Evidence and Evaluation Guidance Series
Population and Public Health Division

Commissioning Economic Evaluations: A Guide

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Contents

1. Executive summary

Economic evaluation is a tool in which evidence about the cost and benefits (outputs, impacts and/or outcomes) of programs* is gathered and compared in order to identify those that represent 'best buys'.

The purpose of this guide is to assist NSW Health staff in the commissioning of economic evaluations, particularly in relation to population health programs. The guide includes information to assist with decisions on whether an economic evaluation should be commissioned and considerations specific to the development of economic evaluation plans. Processes for commissioning evaluations, which are equally relevant to economic evaluations, are outlined in the companion document *Commissioning Evaluation Services: A Guide*.

Economic evaluation essentially compares the costs and benefits of the program in question (new or existing) to an alternative program; it is dependent on the availability of information on the costs and effectiveness of a program. In comprehensive program evaluations process, outcome and economic evaluation should be integrated, with all evaluation components planned at the same time as the development of the intervention. Ideally economic data and other evaluation data are collected simultaneously, however, retrospectively collected cost data can be used along with evidence of effectiveness drawn from the literature or from a previous or retrospective outcome evaluation.

In framing an economic evaluation, commissioning agencies need to consider the perspective of the analysis, the nature of the comparison to be undertaken and the timeframe for analyses.

There are six commonly-used forms of economic evaluation: cost-minimisation analysis, cost-effectiveness analysis, cost-efficiency analysis, cost-utility analysis, cost-consequences analysis and cost-benefit analysis. The NSW Treasury recommends cost-benefit analysis as the preferred approach for evaluating NSW government programs because it captures social and environmental impacts, as well as economic impacts.

Opportunities to collect cost data, including direct and indirect costs, and cost offsets, should be acted upon at an early stage. Options for collection of data on health care utilisation include self-reported data, data linkage and previously published cost information.

In conducting an economic evaluation other issues that need to be considered, particularly in relation to population health programs, are the need to predict through the use of *economic models* the costs and outcomes that occur beyond the period in which they can be directly observed, the *discounting* of future events and the conduct of *sensitivity analysis* to account for uncertainty.

Ultimately the economic evaluation needs to be designed to meet its primary purpose, i.e., to inform the investment decision at hand. It is important for the commissioning agency to set the appropriate question, identify the key parameters for the evaluation and facilitate evaluators' access to appropriate data on costs and outcomes. Evidence from an economic evaluation should be considered alongside other evidence, e.g. equity considerations, in making investment decisions.

* The *NSW Government Program Evaluation Guidelines*[1] define a program as "a set of activities managed together over a sustained period of time that aim to achieve an outcome for a client or client group" (p.4). The *Guidelines* use 'program' to refer to policy, strategy, initiative, service or project. This guide also uses the term 'intervention' as an alternative to 'program'.

2. Introduction

NSW Health is committed to the development of evidence-based policies and programs and the ongoing review and evaluation of existing programs. This guide has been developed to support NSW Health staff in the commissioning of economic evaluations of health programs, particularly those in population health.

Economic evaluation is a tool in which evidence about the cost and benefits (outputs, impacts and/or outcomes) of programs is gathered and compared in order to identify those that represent 'best buys'. The most commonly cited definition of economic evaluation is that it is the "comparative analysis of alternative courses of action in terms of both their costs and consequences".[2] In an era in which health care resources are increasingly stretched, the use of this type of evidence is important in ensuring that health care investments are optimised to achieve value for money.[†]

This *Economic Evaluations* guide should be read in conjunction with *Commissioning Evaluation Services: A Guide*, a companion document from the Evidence and Evaluation Guidance Series of the Population and Public Health Division.[5] The *Evaluation Services* guide promotes a proactive, planned and structured approach to commissioning evaluations including information on when and how to commission an evaluation, and how to make the most of the results. It draws on the *NSW Government Program Evaluation Guidelines* and *NSW Government Evaluation Toolkit*, which outline the requirements, and suggested processes, for suitable evaluation of NSW public programs to assess their effectiveness, value for money and continued relevance, and to improve transparency in decision making.[1,6]

The *Evaluation Services* guide[5] outlines two major steps: Step 1: a pre-evaluation assessment (see Appendix 1) which can be used to decide whether or not a program should be formally evaluated and whether an external evaluator is required, and Step 2: a process for commissioning a program evaluation where an executive sponsor with appropriate delegation has approved the engagement of an external evaluator (Appendix 2). Good practice principles for high quality evaluations are also described; including timeliness, appropriateness, stakeholder involvement, effective governance, methodological rigour, consideration of specific populations and ethical conduct. The two steps and the good practice principles apply equally to economic evaluations of population health programs.

This guide to *Commissioning Economic Evaluations* does not duplicate, but will rather cross-reference, the information provided in the *Commissioning Evaluation Services* guide. It provides additional information to help decide whether an economic evaluation should be commissioned and considerations specific to the development of economic evaluation plans (element 3 in Appendix 2). In particular, it contains information that will assist with the considerations outlined in Figure 1.

The guide is not intended to provide comprehensive information about how to conduct economic evaluations. There are a number of textbooks and reference materials that are available for this purpose which are outlined at the end of the document. Rather, the aim of this guide is to give decision makers an appreciation of the circumstances in which they may benefit from commissioning of an economic evaluation and to provide information to enable this to be done effectively.

[†] Economic evaluations are different from 'cost of illness' or 'burden of disease' studies that aggregate the cost to society associated with a particular disease. Such studies typically produce findings that 'Disease X costs the Australian community $Y per year.' These studies can attract attention to a problem and can be effective advocacy tools but are of limited value in informing the allocation of resources.

It is also worth distinguishing economic evaluation studies from priority setting exercises such as program budgeting and marginal analysis (PBMA) and option appraisals.[3,4] Priority setting exercises address broad allocative efficiency questions by examining how best to allocate across a range of program areas from a given budget, and typically utilise economic evaluation evidence from a range of studies to do so. For instance, a priority setting exercise in PBMA may entail a funding agency looking at how much it invests across a portfolio of disease prevention and curative services. From an economic perspective the imperative would be to prioritise those programs that yield the greatest benefit for a given level of resources and in this respect cost-effectiveness evidence across all potential areas of spending needs to be taken into consideration. This guide focuses on the commissioning of individual economic evaluation studies; the evidence generated from these studies is potentially of use in broader priority setting initiatives.

FIGURE 1. Key considerations specific to economic evaluations

Deciding whether to commission an economic evaluation

- Identify the investment decision of interest
- Decide whether an economic evaluation will be able to inform this decision
- Identify existing, relevant economic evidence and decide whether it will suffice
- Determine the feasibility of the program (or whether information on feasibility will be available)
- Establish the effectiveness of the program (or whether information on effectiveness will be available)
- Determine how important economic evidence is for the investment decision to be made, given other considerations such as equity
- Decide whether the level of investment in a program warrants an economic evaluation
- Identify whether there are plans for scaling up the program
- Consider whether it will be possible to obtain the data required for the economic evaluation
- Decide whether there is a need for special evaluation expertise and/or an independent assessment of the program, hence an external evaluation consultant

Framing the economic evaluation

- Define the perspective of the analysis
- Define the comparator(s)
- Determine the timeframe of the evaluation

Choosing an appropriate economic evaluation technique (refer to the flow diagram in Figure 2)

- Cost-minimisation
- Cost-effectiveness
- Cost-efficiency
- Cost-utility
- Cost-consequences
- Cost-benefit

Identifying and collecting appropriate data

- Define appropriate costs based on the perspective chosen
- Choose an appropriate method of obtaining the data

Considering other issues relevant to economic evaluation in population health

- Decide whether economic modelling is required to extrapolate costs/outcomes
- Choose a discount rate
- Decide what strategies will be used to account for uncertainty, e.g. sensitivity analysis

Interpreting the results

- Ensure that key elements are included in the evaluation report
- Decide whether the results have been interpreted correctly given the technique used and the context of the evaluation

Note that, for external evaluations, some of these decisions will be made by the commissioning agency prior to calling for a request for tender (RFT) for the evaluation. Other decisions may be made by the successful evaluator, in consultation with the commissioning agency. Which decisions are made before and after the call for applications will depend on the level of economic expertise in the commissioning agency (see section 4).

3. When to commission an economic evaluation

Whether or not a program should be formally evaluated will depend on factors such as the size of the program (including its scope and level of funding), its strategic significance, the degree of risk, resources available, timing and degree of program complexity. Appendix 1 outlines issues for consideration in deciding whether or not a program should be formally evaluated and whether an external evaluator is required. An Executive sponsor with appropriate delegation will need to approve the conduct of any proposed evaluation and the associated allocation of resources.

Additional considerations in deciding whether an economic evaluation should be undertaken include: whether it will provide the right type of economic evidence to support the investment decision at hand; whether there is already good, relevant economic evidence available; whether evidence of program feasibility and effectiveness is, or will be, available; how important economic evidence is for the investment decision to be made, given other considerations such as equity; the level of upfront investment; whether there are plans for scaling up the program and whether it will be possible to obtain the data required for the economic evaluation.

i. Will evidence from an economic evaluation support the investment decision of interest?

