where there are 1,000 individuals in each group, the hypothesis is that most respondents

will opt for saving the 1,000 healthy individuals for an additional year. However, increasing the number of blind individuals saved in intervention B will increase the desirability of this intervention as compared to intervention A. If for instance a respondent deems the two alternative interventions as equally worthy when the number of blind individuals is 1,700, then the value of living one year as blind is 1,000/1,700 = 0.59.

Indirect methods (i.e. 'off the shelf' values)

The second method for valuing health states involves using pre-existing values. Respondents complete a multi-attribute health questionnaire for which each health state has a pre-assigned value or utility obtained from general population surveys (Gray *et al.* 2011). Exercises to obtain utility weights for QALYs are typically not aimed at specific diseases but rather health states as described using levels in a number of health dimensions. For example, the commonly used EuroQol-5D classification system uses the dimensions mobility, self-care, usual activities, pain/discomfort and anxiety/depression with three levels in each dimension to describe health states (a sample questionnaire is shown in Figure 15.4). For mobility, these levels are: I have no problems walking about, I have some problems walking about, I am confined to bed. Other assessment systems that are commonly used in valuing QALYs are the SF-36, developed in the USA, and WHOQOL, developed for use in low- and middle-income countries (Fox-Rushby and Cairns 2005).

Care must be taken when using these weights from the literature as the type of valuation method used (e.g. TTO, SG, etc.) has been shown to significantly influence results and preferences for health states across population groups (Jansen *et al.* 2000; Drummond *et al.* 2005; Sinnott *et al.* 2007). Consequently, there is a focus on developing the QALY weights based on the values of either the general population or patients in the setting where an economic evaluation is intended. Significant resources are required for capturing preferences in the general population involving a large number of participants. For instance, a total of 3,395 individuals from the UK participated in a TTO exercise to assign weights to 245 health states from the EuroQol classification system (Dolan *et al.* 1996). Once obtained, utilities are typically combined with survival estimates and aggregated across individuals to generate QALYs or DALYs.

So far we have discussed key approaches to measuring health outcomes using non-monetary values and explored two utility indices in detail. In the next section we examine why and how consequences are measured in terms of money.

Valuing changes in health and non-health consequences using monetary approaches

Health utility indices such as the QALY or DALY are useful for describing improvements in *health* across different health interventions. However, they may not capture the full value of health interventions, particularly if there are outcomes that may not be strictly 'health' (e.g. productivity gains, convenience and information) or there is value to others (e.g. public good, externality). Fox-Rushby and Cairns (2005) identify a long list of additional benefits that might arise from health care interventions ranging from satisfaction with services through to changes in current and future access to care. These are benefits that might arise from health care interventions but are not measured using health indices.

By placing a tick in one box in each group below, please indicate which statements best describe your own health state today

Mobility

I have no problems in walking about ❏

I have some problems in walking ahout ❏

I am confined to bed ❏

Self-Care

I have no problems with self-care ❏

I have some problems washing or dressing myself ❏

I am unable to wash or dress myself ❏

Usual Activities (*e.g. work study housework family or leisure activities*)

I have no problems with performing my usual activities ❏

I have some problems with performing my usual activities ❏

I am unable to perform my usual activities ❏

Pain/Discomfort

I have no pain or discomfort ❏

I have moderate pain or discomfort ❏

I have extreme pain or discomfort ❏

Anxiety/Depression

I am not anxious or depressed ❏

I am moderately anxious or depressed ❏

I am extremely anxious or depressed ❏

Figure 15.4 The EQ-5D-3L descriptive system

Source: Reproduced with kind permission of the EuroQoL Group

One way of capturing all such benefits is using the common unit of money. As we learned earlier, the monetary valuation of benefit is required to conduct CBA and can be compared against costs for informing decisions of resource allocation across all sectors. CBA has been widely used in areas such as environmental, transport and agricultural economics. In health economics the idea of putting a monetary value on human lives and quality of life has always been controversial.

Key approaches for eliciting monetary values of health

There are a number of different methods used to value the benefits of health care interventions in monetary terms. Some of the key ones are discussed below.

The human capital approach

This approach attempts to quantify the loss of a person's marginal productivity as a result of ill health – i.e. the marginal loss in economic output that results from a person not being able to work. The human capital approach has been used for many years and is based on the assumption that each individual contributes to a society's productivity. The monetary value of lost productivity due to ill health is calculated by multiplying the duration of illness by the amount that person would be earning (i.e. the 'market price' of their labour) during that time if they were not ill. Now try the next activity that shows how the human capital approach can be used to value the benefits of health care.

Activity 15.3

A man used to be a coal miner, a physically demanding job for which he was paid $80 per day. Due to a respiratory illness he can no longer go down the mine and instead works in the post room, a less demanding job for which he only gets paid $40 per day. Assuming that for each job the working week is five days and there are 45 working weeks in a year:

1 What is the annual indirect cost of illness?
2 What if the retired father of the miner became ill with the same illness? What would the indirect cost of illness be then?

Feedback

1 Annual earnings as a miner: $80 × 5 × 45 = $18,000
  Annual earnings as a post room clerk: $40 × 5 × 45 = $9,000
  Annual indirect cost of illness = $18,000 − $9,000 = $9,000
2 There is no straightforward answer here. You may have concluded that the indirect cost of illness was zero as the father was retired or you might have used the wage of a miner or a post room clerk as a 'proxy' for what the father could have earned had he been in productive labour.

  There are a number of problems with the human capital approach.

* *It may not be equitable* because higher-wage workers will be deemed to have a higher indirect benefit than lower-wage earners. Also, the wage rates may themselves reflect inequities such as discrimination by gender or race.
* *There may be no labour market and therefore no 'market price'* for many groups including homemakers, the elderly and children. Some economists use proxies – an example of this is using the wage of domestic workers as a proxy for the time of homemakers. There is also an ongoing debate as to whether leisure time should be valued the same as working time (Posnett and Jan 1996).
* *Intangible costs are not included.* Most cost of illness studies exclude intangible costs such as the psychological cost of pain and suffering, despite these being potentially significant.

- *The relationship between health status and productivity is complex and can be two-way.* For example, someone who is unemployed or who is in a low-wage job will have fewer financial means to obtain the same quality of health care as someone earning a higher wage.

The friction cost approach

As you read above, the human capital approach does not take into account the complexities in the relationship between productivity and ill health. During production processes, everyone can be replaced in the short term. This implies that there may be no impact on productivity but increases in costs associated with replacing workers. The friction cost approach to measuring indirect costs has been used as an alternative to the human capital method and takes account of the fact that productivity losses from absences can be reduced in the short term by using excess capacity in the workforce and in the long term by replacing workers with unemployed persons or reallocating employees (Koopmanschap and van Ineveld 1992; Brouwer and Koopmanschap 2005).

Observed (or 'revealed') preferences

Observed preference studies examine the actual choices (i.e. preferences) that decision-makers or individuals express in real life. These are interpreted as revealing the relative value placed on different consequences and risks. An example of decision-makers' observed preferences is using the value of court awards in injury cases as a way of estimating the monetary value of that injury. An example of individuals observed preference is examining the amount paid for risk-reducing goods or services (e.g. bicycle helmets) and multiplying this by the change in risk (e.g. of severe head injury). Another example is the wage–risk approach where the difference in wages between jobs (e.g. miner and factory worker) is multiplied by the difference in risk of injury or death.

Each of these approaches has its problems. For example, using court awards as a way of estimating the monetary value of injury is problematic because the results will vary from situation to situation, and the amount awarded is not only a reflection of the compensation for injury but other factors including the earning potential of the individual and punishment of the defendant. Estimates of individual observed preference also suffer from the problem that individuals' values cannot be assumed to be the same across different situations.

Stated preferences

An alternative approach for estimating indirect costs and benefits uses surveys to elicit the maximum amount individuals are willing to pay (WTP) to receive something or to avoid something. While less common, surveys may also measure willingness to accept (WTA), which is the minimum monetary amount necessary for an individual to forego some good, or to bear some harm. In health care, stated preference studies have been used to estimate the value of new interventions or services for which there may not be a market, in order to assess whether the cost of the proposed intervention justifies the potential benefit to society. They are also used to guide the level at which goods or services need to be subsidized – for example, socially marketed mosquito nets or antimalarials to prevent and treat malaria (Onwujekwe *et al.* 2002; Wiseman *et al.* 2005) or government subsidized community insurance schemes (Mathiyazhagan 1998; Onwujekwe *et al.* 2009).

Two of the main methods for eliciting stated preferences are contingent valuation (CV) and discrete choice experiments (DCEs). While it is beyond the scope of this book to look at these in much detail it is important to gain a basic understanding of these methods. DCEs involve asking individuals to state their preference over hypothetical alternative scenarios. Each alternative is described by several attributes (e.g. convenience, quality of service). Price is treated as one of these attributes and therefore marginal WTP for an attribute can be derived. Contingent valuation seeks to describe a hypothetical market for a 'good'. Respondents are then asked about the maximum value they are willing to pay 'contingent' on this hypothetical market (Ryan *et al.* 2008). Stated preference surveys must be carefully designed in order to ensure validity of the results (Smith 2007). In particular, it is important to be clear about the type and extent of uncertainty. In most situations there is some uncertainty about the consequences or outcomes of a programme or intervention.

A final word of warning about eliciting monetary values of health. There is the potential for double-counting of benefits in cost-benefit analysis. For example, a person's reduced ability to work due to asthma may be included in the calculation of the cost of illness using the human capital approach or an observed or stated preference technique. This can be included in the cost–benefit calculation as a benefit *or* as a cost-offset deducted from the total costs (Drummond *et al.* 2005). Importantly, the effect on a person's ability to work should only be considered once.

Now that you have a better understanding of the different monetary approaches, try Activity 15.4 which focuses on one of these, WTP.

Activity 15.4

Suppose you want to introduce a new water container to reduce morbidity from diarrhoea but find it difficult to measure the benefits of the programme. Haddix *et al.* (1996) asked 100 households in a village about their willingness to pay to avoid diarrhoea. The villagers understood that the trade-off was between buying the container and coping with diarrhoea in the household. The results of the survey are shown in Table 15.1.

Table 15.1 Benefits of a new water container

Maximum WTP ($)	No. of households	Total 'benefit'	Cumulative % of households
25	5	125	5
20	10	200	15
15	50	750	65
10	15	150	80
5	15	75	95
0	5	0	100

1 Theoretically, what percentage of households would be willing to pay at least $10 for the water container?
2 If it was decided to supply the containers at $10 each, what would be i) the total cost to the village, ii) the total benefit and iii) the net benefit?
3 What factors might affect a villager's willingness to pay?