By enabling choices to be made across alternative programs, economic evaluation is a tool for guiding rational investment decisions in population health. Some of the investment decisions (i.e. questions) that population health decision makers are likely to encounter will be well informed by an economic evaluation. Table 1 outlines potential investment decisions of interest and associated analyses.

This guide focuses on investment decisions that may be addressed by economic evaluations and considerations relevant to these evaluations.

Table 1. Potential investment decisions and associated economic analyses

Investment decision of interest	Type of analysis	Rationale
Investing $X in a school-based smoking prevention program versus a smoking cessation program in the community	Cost-effectiveness analysis	A common outcome measure of smokers prevented can be used to evaluate both programs
How much to invest in a program to establish healthy eating habits in childcare settings versus a program targeting increased physical activity during school hours	Cost-benefit/Cost-consequences analysis	Multiple outcomes of interest that could be collapsed into a single metric (monetary values) or reported individually
Comparing a breast cancer screening program versus a road safety program	Cost-utility	Potentially complex outcome requiring assessment of both quantity and quality of life
To invest in a team of counsellors centrally located within a community compared to a telephone counselling service for people with drug addiction	Cost-minimisation analysis	Outcome may be assumed to be equivalent, thus the focus is on which program is the lowest cost option

ii. Is there already high quality, relevant economic evidence available?

An initial review may be useful to see if available economic evidence is sufficient to inform the investment decision at hand. However, as described elsewhere in this document, economic evaluations are best framed around a specific investment decision or question, should use locally relevant cost data where possible, and be based on an incremental analysis in which the comparator usually reflects current practice. Thus, economic evaluations are not designed to achieve a high degree of generalisability. When translating economic evidence from other settings, it is therefore important to account for differences in costs, practice or service variations, population characteristics and the nature of the comparator. Also the findings from previous studies need to be adjusted for inflation. The tasks of making these adjustments to existing published evidence are not inconsequential and therefore, whilst there may not be a need to conduct a new economic evaluation, work will nonetheless be required in extrapolating from the available evidence to the question at hand.

iii. Will evidence of program feasibility and effectiveness be available?

It is important to determine whether the program is in fact feasible and effective and therefore potentially worth investing in.

There are a number of aspects of feasibility that may influence whether a decision maker will want to invest in a program e.g. is there capability (human capital, resources, skills etc.) to implement the intervention? Is the intervention affordable, i.e. is the necessary funding available (as opposed to value for money)? Will the intervention be acceptable to the target population? These issues can be assessed through a process evaluation. Economic evaluation should not be undertaken if a comprehensive process evaluation has not been, or will not be, done.

Economic evaluations are highly dependent on the availability of evidence of program effectiveness. This may be based on either:

- existing evidence from the literature or a previous program evaluation,
- data to be collected prospectively within an evaluation of program effectiveness, alongside which the economic evaluation is to be conducted, or
- if necessary, data collected retrospectively about the effectiveness of a program.

iv. How important is economic evidence for the investment decision to be made?

Economic evaluation is primarily about evaluating efficiency. There are two types of efficiency that are of importance: technical efficiency and allocative efficiency. *Technical efficiency* refers to the maximum output/outcome obtained for a given program from a given set of resources. *Allocative efficiency* is about the optimal allocation of resources across a portfolio of programs so as to achieve the maximisation of benefits for that portfolio. Thus, allocative efficiency focuses on whether better outcomes can be achieved by investing more in one program and less of another. Economic evaluations generally focus on technical efficiency, although cost-benefit analysis can also address questions of allocative efficiency. Cost-utility analysis can also address allocative efficiency, although only when health outcomes are the only outcome of interest across the mix of programs being considered for investment.

In some cases, the rationale for the program in question may be based on an objective, or objectives, other than value for money. For example, equity may be an over-riding criterion for providing a program that seeks to improve health outcomes for certain disadvantaged populations.

In most cases, economic evaluations promote efficiency but do not address *equity*. *Equity* refers to fairness. Economic evaluations determine the program that maximises health gain at least cost (i.e. efficiency) for the respective population as a whole. However, population health programs often target specific groups of people (e.g. men or women, people with different socioeconomic status, Aboriginal or Torres Strait Islander populations or other social/ethnic groups), where there are inequalities in health compared to the general population. There is often a trade-off between efficiency and equity, because the most efficient program (i.e. provides the most health gain overall) is not always the most equitable as programs targeting marginalised groups may require more resources to implement and may not be as effective. Hence decision makers need to assess the results of an economic evaluation alongside other data on equity in order to ascertain a more complete picture of the social impact and investment case for a program. Although there are methods available for incorporating equity considerations alongside an economic evaluation (see Appendix 3), in practice, these are rarely deployed.[7-9]

v. What is the size of the investment in the program?

Agencies are expected to prioritise evaluation, including economic evaluation, of larger, more strategic and/or risky programs.[1] Sometimes, a policy or program in question involves little or no investment of resources, such as the enactment of public regulations or a new tax on tobacco. On the face of it, there seems to be little scope for economic evaluation of such interventions as they may appear to be 'free' or indeed revenue generating. However, it needs to be recognised that such programs potentially have implications for downstream costs to individuals, the community and the government (e.g. costs savings from reduced hospitalisations for chronic diseases, costs involved with law enforcement of the new tax). In these instances, if an economic evaluation is undertaken, the challenge is in capturing relevant costs and consequences.

vi. Are there plans for increasing the scale of the program?

Another issue to consider, which is not directly addressed in economic evaluation, is the scalability of the program. Once a program has been shown to be effective or cost-effective, it can be rolled out to a wider population than the one in which the original evaluation was carried out. The challenge is to assess how well the evaluation evidence gathered during the formal evaluation can be generalised to the program once it is scaled up. For example, will capacity constraints, such as a lack of staff, undermine the ability of governments to scale up the program? This is important in ascertaining whether the outcomes of a program that has been shown to be effective and cost-effective on a small scale will successfully translate into population-wide health improvements (see the Evidence and Evaluation Guidance Series publication *Increasing the scale of population health interventions: A Guide*.)[10]

Scalability and plans for scaling up a program may be important in the consideration of investment options, but may also inform the decision whether or not to undertake an economic evaluation, as they relate to the size of the investment and the strategic importance of the program.

vii. Will it be possible to obtain the data required for the economic evaluation?

Data collection in itself can be a significant impost and expense, and good quality data are essential for high quality economic evaluations. It is important to consider early the types of data likely to be needed for an economic evaluation and whether these data are likely to be available and accessible, or alternatively collectable, and affordable.

When to commission an external evaluator

Engaging an external evaluation consultant is important where there is a need for special evaluation expertise and/or an independent assessment of the program. It is more likely that the expertise required to conduct a high quality economic evaluation will need to be sourced from outside the commissioning agency, than for evaluations of program implementation and effectiveness.

An evaluation plan that is agreed in consultation with stakeholders can help ensure a clear, shared understanding of the purpose of an evaluation and its process (see element 3 in Appendix 2). For external evaluations, elements of the economic evaluation plan will form the basis for a request for tender (RFT) document and a contract with the successful evaluator (see Section 6.1 of the companion document *Commissioning Evaluation Services: A Guide*). Note that all of the information required for a comprehensive economic evaluation plan may not be known when preparing the RFT, and the successful tenderer may value-add to the plan. In addition, external economic expertise may need to be sourced at, or prior to, the development of the RFT for the evaluation, depending on the level of economic expertise in the commissioning agency. An external agency could provide advice on a draft RFT or could be commissioned, as a first step, to develop an economic evaluation options paper.

How much to invest in an economic evaluation

The decision of how much to invest in an economic evaluation in monetary terms should be taken on a case by case basis, given the different aims, size, perspective and scope of each program of interest. One of the key drivers of costs associated with an economic evaluation is data collection which may include linkage to patient-level healthcare utilisation data (i.e. hospital records, Medicare records, etc.). Similarly, if Quality Adjusted Life Years (QALYs)[‡] were the outcome of interest and the economic evaluation required collection of data on QALYs (as opposed to obtaining data from the relevant literature), then one needs to take into account the costs involved in administering the questionnaire (potentially at different points in time), including the associated staff costs. Other drivers of the cost of an economic evaluation include but are not limited to: modelling (if required) of the economic evaluation into the future; and conducting systematic reviews of relevant evidence. A rough estimate of cost for a program evaluation is around 10% of the program costs;[11] around 20-40% of these evaluation costs should be set aside for the economic evaluation.

4. The commissioning process

The approach to commissioning economic evaluations should follow the same processes as for other evaluations (See Appendix 2). Ideally, the economic evaluation should be planned at the same time as the development of the intervention and a data collection strategy developed to enable economic data (alongside other evaluation data) to be collected concurrently with the implementation of the program.

This guide to *Commissioning Economic Evaluations* identifies and explains considerations specific to the development of economic evaluation plans.

5. Framing the evaluation

In commissioning an economic evaluation, the prospective evaluators will need to be guided in framing the analysis. This involves a number of tasks:

i. Defining the perspective of the analysis

The perspective of the economic evaluation is the point of view from which the costs and benefits of the program are to be analysed. The economic evaluation analysis can be conducted from a range of perspectives, including, but not limited to, the agency that funded the program, the health sector, other government sectors such as housing or education, the public sector more generally, particular population subgroups or communities that the program is targeting, or in its broadest form, the societal perspective which takes into account all the costs and benefits accrued by whomever is affected by the program.