Feedback

1 80 per cent of the households would be willing to pay at least $10 for the water container.
2 i) The total cost to the village would be $10 × 80 households = $800
   ii) The total benefit = ($125 + $200 + $750 + $150) = $1,225
   iii) The net benefit = $1,225 − $800 = $425
3 A range of factors could influence their willingness to pay including the level of education, their understanding about the cause of diarrhoea and how much they perceive it to be a problem as well as their income. There are probably others that you thought of!

Willingness to pay studies are popular because they have a number of strengths:

- they can be applied to any situation and therefore can be used to elicit preferences for a theoretical intervention or service;
- they can be used to estimate directly any change in net social welfare – i.e. the benefit to all of society, and not just the individual patient;
- the desired scenarios can be set up exactly as the analyst would like;
- money is the denominator and because it is tangible and has a universally accepted value it can be easily understood.

However, there are also a number of challenges:

- the technique is open to bias because respondents can find the hypothetical situation difficult to understand;
- WTP tends to be positively related to the income of the respondent. It may be necessary to adjust WTP estimates to take account of income effects.
- the practical problems in conducting any survey (e.g. low response rate and deciding how much information to give);
- the people who respond may not be representative of the population as a whole (it is often the better educated who participate);
- the estimates are based on what people *say* they would do and not what they actually *do*;
- many people are unwilling or feel it is impossible to value lives; they frequently place an infinite value on life when responding to surveys and if this is the case then all interventions which save lives will have infinite benefits which will invariably exceed their costs and will always be worthwhile.

Summary

In this chapter we have explored a wide range of both health and non-health outcomes that arise from health interventions. Particular attention was paid to utility measures such as DALYs and QALYs used in CUA, a form of cost-effectiveness analysis. We also revisited the role of CBA and the direct and indirect approaches used to value health outcomes in monetary terms, including the popular human capital approach.

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16 Economic evaluation and decision-making

Damian Walker

Overview

You have been given frameworks to use when comparing costs and consequences of interventions, and you have learned how to calculate these costs and consequences. This chapter will enable you to describe the process of allocating resources using different types of economic evaluation, and discuss the uses of economic evidence in policy, including the factors influencing the uptake of economic evaluation evidence. It will also help you develop an awareness of the critical assumptions made in an economic evaluation.

Learning objectives

After working through this chapter, you will be able to:

- describe the process of allocating resources using different types of economic evaluation
- understand the uses of economic evidence in policy
- discuss areas of application of economic evaluation
- display an awareness of the critical assumptions made in an economic evaluation
- discuss the factors influencing the uptake of economic evaluation evidence

Key terms

Average cost-effectiveness ratio (ACER). Ratio of the difference in cost to the difference in effect of a single intervention against its baseline option (e.g. no programme or current practice).

Benefit–cost ratio (BCR). Ratio of total monetized benefits divided by total costs. An indicator used in cost–benefit analysis (CBA).

Incremental cost-effectiveness ratio (ICER). Ratio of the difference in costs between two alternative programmes to the difference in effectiveness between the same two programmes.

Marginal cost-effectiveness ratio (MCER). Ratio of the difference in cost and effect resulting from the expansion or contraction of a programme.

Net present value (NPV). Total monetized benefits minus costs. An indicator used in CBA.

Evidence-based practice

Limited health care budgets have emphasized the need to use resources effectively and efficiently. In order to achieve this there has been a growing interest in implementing evidence-based policy decisions. Consequently, in recent years economic evaluation has acquired greater prominence among decision-makers, who need to know which interventions represent 'value for money'. You will recall from the preceding chapters that economic evaluation can help provide the necessary information by comparing the value of the *costs* and *benefits* from competing interventions. Exactly how decision-makers then use this information to allocate scarce health care resources is the focus of this chapter.

The process of allocating scarce health care resources using cost–benefit analysis

Having assessed the costs (Chapter 14) and consequences (Chapter 15), the next step in an economic evaluation is to bring together these results in a simple and understandable form for the audience, to provide an overall indication of value for money in a way that will inform decision-making.

You will recall from Chapter 13 that two summary measures typically used in cost–benefit analysis (CBA) are:

• net present value (NPV);
• benefit–cost ratio (BCR).

Let's now look at these in a bit more detail. NPV is calculated by summing the monetized benefits and then subtracting all of the costs, with discounting applied to both benefits and costs as appropriate. The formula for the NPV is:

$$NPV = \sum_{t=0}^{n} \frac{(Benefits - Costs)_t}{(1 + r)^t}$$

where:

r = discount rate
t = year
n = analytic horizon (in years)

The BCR represents the ratio of total benefits over total costs, both discounted as appropriate. The formula for calculating the BCR is:

$$BCR = \frac{PV_{benefits}}{PV_{costs}}$$

where:

$PV_{benefits}$ = present value of benefits
PV_{costs} = present value of costs

A CBA will yield a positive NPV if the benefits exceed the costs. Implementing such a programme will generate a net benefit to society. An equivalent condition is that the

ratio of the present value of the benefits to the present value of the costs must be greater than one. However, if there are two or more mutually exclusive interventions that have positive NPV then there has to be further analysis. From the set of mutually exclusive interventions the one that should be selected is that with the highest NPV or highest BCR ratio.

Activity 16.1

Table 16.1 is a summary of a CBA study for two competing interventions, A and B.

Table 16.1 Costs and benefits

Project	A	B
Costs (£ million)	2	4.7
Benefits (£ million)	10.2	15.5

Assuming that all costs and benefits are present values, and were computed for the same time period:

1 Compute the BCRs for each project.
2 How would you interpret the results to the policy-maker, using layman's language?
3 Based solely on the results from the preceding question, which project would you recommend?
4 Compute the NPV for each project.
5 Interpret the results of the answers to the previous question.
6 Based on those results, what would be your recommendation?
7 Do these results change your previous recommendation? Why or why not?

Feedback

1 BCR_A = 10.2/2 = 5.1:1
  BCR_B = 15.5/4.7 = 3.3:1
2 £1 spent on Project A returns £5.1.
  £1 spent on Project B returns £3.3.
3 Project A has a higher return per pound spent so we would recommend it over Project B.
4 NPV_A = 10.2 – 2 = £8.2
  NPV_B = 15.5 – 4.7 = £10.8
5 Project A gives us a net benefit worth £8.2 million. Project B gives us a net benefit worth £10.8 million
6 Society gains more from Project B than from Project A. Therefore we would recommend Project B.
7 *Yes.* However, other relevant factors need to be taken into consideration:
   • Project B has more than twice the capital outlay of Project A.
   • Society might not be able to implement Project B because of limited resources.
   • Political or societal support might also play a part.

The process of allocating scarce health care resources using cost-effectiveness and cost–utility analysis

There is considerable antipathy in the general public to the idea of placing a monetary value on human life. Therefore, in health care decision-making, cost-effectiveness analysis (CEA) and cost–utility analysis (CUA) are more common evaluative frameworks. In CEA/CUA, the next step is to bring together the costs and effects, in the form of a ratio, to provide an overall indication of cost-effectiveness in a way that will inform decision-making. Depending on the study question and comparison undertaken, there are three types of cost-effectiveness ration. You have already learnt a little about two of these.

1 *Average cost-effectiveness ratio* (*ACER*): an ACER deals with a single intervention and evaluates that intervention against its baseline option (e.g. no programme or current practice. We saw in Chapter 13 that it is calculated by dividing the total cost of the intervention (C) by the total number of health outcomes prevented by the intervention (E).

$$ACER = \frac{\text{Total Costs}_{\text{Intervention A}}}{\text{Total Effects}_{\text{Intervention A}}}$$

2 *Marginal cost-effectiveness ratio* (*MCER*): the MCER assesses the specific changes in cost and effect when a programme is expanded or contracted (e.g. the additional costs and effects of vaccinating an additional child). In practice it is rare for output to change by one unit, so the marginal CER of a particular programme is often approximated by dividing the additional costs associated with a larger change in production than one unit, by the change in production. An example might be the cost of extending the same vaccination service to another village and dividing this by the additional number of vaccinations in order to approximate the marginal cost per additional child vaccinated.

$$MCER = \frac{\text{Total Costs}_{\text{Intervention A+1}} - \text{Total Costs}_{\text{Intervention A}}}{\text{Total Effects}_{\text{Intervention A+1}} - \text{Total Effects}_{\text{Intervention A}}}$$

3 *Incremental cost-effectiveness ratio* (*ICER*): an ICER compares the differences between the costs and health outcomes of two alternative interventions that compete for the same resources, and is generally described as the additional cost per additional health outcome. You will recall from Chapter 13 that the ICER numerator includes the differences in programme costs. This can also include the averted disease costs and averted productivity losses depending on the choice of perspective. Similarly, the ICER denominator is the difference in health outcomes.

$$ICER = \frac{\text{Total Costs}_{\text{Intervention A}} - \text{Total Costs}_{\text{Intervention B}}}{\text{Total Effects}_{\text{Intervention A}} - \text{Total Effects}_{\text{Intervention B}}}$$

It should be noted that the terms MCER and ICER are often used interchangeably in the literature. And while many believe that an ACER provides no useful information for decision-makers, the World Health Organization (WHO) has argued for their use as part of 'generalized cost-effectiveness analysis' (Murray *et al.* 2000; Hutubessy *et al.* 2002). Generalized CEAs require the evaluation of a set of interventions with respect

to the counterfactual of the null set of the related interventions – i.e. the natural history of disease. Thus data on the relative *average* cost-effectiveness of interventions, which do not pertain to any specific decision-maker, can be a useful reference point for evaluating the directions for enhancing allocative efficiency in a variety of settings. WHO's framework does not preclude the analysis of *incremental* (or *marginal*) cost-effectiveness; rather it allows the identification of current (via the use of ACERs) allocative inefficiencies *as well* as opportunities presented by new interventions (via the use of ICERs).

Activity 16.2

1 Calculate the MCER for expanding the programme:
   • Total cost$_A$ = £5,000
   • Total cost$_{Ax}$ = £10,000
   • Total outcomes$_A$ = 3
   • Total outcomes$_{Ax}$ = 5
   where subscripts:
   • A refers to the original programme and
   • Ax refers to the expanded programme.
2 Calculate the ICER for two alternative programmes, A and B, competing for resources, given:
   • Total cost$_A$ = £5,000
   • Total cost$_B$ = £26,000
   • Total outcomes$_A$ = 3
   • Total outcomes$_B$ = 10
   where a programme outcome is the number of disease cases attributable to the programme for the same-sized patient population.