While it would be ideal to take a societal perspective,[12] in practice collecting all relevant cost and benefit information is costly and very time-consuming; the health sector is the most commonly used perspective for health economic evaluations. The choice of perspective can influence the conclusions drawn from the economic evaluation.

The commissioning agency will need to make a choice regarding the perspective. Relevant questions are:

- What is the investment question being addressed?
- Who is the decision maker using the information from the evaluation to change practice?
- Does the perspective chosen (if not societal) capture the significant costs and benefits accrued from the program?

Whichever perspective is chosen, it is important to ensure that all important costs and benefits are captured within this perspective, thus the choice of perspective dictates the data collection strategy and in particular the type of costs that are to be estimated in the evaluation (see Section 8).

By way of illustration, the implementation of a population health program could see costs and benefits realised upon a range of different parties since the achievement of population health outcomes often depends on action in non-health sectors. A healthy eating information program at school for example would impose costs for the education department and generate benefits to the health sector. The results of an economic evaluation will differ depending on the perspective taken. Although the commissioning agency may only be interested in their own particular perspective, a danger is that a program deemed to be cost-effective through the lens of a single agency may only achieve this due to a shifting of costs onto other parties. As such, even if a single agency perspective is the most relevant to the investment decision at hand, it is good practice to supplement this primary analysis with secondary analyses that look at alternative perspectives such as 'whole of government', 'health sector' and 'societal'. This will help untangle issues of cost-shifting from those of efficiency.

ii. Defining the comparator

Economic evaluation is essentially a comparative analysis between two or more different options - usually a new intervention versus the status quo or 'do nothing different' option. The comparator is generally intended to reflect current practice or what was historically done prior to the program of interest. Ultimately the question that needs to be addressed in defining the comparator is 'what would be in place if the program in question did not exist?'

It is important that the comparator is realistic. If the comparator is based on an unfavourable account of current practice, the evaluation will generate results that potentially overstate the added value and cost effectiveness of the new program.

iii. Defining the timeframe

The timeframe represents the period over which evidence of costs and outcomes will be collected. Deciding on a timeframe requires the commissioning agency to identify the potential health outcomes associated with the program, how long the program needs to be implemented to exert enough influence to achieve these outcomes, and the length of time over which these outcomes are likely to accrue. It is important to note that the costs and benefits of some population health programs can extend many years after the program has concluded. In such circumstances it may not be possible to rely completely on primary data and the health economic evaluation will need to use modelling techniques to extrapolate costs and outcomes into the future (see Section 9).

6. Selecting the appropriate economic evaluation technique

Six forms of economic evaluation applied in population health are summarised in Table 2 and then described in more detail in Section 7. Drummond et al. 2005[2] provides further reading on these economic evaluation techniques (except cost-efficiency analysis); examples of each technique from the literature are provided in text boxes in Section 7. The NSW Treasury recommends cost-benefit analysis as the preferred approach for evaluating NSW government programs because it captures social and environmental impacts, as well as economic impacts.[12]

Table 2. Summary of the key characteristics of economic evaluation methods

Type of analysis	Assessment of costs	Assessment of benefits	Characteristics	Strengths	Challenges
Cost-minimisation analysis (CMA)	Monetary units	Outcomes are assumed to be equal between alternatives and thus are not assessed	The relative costs of the program are measured with the assumption that the outcomes are equal	Simplest of all forms of economic evaluation	There are very limited circumstances where the assumption of equal health outcomes can be made
Cost-effectiveness analysis (CEA)	Monetary units	Natural health units	Allows comparisons among options with the same indicator of effectiveness. An intervention with a lower incremental C/E† ratio (ICER) is deemed preferable to one with a higher ICER	Enables comparison of programs using the same health outcomes	Limited to a single dimension of effectiveness so doesn't capture the multidimensional outcomes of most population health programs
Cost-efficiency analysis	Monetary units	Service outputs	A modification of CEA where the benefits of interest are service outputs rather than health outcomes	Focus on minimising the cost per unit of output	Does not consider potential impact on health outcomes
Cost-utility analysis (CUA)	Monetary units	QALYs/ DALYs‡	Estimates costs in monetary terms and benefits expressed as either QALYs or DALYs†	A common outcome measure is provided so that different programs can be compared	Multiple methods to evaluate quality of life which could affect results. Population health programs have additional benefits beyond that which are captured in a QALY or DALY
Cost-consequences analysis (CCA)	Monetary units	Natural health units but there may be multiple outcomes	A modification of CEA where all important outcomes are profiled so that none may be overlooked	Ensures all outcomes of importance are assessed	Difficult to determine whether a program is effective if some outcomes improve and others deteriorate
Cost-benefit analysis (CBA)	Monetary units	Monetary units	Values and compares all of the costs (C) and benefits (B) of programs in equivalent monetary terms. An intervention is considered efficient if B-C>0 or B/C>1	Comparability across programs that generate different types of benefits, inside or outside of the health sector	Difficulty in assigning a monetary value to benefits of a program

† Further details regarding how to interpret cost-effectiveness and cost-utility results are provided in Appendix 4.

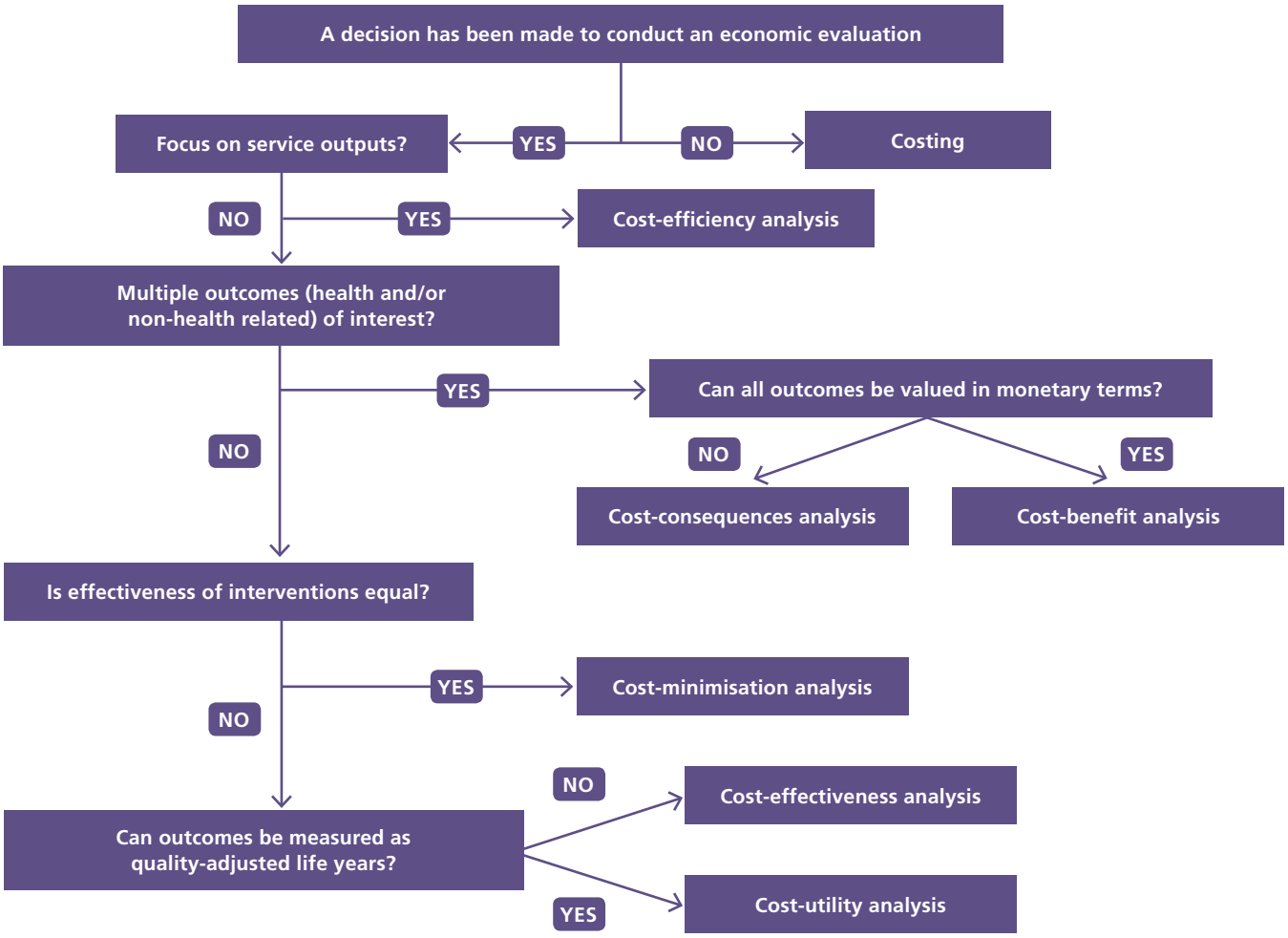
‡ See Section 7iii and Section 13 'Key definitions' for details on QALYs and DALYs.

Clark et al. have outlined a simple flow diagram to assist in choosing the appropriate economic evaluation technique for different situations.[13] This has been adapted for use in this guide (Figure 2). The particular technique to be chosen should be determined by the nature of the program alternatives under consideration for investment.