Feedback

1 The MCER is the ratio of the differences in total costs and total outcomes between the initial programme level and expansion level.
   MCER = (£10,000 − £5,000) / (5−3)
   MCER = £5,000 / 2
   MCER = £2,500 per outcome
2 The ICER is the ratio of the differences in total costs and total outcomes between the two programmes.
   ICER = (£26,000 − £5,000) / (10 − 3) ICER = £21,000 / 7
   ICER = £3,000 per disease case prevented

Comparing interventions

When the choice is between a new intervention and the status quo, the analyst should begin by applying the principle of dominance (sometimes called 'strong' dominance). Dominance favours a strategy that is both more effective *and* less costly. Either the new intervention or the status quo may be preferred using this principle.

When one of these is both more effective and more costly, the decision-maker must decide if the greater effectiveness justifies the cost of achieving it. This is done by calculating a cost-effectiveness ratio.

In studies that compare multiple mutually exclusive interventions – i.e. if somebody receives one of the interventions they cannot receive the other – an additional dominance principle should be applied. The analyst should first apply the principle of strong dominance; any of the competing interventions is ruled out if another intervention is both more effective and less costly or vice versa. The analyst should then apply the principle of extended dominance (sometimes called 'weak dominance'). The list of interventions, trimmed of strongly dominated alternatives, is ordered by effectiveness. Each intervention is compared to the next most effective alternative by calculating the ICER. Extended dominance rules out any intervention that has an ICER that is greater than that of a more effective intervention. The decision-maker prefers the more effective intervention with a lower ICER. By approving the more effective interventions, quality adjusted life years (QALYs) gained or disability adjusted life years (DALYs) averted, for example, can be purchased more efficiently. Note that dominance principles can be also applied by ranking interventions in the order of their cost; the same finding will result. Dominance principles can be applied when outcomes are measured in units other than QALYS or DALYs. It is important to note that while this approach is technically correct, other criteria shape policies in addition to efficiency.

Comparing the costs and effects of multiple, mutually exclusive interventions

Assume there five interventions (A–E) available in addition to the standard of care. The average cost and QALYs per patient are shown in Table 16.2.

Table 16.2 Average cost and QALYs in a hypothetical comparison of interventions

Intervention	£ per patient	QALYs per patient
Standard care	50	1.0
A	120	1
B	100	2.0
C	250	3.0
D	350	4.0
E	550	5.0

We can exclude intervention A as it is strongly dominated by intervention B, i.e. intervention B is both cheaper and more effective. Removing intervention A from the table, each intervention is now compared to the next most effective alternative by calculating the ICER. This results in Table 16.3.

Table 16.3 Hypothetical comparison of costs and effects of interventions (continued)

Intervention	£ per patient	QALYs per patient	ICER (£)
Standard care	50	1.0	–
B	100	2.0	50
C	250	3.0	150
D	350	4.0	100
E	550	5.0	200

We can exclude intervention C as it is weakly dominated by interventions B and D. For example, if 100 patients were given intervention C it would cost £25,000 and 300 units of effect would be gained. However, 300 units (50 × 2 + 50 × 4) can be gained at a cost of £22,500 (50 × £100 + 50 × £350) if 50 patients are given intervention B and 50 patients are given D. Or alternatively, 320 units (40 × 2 + 60 × 4) can be gained at a cost of £25,000 (40 × £100 + 60 × £350) if 40 patients are given intervention B and 60 patients are given D. Weak or extended dominance requires two strong assumptions: 1) that treatments are perfectly divisible; and 2) that there are constant returns to scale. In other words, it has to be possible to deliver alternatives B and D to smaller numbers of patients without any change in cost-effectiveness. The final results are shown in Table 16.4.

Table 16.4 Final results of the hypothetical cost-effectiveness analysis

Intervention	£ per patient	QALYs per patient	ICER (£)
Standard care	50	1.0	–
B	100	2.0	50
D	350	4.0	125
E	550	5.0	200

Interpreting cost-effectiveness data: the cost-effectiveness plane

The incremental cost-effectiveness ratio represents a measure of how efficiently the proposed intervention can produce an additional unit of effect (e.g. DALY averted or QALY gained). By using this standard method, the cost-effectiveness of alternative interventions can be compared, helping policy-makers decide which they should adopt. The goal of the decision-maker is to adopt all health interventions that represent efficient ways of averting morbidity and/or mortality or, conversely, of gaining health.

The incremental cost and incremental effect can be represented visually using the incremental cost-effectiveness plane. The horizontal axis divides the plane according to incremental effect (positive above, negative below) and the vertical axis divides the plane according to incremental cost (positive to the right, negative to the left). This divides the incremental cost-effectiveness plane into four quadrants through the origin (see Figure 16.1).

Each quadrant has a different implication for the decision. If the ICER falls in the south-east quadrant, with negative costs and positive effects, the new intervention dominates and is always considered cost-effective. If the ICER fell in the north-west quadrant, with positive costs and negative effects, the new intervention is dominated and is never considered cost-effective. If the ICER fell in the north-east quadrant, with positive costs and positive effects, or the south-west quadrant, with negative costs and negative effects, trade-offs between costs and effects would need to be considered. These two quadrants represent the situation where the new intervention may be cost-effective compared to current practice, depending upon the value at which the ICER is considered good value for money.