Other factors, such as the availability of relevant and reliable data, the resources assigned to the economic evaluation, the requirements of those commissioning the economic evaluation, the feasibility of the research, and the decisions that will be made using the results of the evaluation might also influence the choice of technique.

If a decision is made not to go ahead with an economic evaluation, at the very least the major elements of the program should be costed (referred to as costing in Figure 2) to provide information for program management.

FIGURE 2. Choosing an economic evaluation technique



7. Economic evaluation techniques

i. Cost-minimisation analysis

A cost-minimisation analysis (CMA) is conducted when the comparison involves two or more programs (usually including a status quo option) in which the outcomes are assumed to be, or have been demonstrated to be, equivalent and thus the comparison is made solely on the basis of cost. The program which accrues the lowest cost would be the most desirable from an economic perspective. CMA is quite a narrow form of analysis and should be undertaken with caution as the assumption of equivalent outcomes is often difficult to justify.

Example of cost-minimisation analysis

Mariño et al. undertook a cost-minimisation analysis comparing a new community-based oral health promotion program versus usual-practice among immigrant older adults in Melbourne, Australia.[14] The intervention program incorporated oral health seminars; one-to-one oral hygiene sessions demonstrating tooth brushing and dental flossing; and the provision of relevant oral health products. Usual practice was non-tailored one-on-one chairside oral hygiene instruction at a public dental clinic over 6 weeks. The outcome of interest (assumed equal between the two groups) was a reduction in gingival bleeding.

The cost-minimisation analysis found that the community-based intervention would cost $69.65 per participant, whereas the chairside instruction would cost $401.85. The program would therefore result in a saving of $332.20 per person in favour of the community-based intervention over a six-week period.

ii. Cost-effectiveness analysis

A cost-effectiveness analysis (CEA) is carried out when programs being compared are similar to the extent that their outcomes can be valued in the same units of health gain. Typically, cost-effectiveness analysis produces an incremental cost-effectiveness ratio presented in terms of a cost-per-unit of health outcome gained relative to the comparator (e.g. incremental cost per case prevented or incremental cost per life year gained). This is the most common form of economic evaluation in health. Its advantage is that it provides a fairly transparent means of comparing the costs and outcomes of interventions. However, a potential weakness of CEA is the lack of comparability of the relative value of health outcomes across different programs (e.g. incremental cost per fall prevented compared to incremental cost per death averted).

A variation of CEA is cost-efficiency analysis. It compares options in terms of cost relative to a common measure of output e.g. client visited, service delivered, procedure performed etc. It differs from conventional CEA because its focus is on service outputs rather than health outcomes. The objective with efficiency analysis is that the focus is on achieving the lowest cost per unit of output, the assumption being that potential differences in health outcomes between options either do not exist, are difficult to measure or are irrelevant to the question at hand. In health economics this category of evaluation tends to be grouped under CEA.

Example of cost-effectiveness analysis

The "Healthy Beginnings Trial" (HBT) by Hayes et al., set out to determine the cost-effectiveness of an early-childhood obesity prevention program delivered to families in socioeconomically disadvantaged areas of Sydney, Australia.[15] The economic evaluation was a complete-case analysis (i.e. patients were followed up for the length of the study) of the costs and cost-effectiveness of the intervention during the intervention phase, up to age 2 years only. The perspective was that of the health care funder.

Height and weight were measured for the infant patients at 2 years of age to calculate comparative body mass index (BMI). The direct costs of delivering the intervention over 2 years included staff time, vehicle purchase, vehicle running costs for home visits, costs of training community nurses, educational materials, and equipment costs of scales and portable stadiometers. Downstream costs due to healthcare utilisation by participants were assessed through analyses of de-identified claims details for individual patients under the Medicare Benefits Schedule (MBS) and Pharmaceutical Benefits Scheme (PBS) and data linkage to the NSW Admitted Patient Data Collection, for hospitalisations and the NSW Emergency Department Data Collection, for emergency presentations.

A discount rate of 5% per year was used.

The cost of the intervention over 2 years was $1,309 per child. The mean (95% Confidence Interval) costs of other healthcare, over the first 2 years of life, were $2,706 ($2,238-$3,175) in the intervention group and $2,582 ($2,199-$2,964) for usual care. The incremental cost-effectiveness ratio (ICER) was $4,230 per unit of BMI avoided based on results from the trial. Under a more realistic model of intervention delivery with shorter travel times for home visits, the ICER was $2,697 per unit of BMI avoided.

iii. Cost-utility analysis (QALYs & DALYs)

Cost-utility analysis (CUA) is one means of addressing a limitation of cost-effectiveness analysis: namely, its limited comparability based on its reliance on a single, program-specific measure of outcome. CUA uses either Quality Adjusted Life Years (QALYs) or Disability Adjusted Life Years (DALYs) as outcome measures and these can be employed as a means of comparing across diverse sets of programs.

QALYs are a measure of health outcomes in which life expectancy, in terms of life years, is weighted by an index of quality of life and measured on a scale in which 1 represents full health and zero represents health states equivalent to death. For instance, if an intervention results in a 10 year gain in life-expectancy but the quality of life of each of those life-years was valued at 0.5, then the QALY gain over a 10 year period is deemed to be 5. Cost-utility analysis enables comparison of diverse interventions because it accounts for both length and quality of life. It also enables comparison across programs which are focused on different areas of population health as the benefits are measured with the same units (QALYs or DALYs).

QALYS are recommended for use in economic evaluations of health regulatory programs in guidelines produced by the Pharmaceutical Benefits Advisory Committee (PBAC) in Australia and the National Institute for Health and Clinical Excellence (NICE) in the UK.

There are a number of methods available for assessing quality of life for the purposes of estimating QALYs. The method generally recommended for health technology assessment (including by the Australian PBAC) is the use of a multi-attribute utility index (MAUI) such as the Euro-Qol 5D (EQ-5D), Health Utilities Index Mark 3 (HUI3), SF-6D or the Assessment of Quality of Life (AQoL), which are questionnaires used to generate preference-based measures of health status and health-related quality of life to estimate QALYs in economic evaluations. In principle there is no reason why these measures cannot be used in population health, although in practice it is unlikely that changes in these outcomes will be seen within the limited timeframe of most studies. Further information on these measures can be found in the Useful Resources section.

DALYs are a measure of overall disease burden, which is expressed as the number of years that are lost due to ill-health, disability or early death. They were developed by the World Health Organization (WHO) primarily to enable assessments of the global burden of diseases. A DALY can be thought of as the equivalent of one lost year of "healthy life". DALYs can be measured as the sum of the years of life lost (YLL) due to premature mortality in the population and the years of life lost due to disability (YLD) for people living with the health condition or its consequences. The sum of DALYs measured across a population is the gap between the current health status of the population and the "ideal" situation where the entire population lives to an advanced age, free of ill-health or disability. However, DALYs have also been used in economic evaluation whereby the disability weights used in the assessment of DALYs for a particular disease are used to weight years of life lost. Such weights are based on pre-assigned values generated by the WHO and operate in much the same manner as the quality of life weights used to assess QALYs, except in reverse, where the DALYS are assessed in terms of the number averted, whilst QALYs are assessed in terms of the number gained.

Example of cost-utility analysis

a) QALYs

Dalziel et al. conducted a modelled cost-utility analysis in New Zealand to determine whether a physical activity counselling program was cost-effective in general practice.[16] The cost-utility of the intervention was compared with "usual care" (assumed to be the patient being routinely seen in primary care).

The economic evaluation took a health system perspective, with the effectiveness of the program based on published trial data of 878 inactive patients who presented to general practice, with costs collected as part of the trial. The trial was over a period of 12 months, with a Markov Model developed to extrapolate over an individual's lifetime (see Section 9). The main outcome measure was cost per QALY gained. The incremental cost-utility of the program was NZ $2,053 per QALY.

The study found that if decision makers were willing to pay at least NZ $2,000 per QALY, the program was likely to be better value for money than usual care.

b) DALYs

Lal et el. conducted a cost-utility analysis, from a health system perspective, using a deterministic model to assess the impact of tobacco control programs on costs and health.[17] The analysis was a cost-effectiveness study evaluating the impact of a call-back counselling service for smoking cessation (which included multiple counselling sessions and self-help materials) as part of the "Quitline" in Queensland, Western Australia and the Northern Territory, compared to current practice. Current practice was defined as provision of counselling if requested through the initial call to Quitline.

The cost-utility analysis assessed the potential impact of varying tobacco control interventions on costs and health using data from a similar counselling service in Victoria and the literature. Varying estimates of efficacy and cost from these sources were used and current practice was used as the comparator. The outcome measure was disability adjusted life years (DALYs) averted over a lifetime. Costs were obtained and adapted from the Victorian study which included telephone counsellors, team leaders, recruitment of smokers by GPs and counselling sessions with smokers. Costs and benefits were adjusted to 2010 Australian dollars, with a discount rate of 3%.