In order to decide if an intervention offers 'good' value for money, the ICER must be compared to a specified monetary threshold. This threshold represents the maximum

amount that the decision-maker is willing to pay for health effects. The intervention is deemed cost-effective if the ICER falls below this threshold and not cost-effective otherwise. For example, if a decision-maker is willing to pay an additional £50,000 for a year of life, the intervention is considered cost-effective if the ICER is below £50,000 per life year gained. In situations where a threshold is not stated explicitly, the act of decision-making implies a value for the threshold. Based on the recommendation of the Commission on Macroeconomics and Health (World Health Organization 2001), WHO classifies interventions as 'highly cost-effective' for a given country if results show that they avert a DALY for less than the per capita national gross domestic product. Several countries have their own thresholds. For example, $50,000 per QALY gained (1982 US$) is commonly used as the threshold in the USA (Hirth *et al.* 2000). Likewise, in Canada the range of values proposed is CAN$20,000–120,000 (1990 CAN$) (Laupacis *et al.* 1992). In the UK, £20,000–30,000/QALY is commonly used in economic evaluation as the ceiling ratio. These thresholds all apply to decision-making at the national level; however, decisions may be made at the international, sub-national or individual hospital levels and decision-makers may wish to define thresholds according to their own contexts.
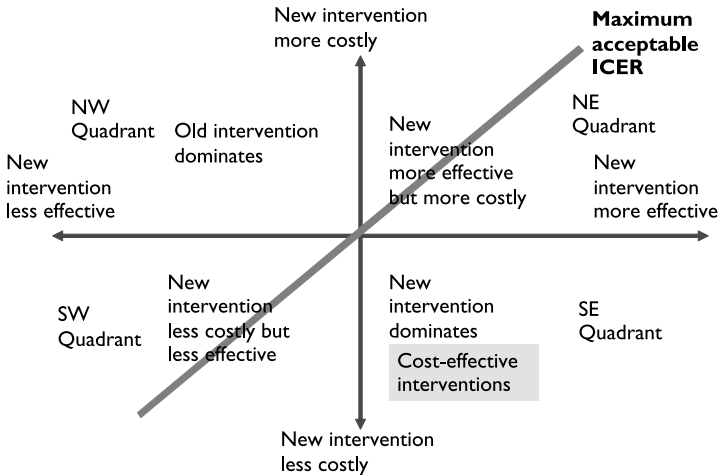
Figure 16.1 The cost-effectiveness plane

Note that the CER is usually presented as a range. The range is generated from the sensitivity analysis and reflects the uncertainty underlying the assumptions made in the estimation of both costs and outcomes.

Applications of economic evaluation nationally and internationally

In recent years it has become fashionable to make comparisons (in 'league tables' or rankings) between health care interventions in terms of their relative cost-effectiveness, in cost per life year, cost per QALY gained or cost per DALY. However, league tables frequently compare ICERs from studies that have computed these ratios using different methods and assumptions including choice of comparator, choice of discount rate, time horizon and population sub-group (Gerard and Mooney 1993). The methodological differences among studies may influence the ranking of the studies

and therefore decisions made using a league table may not always reflect differences in the relative value for money of interventions. However, there have been attempts to gain greater consistency in economic evaluation methodology. In addition, league tables generally do not include measures of the uncertainty of the cost-effectiveness esti-mates. In spite of these issues, economic evaluation has been used to ration health services by influencing the design of a variety of essential packages of care in developed and developing countries as the following examples show.

The World Bank's 1993 World Development Report (WDR)

In 1993 the *World Development Report* (WDR) (World Bank 1993) presented a global priority-setting exercise which led to recommendations about essential public health and clinical services packages for low- and middle-income countries. The WDR used DALYs to measure the burden of various diseases, and advocated a minimum (or 'essential health') package of public health interventions and clinical services that should be financed by public resources. A 'good buy' was deemed to be one which is both cost-effective and addresses a large burden of disease. Table 16.5 presents the

Table 16.5 Cost-effectiveness of the health interventions (and clusters of interventions) included in the minimum package of health services in low-income countries

Country group and component of package	Cost per DALY ($)
Public health	
EPI Plus	12–17
School health programme	20–25
Other public health programmes (including family planning, health and nutrition information)[a]	[b]
Tobacco and alcohol control programme	35–55
AIDS prevention programme[c]	3–5
Clinical services	
Short-course chemotherapy for tuberculosis	3–5
Management of the sick child	30–50
Prenatal and delivery care	30–50
Family planning	20–30
Treatment of STDs	1–3
Limited care	200–300

Note: cost per DALY is rounded to the nearest $

a. Includes information, communication and education on selected risk factors and health behaviours, plus vector control, disease surveillance and monitoring.

b. The health benefits from information and communication and from disease surveillance are counted in the other public and clinical services in the health package. The health benefits from vector control are unknown consumption; if such prevalence were to rise, the potential benefits would be larger.

c. Excludes treatment of STDs, which are in the clinical services package.

Source: Adapted from (World Bank 1993)

essential package of public health interventions developed for the WDR. From high-income countries there are only a few such examples. A scheme that attracted considerable interest and debate was the 'Oregon Plan'.