The introduction of call-back counselling for smoking cessation in Quitlines achieved net cost savings due to the cost offsets being greater than the cost of the intervention. The study found that even where the cost offsets (the projected healthcare costs that would have resulted in the absence of the intervention) were excluded, the cost per quitter is $773 and the incremental cost–effectiveness ratio was $294 per DALY.

iv. Cost-consequences analysis

Cost-consequences analysis (CCA) recognises that there are often multiple outcomes from an intervention, which may include a range of health and/or non-health benefits. This form of economic evaluation may appeal to population health decision makers due to the multi-dimensional outcomes of their programs. CCA involves estimating changes resulting from an intervention across each type of outcome, measured in their natural units. This type of evaluation is particularly useful for interventions where, in addition to health gain, an objective may be to initiate other valuable changes within an organisation or community,[18] for example, the encouragement of volunteer activity through a health promotion program. The general limitation of cost-consequences analysis is that because it uses multiple measures of outcome it does not always provide decision makers with a clear indication on whether or not to invest. It is often employed as a supplement rather than as an alternative to approaches such as CEA or CUA, which reduce the evaluation to single numerical value i.e. a cost-effectiveness or cost-utility ratio. Ideally, a CCA is conducted with a pre-specified protocol outlining the outcomes (or 'consequences') of interest, along with the rationale for their inclusion.[19]

Example of cost-consequences analysis

Moss et al. performed a cost-consequence analysis of providing women with mild gestational diabetes mellitus with dietary advice, blood glucose monitoring and insulin therapy as needed, compared with routine pregnancy care, using data from a multi-centre randomised clinical trial in Australia.[20]

Primary clinical outcomes were perinatal deaths, serious perinatal complications, admission to neonatal nursery, jaundice requiring phototherapy, induction of labour and caesarean delivery. Economic costs measured were outpatient and inpatient hospital costs.

The results showed that for every 100 women who were offered the intervention in addition to routine obstetric care, $53,985 additional direct costs were incurred at the hospital and $6,251 additional costs were incurred by women and their families. There were 2.2 fewer babies who experienced serious perinatal complications and 1.0 fewer babies experiencing perinatal death for every 100 women. The study found that the additional costs associated with achieving reductions in perinatal mortality and serious complications were justified.

v. Cost-benefit analysis

A cost-benefit analysis (CBA) is the broadest form of economic evaluation and is typically carried out using a societal perspective (i.e. including costs and benefits to all individuals and agencies in society). Like cost-consequences analysis, cost-benefit analysis may be of particular value in population health where programs often seek to achieve a diverse set of outcomes. The defining characteristic of cost-benefit analysis is that it values the benefits of programs in monetary terms. Strictly, all costs and benefits should be included however, studies labelled as cost-benefit analyses often measure only those costs and benefits that can be easily monetised and miss relevant outcomes that are not amenable to such valuation, creating bias in the evaluation.

As costs and benefits are valued in the same (monetary) units, the advantage of cost-benefit analysis is that it provides a simple decision rule for decision makers: if benefits to society exceed the costs to society, then the program should be funded and vice versa (although other factors such as feasibility and equity may need to be considered). In relation to health programs this means undertaking the potentially contentious task of valuing lives saved or other dimensions of health in dollar terms (see Appendix 5 for discussion of methods used to derive such monetary values).

Example of cost-benefit analysis

Wang et al. conducted a cost-benefit analysis, from a public health perspective, of physical activity using bike or pedestrian trails to reduce health care costs associated with inactivity in Lincoln, Nebraska, USA.[21]

The cost of construction and annual maintenance of five bike/pedestrian trails was obtained from the city's Recreational Trails Census Report and the literature. The trails were assumed to last for 30 years with the construction costs allocated evenly over that period. The annual cost of using the trails which included construction and maintenance was US$209.28 per user. The direct health benefit was measured using the estimated difference in the direct medical cost for active persons and their inactive counterparts. Using the National Medical Expenditure Survey, the difference was estimated to be US$564.

Sensitivity analysis was conducted using worst and best-case scenarios for key parameters (construction and maintenance of trails, equipment and travel costs, direct health benefit, the life of the trails).

The benefit-cost ratios ranged from 1.65 to 13.40 with an average of 2.94. This study showed that every US$1 invested in trails subsequently resulted in a greater return in direct medical benefit.

8. Collecting cost data

The accuracy and usefulness of cost data can be substantially improved if methods for its collection are planned prior to program implementation, for example, the development of surveys or diaries for recording costs and the processes surrounding ethics approval and consent to release data. This allows the collection of cost data to be built into program delivery.

It is important when costing an intervention to consider all the types of costs that may be incurred that are relevant to the intervention.

Costs can be categorised into four types:

1. **Direct costs:** Costs incurred in implementing and running the intervention (e.g. staff, consumables, drugs, etc).
2. **Indirect costs:** The economic burden incurred by individuals, family and community associated with an illness or condition (e.g. time off work, lost educational opportunities).
3. **Cost offsets:** Healthcare costs experienced by patients downstream from the intervention e.g. the direct costs of a screening intervention that identified and subsequently treated patients at risk of cardiovascular disease with a lipid-lowering medication would be offset, at least partially, by lower downstream costs arising from reduced hospitalisations for cardiovascular disease.
4. **Non-healthcare cost offsets:** costs incurred in other sectors as a result of the intervention e.g. reduced costs of incarceration due to a program to prevent illicit drug use.

Guidance on how to collect direct and indirect costs associated with large-scale health programs can be found in *Issues in the Costing of Large Projects in Health and Healthcare*.[22]

There are three methods by which data on healthcare utilisation for the purposes of assessing cost offsets can generally be obtained. These methods may also provide information about indirect costs and non-health cost offsets:

i. Patient Diaries

Patient diaries are a method used to ascertain health care utilisation. They involve, for example, patients recording whether they had any doctors' visits or how much they spent on medications. Diaries could be completed at regular intervals, for example every 3 or 6 months throughout the intervention period. An appropriate value for the cost of a doctor's visit would then be applied to all patients. The disadvantages of diaries are that they may be subject to recall error, patients may not maintain their diaries (resulting in a large amount of missing data), and they are burdensome for patients. Administrative support to follow-up with patients to ensure diaries are maintained is also required throughout the study.

ii. Linked data

Linkage of routinely collected data is a relatively quick and cost effective method for obtaining data on healthcare utilisation. Linked data can be used to investigate the effectiveness of prevention and screening programs, and the patterns, costs and outcomes of health care for people with specific conditions such as diabetes, cancer and heart failure. Linkage of health data with data from other agencies, such as education, aged care and community services, can be used in evaluation projects to study the broader outcomes of ill health and disability.

Use of linked routinely collected data avoids the prohibitive cost and time of establishing new studies. To the extent that these datasets provide coverage of complete populations the outputs of record linkage studies avoid some of the potential biases associated with unrepresentative or incomplete samples compared with traditional study designs.

In NSW it is possible to obtain linked records for a range of health and health-related data collections, such as patient hospitalisations, emergency department presentations and death records through the Centre for Health Record Linkage (CHeReL). Cost weights can be attributed to the Australian Diagnosis Related Group (AR-DRG) codes for the cause of hospitalisation. These can be found on the Independent Hospital Pricing Authority (IHPA) website.[23]

Medicare linkage can be used to obtain costs of individuals' utilisation of non-hospital health services and medications. The cost of doctor and specialist visits, tests and diagnostics can be obtained from the Medicare Benefits Schedule (MBS) claims and the cost of medicines from Pharmaceutical Benefits Scheme (PBS) claims. A complete record of claims is obtained and it provides both funder (government) costs and out-of-pocket costs. A limitation of linked data is cost of medicines are not recorded when there is no government contribution; this will apply to general patients (i.e. non concession card holders) for medicines that cost less than the threshold. Hence out-of-pocket costs for these patients will be underestimated. Another limitation is that Medicare only holds a maximum of four and a half years of retrospective claims, which may be restrictive given the long time horizon of many population health programs.

iii. Published cost information

Published costs studies can be used to inform an economic evaluation, if the costs collected are suited to the evaluation. Published cost information can be collected from different sources: e.g. academic literature reporting costs collected from a previous economic evaluation, randomised controlled trial or cohort based study using the techniques listed above; health ministry websites that report the costs involved with undertaking a health-related procedure, pharmaceuticals or wages of medical staff. It is important to note that if the studies were conducted in another country and thus another currency, the costs must be made relevant to their country of context using the purchasing power parity conversion factor.[24] Similarly, the inflation will need to be taken into account in order to convert the published costs data into today's costs. This can be done using a consumer price index, which is available online from the Australian Bureau of Statistics.[25]

9. Other issues relevant to economic evaluation in population health

i. Economic modelling to extrapolate costs and outcomes

Often economic modelling is required within health economic evaluation as a means of generating estimates of long term costs and benefits. Notably, this is standard practice in Australia for demonstrating the cost-effectiveness of health technologies for listing on the Pharmaceutical Benefits Scheme (PBS) and Medicare Benefits Schedule (MBS). There are three main reasons why evidence from individual studies may need to be augmented with external evidence (such as through literature review) to enable modelled estimates of the costs and health benefits of an intervention to:

- adjust for potential differences between study and policy sites in terms of population characteristics and circumstances of use,
- extrapolate long term costs and outcomes of the intervention given that the duration of studies, particularly in population health, may not be long enough to capture all relevant costs and benefits, and
- transform study endpoints, that are often intermediate outcomes (i.e. changes in the level of physical activity in the case of population health programs involving exercise, or biological markers such as blood pressure), into generalisable *health* endpoints, such as reduction in disease events, Quality Adjusted Life Years or survival.

A number of techniques are available to carry out the modelling, including decision tree analysis, Markov modelling and Monte Carlo simulation. These involve the consolidation of multiple sources of evidence and as such, the validity of economic models is constrained by the quality of data available. Given the health benefits of population health programs are likely to be long term and subject to multiple influences, economic modelling has the advantage of being able to capture some of this complexity to an extent not possible through individual studies. Further information on these techniques can be found in the Useful Resources section.

ii. Discounting

Discounting is an adjustment made to the value of costs and outcomes occurring in the future and is standard practice in economic evaluation. One rationale for discounting is based on the assumption that society places a lower value on events that occur in the future than those that occur in the present (in terms of both costs and outcomes). That is, they would rather enjoy benefits now than deferring them into the future. In practice, both costs and outcomes should be discounted, for both the intervention and the comparator program.

The cost-effectiveness of population health programs is often particularly sensitive to discounting, and the rate that is used, as outcomes could occur many years in the future.

For example, Torgerson and Raftery demonstrated the effects of discounting on the cost-effectiveness of hip fracture prevention.[26] The undiscounted cost-effectiveness ratio for 10 years of hormone replacement therapy was estimated at £7,362 per QALY, whereas at a 6% discount rate, the discounted cost-effectiveness ratio was estimated at £42,374 per QALY. The NSW Treasury recommends a 7% discount rate (in real terms).[12] The recommended discount rate can differ according to the country or state in which the economic evaluation is conducted, e.g. the Australian Department of Health uses 5%[27] and the UK has a recommended discount rate of 3.5% for both costs and benefits. Different discount rates should be tested in sensitivity analyses to determine whether they have an impact on the results. The NSW Treasury recommends sensitivity testing of discount rates at 3% and 10% (in real terms) to test how robust the results are at these different rates.[12]

iii. Sensitivity analyses

All economic evaluations are subject to uncertainty. Assessing the impact of uncertainties on the results of an economic evaluation is therefore considered standard practice. Sensitivity analysis is conducted in economic evaluations to ensure that the results generated do not change drastically if the values of underlying variables, or assumptions made in the economic evaluation, are changed. It also identifies which variables contribute most to the uncertainty around the results of the economic evaluation.

One-way sensitivity analysis explores the impact on results if an assumed parameter is adjusted. For example, would a program remain a cost-effective intervention if the discount rate was varied from 5% to 10%? Other parameters that could be tested are:

- the uncertainty around the value of certain costs attributed to the intervention,
- the uncertainty around the effectiveness of the intervention, and
- the time horizon of the study (whether the intervention is beneficial in the short or long-term).

More advanced sensitivity analyses can be conducted with the availability of individual-level data combined with modelling approaches. Probabilistic sensitivity analysis (PSA) is an example of such a technique and is described in detail by Briggs et al.[28] PSA is now part of the guidance provided by the National Institute of Health and Clinical Excellence in the UK.

10. Interpreting the results of an economic evaluation

The fundamental reason for commissioning an economic evaluation is to inform health policy and program decisions for the benefit of the NSW public. To this end the report of the evaluation should contain key inclusions such as those recommended by the International Society for Pharmacoeconomics and Outcomes Research (ISPOR) in their checklist for reporting standards for health economic evaluations.[29]

A comprehensive report will allow readers, including the commissioning agency, to assess whether:

- fair comparisons have been made,
- the appropriate technique has been used,
- they agree with the assumptions on which the economic evaluation was based,
- appropriate methods were employed to account for uncertainty, and
- results have been interpreted correctly given the technique used and the context of the evaluation.

Within the description of the economic techniques included in this guide, examples of typical results arising from the technique have been provided, along with information to assist in the interpretation of the results.

Depending on the level of economic expertise in the commissioning agency, it may be prudent to seek independent economic advice on the quality of the evaluation report and the interpretation of the findings.

It is important to emphasise that economic evaluations provide evidence around whether a program of interest is worth investing in compared to alternatives. To this end, economic evaluations can provide a rational framework for decisions about investments. However, evidence from an economic evaluation should be considered alongside other evidence in making investment decisions, such as information on program feasibility and effectiveness, and equity considerations which may be relevant to the investment decision of interest.

11. Useful resources

Economic Evaluation

- NSW Treasury. *NSW Government Guide to Cost-Benefit Analysis: Policy and Guidelines Paper.* Sydney: NSW Treasury, 2017. Available online: https://www.treasury.nsw.gov.au/sites/default/files/2017-03/TPP17-03%20NSW%20Government%20Guide%20to%20Cost-Benefit%20Analysis%20-%20pdf_0.pdf
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NSW Government Evaluation resources

- NSW Government. *NSW Government Program Evaluation Guidelines.* Sydney: NSW Department of Premier and Cabinet, 2016. Available online: http://arp.nsw.gov.au/sites/default/files/NSW%20Government%20Program%20Evaluation%20Guideline%20January%202016_0.pdf
- NSW Government. *Circular C2016-01- Program Evaluation.* Sydney: NSW Department of Premier and Cabinet, 2016. Available online: http://arp.nsw.gov.au/c2016-01-program-evaluation
- NSW Government. *NSW Government Evaluation Toolkit.* Sydney: NSW Department of Premier and Cabinet, 2016. Available online: http://www.dpc.nsw.gov.au/programs_and_services/policy_makers_toolkit/evaluation_toolkit
- NSW Agency for Clinical Innovation (ACI). *Understanding Program Evaluation: An ACI Framework.* Sydney: Agency for Clinical Innovation, 2013. Available online: http://www.aci.health.nsw.gov.au/__data/assets/pdf_file/0008/192437/Framework-Program-Evaluation.pdf

Evidence and Evaluation Guidance Series

- Centre for Epidemiology and Evidence. *Commissioning Evaluation Services: A Guide.* Evidence and Evaluation Guidance Series, Population and Public Health Division. Sydney: NSW Ministry of Health, 2017. Available online: http://www.health.nsw.gov.au/research/Pages/evaluation-guide.aspx
- Centre for Epidemiology and Evidence. *Increasing the scale of population health interventions: A Guide.* Evidence and Evaluation Guidance Series, Population and Public Health Division. Sydney: NSW Ministry of Health, 2014. Available online: http://www.health.nsw.gov.au/research/Pages/scalability-guide.aspx

Multi-attribute utility instruments

- EuroQol. *EQ-5D.* Available online: http://www.euroqol.org/
- Health Utilities Inc. *Health Utilities Index Mark 3 (HUI3).* Available online: http://www.healthutilities.com/
- Assessment of Quality of Life. *AQoL*. Available online: http://www.aqol.com.au/
- Brazier J, Usherwood T, Harper R, Thomas K. Deriving a preference-based single index from the UK SF-36 Health Survey. *Journal of Clinical Epidemiology* 1998; 51(11): 1115–1128.
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NSW Gateway Policy

- NSW Treasury. *NSW Gateway Policy: Policy and Guidelines Paper.* Sydney: NSW Treasury, 2017. Available online: http://arp.nsw.gov.au/sites/default/files/TPP17-01_NSW_Gateway_Policy.pdf

Health economic modelling resources

- Drummond MF, Sculpher MJ, Torrance GW, O'Brien BJ, Stoddart GL. *Methods for the economic evaluation of health care programmes*. Oxford: Oxford University Press, 2005.
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Interpreting cost-effectiveness results

- Cohen D, Reynolds M. Interpreting the results of cost-effectiveness studies. *Journal of the American College of Cardiology* 2008; 52(25): 2119–2126.

Linked data

- The Centre for Health Record Linkage (CHeReL) http://www.cherel.org.au
- NSW Health support services: Electronic medical record web-based training site http://nswhealth.moodle.com.au/DOH_HSS/eMR/wbt/index.php/home
- Australian Institute of Health and Welfare: Australian Refined Diagnosis-Related Groups (ARDRG) http://www.aihw.gov.au/hospitals-data/ar-drg-data-cubes/

Costing issues

- NSW Department of Health. *Issues in the Costing of Large Projects in Health and Healthcare.* Sydney: Centre for Health Economics Research and Evaluation, 2009. Available online: http://www.health.nsw.gov.au/research/Publications/costing-large-projects.pdf.
- Mihaylova B, Briggs A, O'Hagan A, Thompson S. Review of statistical methods for analysing healthcare resources and costs. *Health Economics* 2011; 20: 897–916.
- OECD.Stat. *Purchasing power parities for GDP and related indicators.* Available online: http://stats.oecd.org/Index.aspx?DataSetCode=PPPGDP
- Australian Bureau of Statistics. *Consumer price index, Australia, 6401.0.* Available online: http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/6401.0Sep%202013?OpenDocument
- The Pharmaceutical Benefits Scheme. *Manual of Resource Items and their Associated Unit Costs.* Available online: http://www.pbs.gov.au/info/industry/useful-resources/manual. [includes drugs, medical and hospital services]

Sensitivity analysis

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Discounting

- Torgerson D, Raftery J. Discounting. *BMJ* 1999; 319(7214): 914–915.