The Oregon experience

In 1989 the US state of Oregon launched an initiative to ration treatment under the Medicaid scheme. The aim was, under a fixed budget, to provide the most efficient services to the largest number of people, rather than providing less efficient services to all. The approach developed a league table which ranks health care interventions in terms of their gains in health-related quality of life. Since 1989 several lists have been developed allowing some flexibility for change and improvement of methodology. For example, in the version that was implemented in 1994, 565 treatments were listed and only these treatments were reimbursed by Medicaid. Notably, the public has been involved in this process and preferences and values of community committees were incorporated into the complex process of ranking of treatment outcomes (Ganiats and Kaplan 1996).

During public discussions the approach was criticized for a variety of methodological, ethical and political reasons:

1 Is it justified to use preferences of non-Medicaid recipients to prioritize services for the poor?
2 Are the methods used to attach utility weights reliable? Different methods yielded different weights.
3 As recipients of Medicaid are mainly the poor and among them women and children, does the rationing discriminate against those who are most vulnerable and need care most?
4 Do politicians have a mandate to ration health services, before other sectors of expenditure such as defence or space exploration come under similar close scrutiny?

Proponents of the scheme have argued that rationing occurs in all health care systems, though mostly invisible and implicit, whereas attempts such as the Oregon Plan make rationing explicit and visible. They also emphasize that the Plan had increased access to care for many recipients. As the debate demonstrated, economic evaluation for priority-setting involves complex political and ethical issues and is not merely a technical exercise.

NICE – the National Institute for Health and Clinical Excellence

The National Institute for Health and Clinical Excellence or NICE is a special health authority of the NHS in England and Wales. Given that the NHS has a limited budget NICE attempts to assess the cost-effectiveness of potential expenditures to establish whether or not they represent 'better value' for money than treatments that would be neglected if the expenditure took place. NICE uses the QALY to measure the health benefits delivered by a given treatment regime. Theoretically it might be possible to draw up a table of all possible treatments sorted by increasing the cost per QALY gained. Those treatments with lowest cost per QALY gained would appear at the top of the table and deliver the most benefit per pound spent and would be the easiest to

justify funding for. Those where the delivered benefit is low and the cost is high would appear at the bottom of the list. Decision-makers would, theoretically, work down the table, adopting services that are the most cost-effective. The point at which the NHS budget is exhausted would reveal the cost-effectiveness threshold. In practice this exercise is not performed, but a threshold has been used by NICE for many years in its assessments to determine which treatments the NHS should and should not fund – £20,000–30,000 per QALY gained, although, in practice, the threshold for rejecting technologies has been found to be in the range of £35,000 to £48,000 (Devlin and Parkin 2004).

The Copenhagen Consensus

A final example is the Copenhagen Consensus, which attempts inter-sectoral priority-setting and thus needs to use CBA. The goal of the Copenhagen Consensus project is to use CBA to set priorities among a series of proposals for confronting 10 great global challenges. These challenges, selected from a wider set of issues identified by the United Nations, are: civil conflicts; climate change; communicable diseases; education; financial stability; governance; hunger and malnutrition; migration; trade reform; and water and sanitation. A panel of economic experts was invited to consider these issues. The panel was asked to address the 10 challenge areas and to answer the question, 'What would be the best ways of advancing global welfare, and particularly the welfare of developing countries, supposing that an additional £50 billion of resources were at governments' disposal?' The 2004 meeting found that combating HIV/AIDS had a very high rate of return and should be at the top of the world's priority list. About 28 million cases could be prevented by 2010. The cost would be £27 billion, with benefits almost 40 times as high. See www.copenhagenconsensus.com for further details.

Activity 16.3

In your view, how could the use of economic evaluations in your setting be encouraged?

Feedback

You might wish to consider both the demand and supply of economic evidence. For example, with respect to the former, decision-makers could be encouraged to acknowledge the importance of considering the economic consequences of their decisions. And with respect to the latter, are there enough health economists and others with relevant training and expertise so that decision-makers can trust the results of studies that are performed?

Some perceived advantages and disadvantages of economic evaluation

As a decision-making tool that helps allocate scarce resources to programmes that maximize societal economic benefit, CBA compels analysts to study the full economic impact of all potential outcomes of an intervention. Expressing the results of this com-

prehensive analysis in purely monetary terms makes it possible to compare different programmes having different health outcomes, or health programmes to non-health programmes. Furthermore, the identification of all resource requirements (costs) and benefits of an intervention or programme allows analysts to examine its distributional aspects (e.g. who will receive these benefits and who will bear the costs). The major limitation of CBA is the empirical difficulty associated with assigning monetary values to benefits (e.g. extended human life, improved health and reduced health risks). Besides the complexity of various methods designed to value these benefits, analysts usually confront controversy over the appropriateness of attaching a certain monetary value to human life.

Measuring the cost per unit of *health outcome* in CEA/CUA circumvents the need to make an explicit valuation of human life. Nevertheless, when decisions are to be made as to whether to implement a life-saving intervention based on its cost-effectiveness measure, policy-makers must make the *implicit* decision as to whether the investment is worth the lives it will save. CBA makes this consideration *explicit*. Finally, as in any other study, the results of an economic evaluation are only as good as the assumptions and valuations on which they are based. Understanding the implications of analysis assumptions and methods is essential for a correct interpretation of results.

Activity 16.4

Answer true or false to the following questions:

1 CEA is used widely in public health to evaluate alternative programmes or policies to gain the maximal health outcome for a given level of resources.
2 A CEA would be useful for an organization to determine the return on investment from a health programme.
3 For a CEA to be useful in comparing two different programmes, common health outcomes must be employed.
4 The results of a CEA evaluating a vaccination programme designed to reduce infant mortality in a developing country could be used by a programme manager in the UK for evidence of the programme's cost-effectiveness.