Checklist for reporting standards in health economic evaluations

- Husereau D, Drummond M, Petrou S, Carswell C, Moher D, Greenberg D, Augustovski F, Briggs AH, Mauskopf J, Loder E. ISPOR Task Force Report. Consolidated Health Economic Evaluation Reporting Standards (CHEERS)—explanation and elaboration: a report of the ISPOR Health Economic Evaluation Publication Guidelines Good Reporting Practices Task Force. *Value in Health* 2013; 16 (2): 231–50. Available online: http://www.ispor.org/ValueInHealth/ShowValueInHealth.aspx?issue=3D35FDBC-D569-431D-8C27-378B8F99EC67

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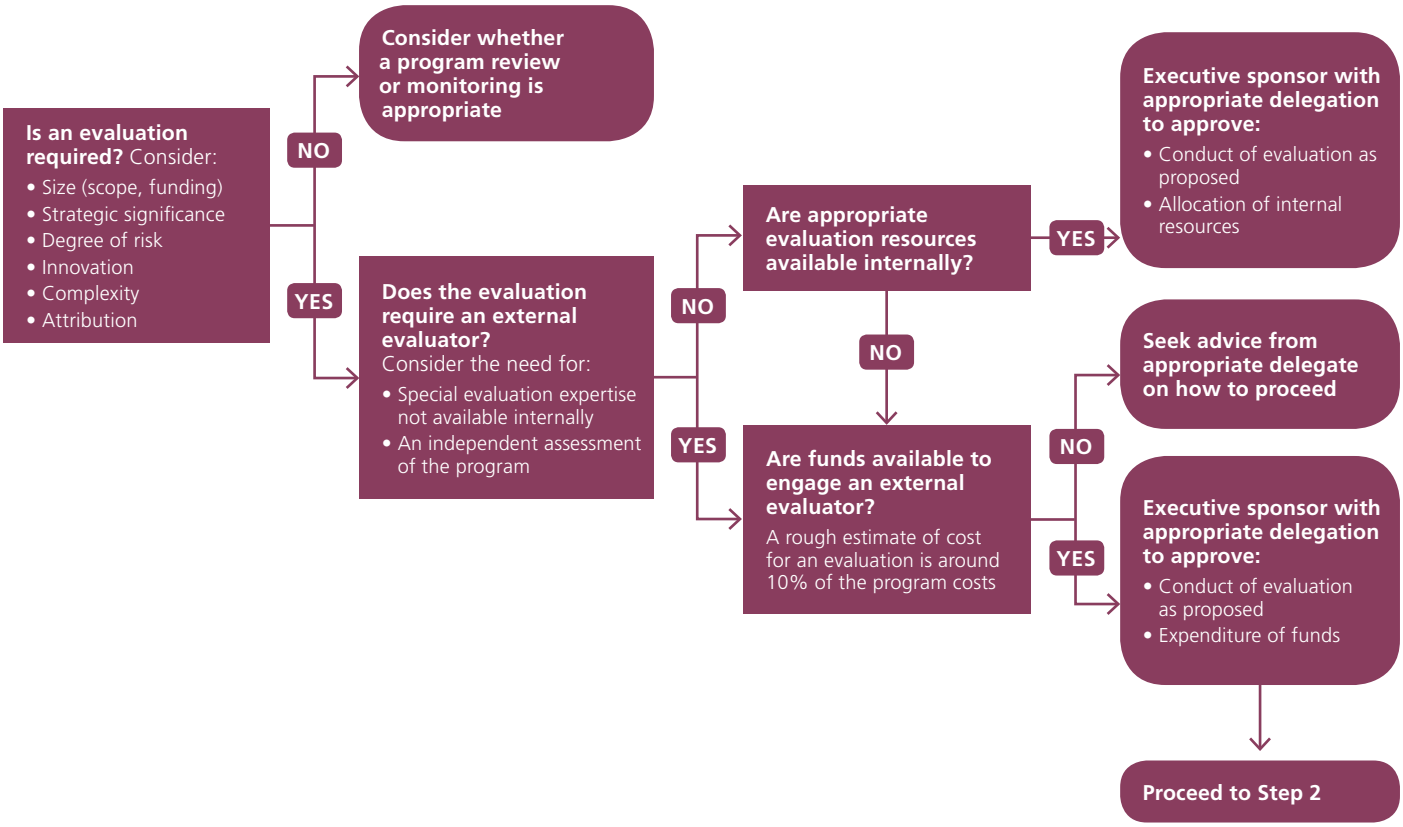
13. Key definitions

- **Comparator:** An alternative against which one compares costs and outcomes of a health program for the purposes of economic evaluation. Typically, the comparator is defined as a status quo option (current practice or in a clinical setting, standard care)
- **Costs, direct:** The amount of money spent on the design and implementation of the program in question
- **Costs, indirect:** The economic burden incurred by individuals, family and community associated with an illness or condition (e.g. time off work, lost educational opportunities). It is not common practice to factor such costs into health economic evaluations. Whether or not to do so depends on the underlying policy question
- **Costs, offsets:** Costs experienced by patients downstream from the intervention as a result of an effective program which would hypothetically result in lower long term hospitalisation and other health service costs thereby offsetting its direct costs
- **Cost-benefit analysis:** A method of economic evaluation designed to assess the case for investment in a program by valuing the social and health benefits of programs in monetary terms. A program is deemed a worthwhile investment if the value of such benefits are found to exceed costs
- **Cost-consequence analysis:** A form of economic evaluation in which the costs of the program are measured and presented alongside multiple indicators of outcomes attributed to the program. This form of evidence provides wide-ranging but less definitive guidance on whether or not to invest than say cost-benefit or cost-utility analysis
- **Cost-effectiveness analysis:** A method of economic evaluation that estimates costs in monetary terms and benefits expressed in a single unit of health outcome e.g. cost per life saved, cost per road crash prevented, etc.
- **Cost-efficiency analysis:** A variation of cost-effectiveness analysis, differing only in that the outcome of interest is a service output (e.g. achieving a targeted level of population coverage) rather than a health outcome
- **Cost-minimisation analysis:** A form of economic evaluation that assumes the outcomes between the program in question and its comparator are equal and thus compares the two only on the basis of cost
- **Cost-utility analysis:** A method of economic evaluation that varies from cost-effectiveness analysis in one way, i.e., the outcome of interest is either a Quality Adjusted Life Year or a Disability Adjusted Life Year
- **Disability adjusted life years (DALYs):** A measure of overall disease burden, expressed as the number of years lost due to ill-health weighted by a measure of disability associated with the disease in question
- **Discounting:** An adjustment made to the value of costs and outcomes occurring in the future. In practice, both costs and outcomes should be discounted, for both the intervention and the comparator
- **Economic evaluation:** The comparative analysis of alternative courses of action in terms of both their costs and consequences
- **Efficiency, allocative:** Refers to the optimal allocation of resources across a portfolio of programs in order to achieve the maximisation of benefits for that portfolio
- **Efficiency, technical:** Refers to the maximum output obtained for a given program from a given set of resources
- **Equity:** Refers to the notion of fairness in the way in which resources are distributed for programs. Although there is no one single criterion for fairness or equity, it is usually associated with a prioritisation of programs that benefit disadvantaged population groups
- **Incremental cost-effectiveness ratio (ICER):** This is the way in which the findings of a cost-effectiveness analysis are presented. It is difference between the cost of the program and its comparator as a ratio over the difference between the outcomes of the program and its comparator
- **Life years:** A modified mortality measure where the remaining life expectancy (measured in years) at a given point in time is taken into account
- **Opportunity cost:** The cost associated with a loss of other alternatives when one alternative is chosen
- **Option appraisal:** A technique used to review the program options and analyse the costs and benefits of each one to inform decision makers. The process allows debate and clarification of the objectives of any policy, of the relative importance of different objectives, the identification of the relevant effects both positive and negative of different options, the weights to be attached to these effects and a way of bringing all of this together to be able to form an overall assessment of the relative worth of different options for addressing the issue or problem to hand
- **Perspective:** The point of view from which the costs and benefits of the economic evaluation are recorded and assessed
- **Quality Adjusted Life Years (QALYs):** A measure of disease burden which includes both the quality and quantity of life lived. It is a score between 0 (equivalent to death) and 1 (full health)
- **Sensitivity analysis:** Conducted as part of an economic evaluation, its aim is to test the robustness of study findings to variations in key assumptions made during the analysis. It can be used to assess uncertainty as well as the generalisability of the findings
- **Time frame:** Represents the period over which evidence of costs and outcomes will be collected

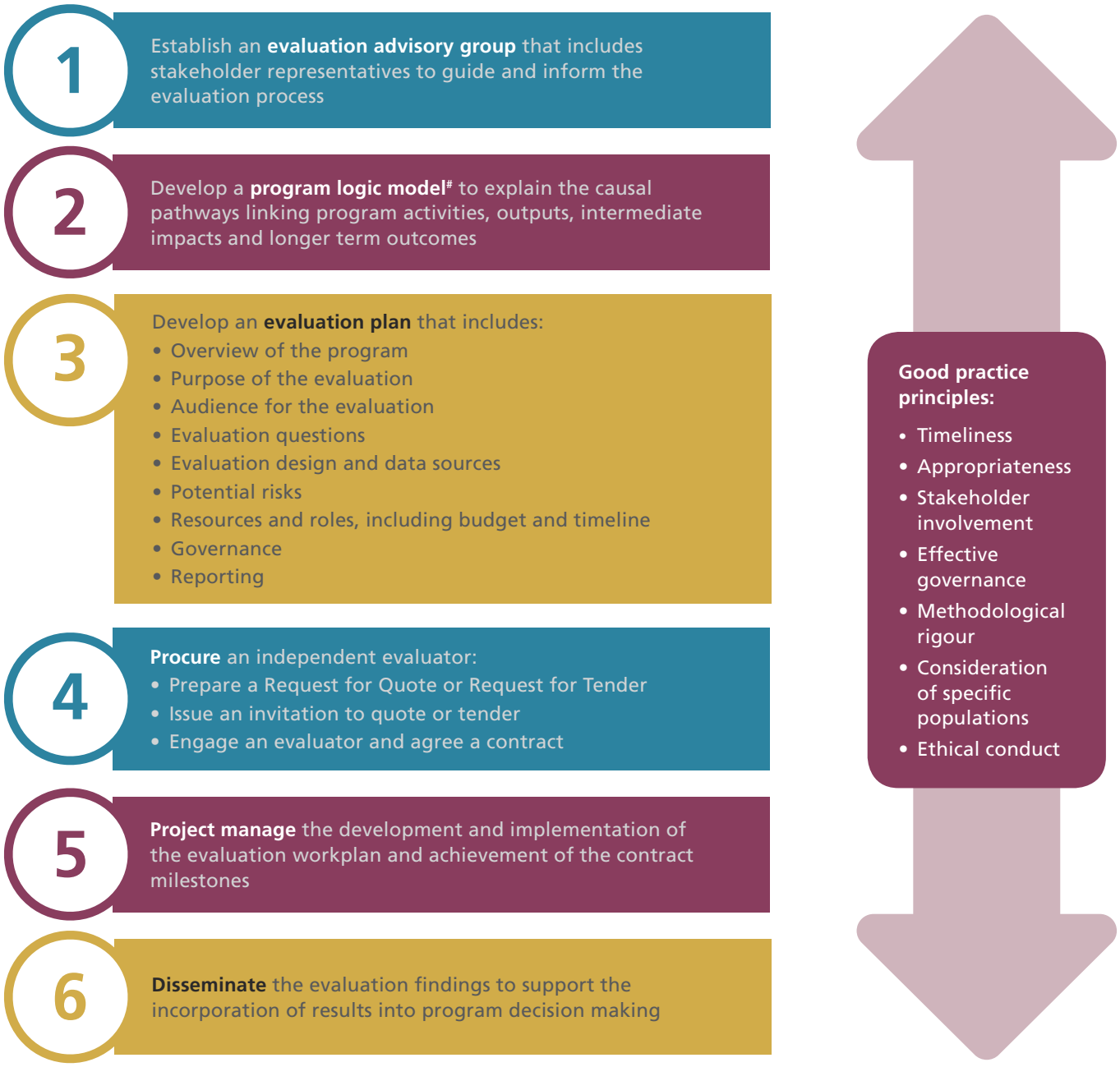
14. Appendices

APPENDIX 1. Step 1 – Pre-evaluation assessment[§]



[§] Centre for Epidemiology and Evidence. *Commissioning Evaluation Services: A Guide*. Evidence and Evaluation Guidance Series, Population and Public Health Division. Sydney: NSW Ministry of Health, 2017.

APPENDIX 2. Step 2 – Commissioning a population health program evaluation**



** Centre for Epidemiology and Evidence. *Commissioning Evaluation Services: A Guide*. Evidence and Evaluation Guidance Series, Population and Public Health Division. Sydney: NSW Ministry of Health, 2017.

Ideally a program logic model should be developed in the program planning phase.

APPENDIX 3. Incorporating equity considerations alongside an economic evaluation

Cookson et al.[††] provide three approaches to providing evidence in relation to equity considerations that can be used alongside an economic evaluation:

Review of background information on equity

This approach is the least costly and easiest to do as it does not involve the generation of any new quantitative evidence. Instead, it requires an outline and review of relevant equity considerations and background information that might be useful to decision-makers.

Background information may include patterns and causes of the type of health inequality being studied, information on the effects of similar interventions on inequality in other settings and the views of stakeholders on how important reducing a health inequality is compared to other potential uses of scarce resources that would benefit a population.

Health inequality impact assessment

This approach looks at the impact the intervention is likely to have on health inequalities. As generation of new quantitative evidence is required, it is more complex than reviewing background information on equity. Here, standard evaluation methods can be used to determine the effectiveness or cost-effectiveness of an intervention across equity-relevant subgroups (e.g. socioeconomic status, ethnicity, age or gender).

Tugwell et al.[*] has proposed a method using existing epidemiological studies. One difficulty that may arise when using this approach is that some trials or studies may not look at the effect of an intervention on particular subgroups but rather, the average effect on the general study population. Where resources are available, simulation modelling can be used by combining data on existing patterns of health inequality and data on cost-effectiveness of the intervention for particular subgroups.

Analysis of the opportunity cost of equity

The aim of this approach is to estimate the opportunity cost of a particular equity consideration by looking at how important it is. This is determined by looking at what was forgone by the population in order to pursue the equity consideration. Cookson et al.[††] provide the example of Quality Adjusted Life Years (QALYs) that would be forgone in order to pursue an equity option instead of a QALY maximising option.

An advantage of this approach is that it is flexible and can be used to answer other questions beyond equity considerations. A disadvantage of this approach is that it does not look at benefits, only the cost of the equity consideration. This approach can be applied using standard methods of cost-effectiveness analysis.

[††] Cookson R, Drummond M, Weatherly H. Explicit incorporation of equity considerations into economic evaluation of public health interventions. *Health Economics, Policy and Law* 2009; 4(2): 231–245.

[*] Tugwell P, de Savigny D, Hawker G, Robinson V. Applying clinical epidemiological methods to health equity: the equity effectiveness loop. *BMJ* 2006; 332(7537): 358–361.

APPENDIX 4. Interpreting results of cost-effectiveness and cost-utility studies

In both cost-effectiveness analysis and cost-utility analysis, the program of interest is compared to an alternative in terms of costs and benefits. An incremental cost-effectiveness ratio (ICER) can be calculated which incorporates both variables of interest into one unit:

$$\textit{Incremental cost–effectiveness ratio} = \frac{\textit{(Costs Program 1 – Costs Program 2)}}{\textit{(Benefits Program 1 – Benefits Program 2)}}$$

An ICER can be interpreted as the net cost for an additional unit of benefit. For example, in a cost-effectiveness study conducted for a falls prevention program, the findings could be presented as an incremental $10,000 per fall prevented, or in a cost-utility analysis, as an incremental $10,000 per QALY gained. A program with a lower ICER is deemed preferable to one with a higher ICER. However, in Australia there is no explicitly stated threshold for what is defined as cost-effective, as other relevant factors (equity, feasibility, affordability, the degree of uncertainty around the cost-effectiveness results, etc.) need to be considered when making a decision. A review of submissions made to the Pharmaceutical Benefits Advisory Committee (PBAC) between 1991 and 1996 found the cost-effectiveness threshold lay between $37,000 and $69,000 per extra life year gained.[§§]

Further information about interpreting cost-effectiveness results is available in the Useful Resources section.

[§§] George B, Harris A, Mitchell A. Cost-effectiveness analysis and the consistency of decision making: evidence from pharmaceutical reimbursement in Australia 1991–96. *Pharmacoeconomics* 2001; 19(11): 1103–1109.

APPENDIX 5. Methods for the monetary valuation of the benefits of health programs

Willingness to pay

Willingness to pay estimates provide a measure of the economic benefit arising from participation in a program. It is based on the premise that the value of a program is reflected in how much consumers are willing to pay for it. Of course, this assumes then that consumers are well informed about the merits of the program in question. Willingness to pay estimates, regardless of how they are elicited, tend to be related to individuals' ability to pay and therefore when applied to the valuation of health, tend to value more highly health gains to the rich than gains to the poor. Willingness to pay estimates can be generated through either revealed preference or stated preference methods:

Revealed preference: The revealed preference method involves estimating consumers' willingness to pay for a program by observing actual decisions to purchase (or not purchase) at given prices. It also can be used to estimate the benefits from a program by assessing how a change in price influences demand. The assumption is that the prices paid by consumers are a reflection of the value they derive from participation. For instance, in health it can be used to derive valuations of the benefit of lives saved based on the actual amounts individuals pay for safety products, such as fire alarms, safety features on cars, etc.

Stated preference: Stated preference approaches involve eliciting willingness to pay through a survey. The survey constructs a hypothetical 'market' in which individuals are asked to offer or accept a price for the program in question. A challenge in the use of this approach lies in establishing the validity of responses to these questions, since they are based on hypothetical choices.

Human capital

The human capital approach involves the valuation of health based on its contribution to individuals' economic production. Production is generally valued by wage rates, based on the assumption that such rates reflect individuals' contribution to production. As such, an intervention that increases life expectancy (such that an individual gains 10 working years) would be valued by the wage paid to that person over that period, subject to appropriate discounting. Although potentially useful in cost-benefit analyses, this approach has most commonly been used in the health economics literature within 'burden of disease studies' in which production losses generally form a significant component of the measured economic burdens to society, along with the costs of treatment. A general criticism of the human capital approach is the equity implications associated with valuing health according to income.

SHPN (CEE) 170070