Feedback

1 True.
2 False. A CBA measures health outcomes in monetary terms and should be used to determine the return on investment for a particular health programme.
3 True.
4 False. The risk factors and exposures of vaccine-preventable diseases among children in the developing world are different than those experienced by children in developed nations, which would result in dissimilar outcomes that should not be compared.

Ten questions to ask of any study – the Drummond checklist

As a decision-maker in the health sector, you may find yourself in the position of receiving an economic evaluation on the basis of which you may be expected to take

some action. The following questions were drawn up by Drummond and Stoddart in a 1985 article, and they have stood the test of time. These questions provide a framework for assessing the results of any economic evaluation (see Drummond *et al.* 2005).

1 Was a well-defined question posed in answerable form?
   a) Did the study examine both costs and effects of the service(s) or programme(s)?
   b) Did the study involve a comparison of alternatives?
   c) Was a viewpoint for the analysis stated or was the study placed in a particular decision-making context?
2 Was a comprehensive description of the competing alternatives given?
   a) Were any important alternatives omitted?
   b) Was (should) a 'do-nothing' alternative (have been) considered?
3 Was there evidence that the programmes' effectiveness had been established? Was this done through a randomized, controlled clinical trial? If not, how strong was the evidence of effectiveness?
4 Were all important and relevant costs and consequences for each alternative identified?
   a) Was the range wide enough for the research question at hand?
   b) Did it cover all relevant viewpoints (e.g. those of the community or society, patients and third-party payers)?
   c) Were capital costs as well as operating costs included?
5 Were costs and consequences measured accurately in appropriate physical units (e.g. hours of nursing time, number of physician visits, days lost from work or years of life gained) prior to valuation?
   a) Were any identified items omitted from measurement? If so, does this mean that they carried no weight in the subsequent analysis?
   b) Were there any special circumstances (e.g. joint use of resources) that made measurement difficult? Were these circumstances handled appropriately?
6 Were costs and consequences valued credibly?
   a) Were the sources of all values (e.g. market values, patient or client preferences and views, policy-makers' views and health care professionals' judgements) clearly identified?
   b) Were market values used for changes involving resources gained or used?
   c) When market values were absent (e.g. when volunteers were used) or did not reflect actual values (e.g. clinic space was donated at a reduced rate) were adjustments made to approximate market values?
   d) Was the valuation of consequences appropriate for the question posed (i.e. was the appropriate type, or types, of analysis – cost-effectiveness, cost–benefit or cost–utility – selected)?
7 Were costs and consequences adjusted for differential timing?
   a) Were costs and consequences that occurred in the future 'discounted' to their present values?
   b) Was any justification given for the discount rate used?
8 Was an incremental analysis of costs and consequences of alternatives performed? Were the additional (incremental) costs generated by the use of one alternative over another compared with the additional effects, benefits or utilities generated?
9 Was a sensitivity analysis performed?
   a) Was justification provided for the ranges of values (for key parameters) used in the sensitivity analysis?

b) Were the study results sensitive to changes in the values (within the assumed range)?

10 Did the presentation and discussion of the results of the study include all issues of concern to users?

a) Were the conclusions of the analysis based on some overall index or ratio of costs to consequences (e.g. CER)? If so, was the index interpreted intelligently or in a mechanistic fashion?

b) Were the results compared with those of other studies that had investigated the same questions?

c) Did the study discuss the generalizability of the results to other settings and patient/clinic groups?

d) Did the study allude to, or take account of, other important factors in the choice or decision under consideration (e.g. distribution of costs and consequences or relevant ethical issues)?

e) Did the study discuss issues of implementation, such as the feasibility of adopting the 'preferred' programme, given existing financial or other constraints, and whether any freed resources could be used for other worthwhile programmes?

Other criteria to consider when making decisions

While the emphasis of this chapter is on value for money – that is, whether a health policy should be adopted and not who pays for it – if the object is to decide how to spend public funds, economic evaluation is only one of at least nine criteria relevant for priority-setting in health. Cost alone matters, as do the capacities of potential beneficiaries to pay for an intervention. The other criteria that may affect priorities include horizontal equity and vertical equity (discussed in Chapter 17); adequacy of demand; and public attitudes and wants. Two criteria, whether an intervention is a public good and whether it yields substantial externalities, are classic justifications for public intervention, because private markets could not supply them efficiently, just as in other sectors.

Poverty and risk of impoverishment from ill health may also influence priorities; so do the budgets available, and the decisions of how much to make available for buying interventions. Finally, the effectiveness of an intervention and, therefore, the degree to which it deserves priority, depend on how far it is culturally appropriate or acceptable for the population it is intended to benefit. Identical interventions, technically speaking, may lead to different degrees of use or compliance in different population groups, and information and incentives may be needed to achieve the full potential outcomes.

Summary

In this chapter you have looked at the process of combining costs and outcomes using different types of economic evaluation. You have also read about issues arising from the use of economic evaluation in priority-setting of health services at different levels (local and global) and different income levels (low- and high-income settings). You also looked at some of the pros and cons of economics evaluation. Before finishing we

reviewed some of the other criteria, in addition to cost-effectiveness, that are often used when health care decisions are made.

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