Discounting in Economic Evaluations in Health Care: A Brief Review

What is CREST?

The Centre for Health Economics Research and Evaluation (CHERE) at UTS has been contracted by Cancer Australia to establish a dedicated **Cancer Research Economics Support Team (CREST)** to provide high quality, expert advice and support to Multi-site Collaborative Cancer Clinical Trials Groups.

Factsheets

CREST will produce a series of factsheets as resources for cancer collaborative group researchers wishing to include economic evaluation in their clinical trials.

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SUMMARY

- Economic evaluations compare costs and outcomes for interventions over time.
- Discounting seeks to take into account the impact of time on how those costs and outcomes are valued.
- Typically, individuals (society) prefer to consume a product or service now rather than delay that same consumption until sometime in the future. This reflects a positive rate of time preference, or discount rate. The higher the discount rate, the more highly valued is current consumption (or outcomes) compared to future consumption (or outcomes).
- The present value of future costs or outcomes is estimated by adjusting them using the discount rate, where *X* is the cost or outcome of interest, *r* is the discount rate, and *t* is the number of years into the future *X* occurs:

$$Present\ Value = \frac{X}{(1+r)^t}$$

- The discounted present value of a cost or outcome of a given amount is lower the further into the future we discount.
- In most cases, it is standard practice to apply the same discount rate to costs and outcomes, and to keep the discount rate constant over time.
- Discounting tends to have a greater impact on cost-effectiveness ratios for evaluations where costs occur upfront but outcomes occur sometime later (such as in cancer screening or vaccination), or where there is a long term stream of benefits (such as paediatric indications).

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Conducting an economic evaluation requires the comparison of the costs and outcomes of two or more interventions. For most interventions, these costs and outcomes accumulate over a number of years, and may occur at different points in time. For example, the costs of immunising against human papillomavirus are incurred at the time the immunisation program is implemented (ie immediately), but the outcomes in terms of cancer prevention occur over time. The impact of the timing of costs and outcomes influences the results of economic evaluations in two ways: through its impact on the prices of goods and services; and in terms of the relative value we place on current costs and outcomes compared with those that arise in the future. How we deal with the effects of time is therefore important to the results of economic evaluations.

We want to ensure that when combining costs and outcomes for comparison we place them on a level playing field in terms of the effects of time. The effect of time on prices is dealt with via adjustments for price inflation and converting prices to those of the year in which the analysis is conducted (called the base year, which is most often the year in which the analysis is conducted). This is a relatively straightforward process of ensuring that all prices and wages for valuing resource use are measured in the same year. Where this is not possible, prices and wages are inflated or deflated to the base year using a price index such as the Consumer Price Index or AIHW Health Price Index.[1, 2] This FactSheet does not deal with adjusting for price inflation further, but more information can be obtained from the publication by Kumaranayake (2000).[3]

The more challenging aspect for many developers and users of economic evaluations is dealing with the impact of time preference – the fact that society values future costs and outcomes differently from those that occur immediately. This aspect of relative value is addressed through discounting, which is the subject of this FactSheet.

Why do we Discount?

Most health care interventions incur costs and outcomes over a number of years. Discounting seeks to take into account the impact of time on how those costs and outcomes are valued. In general, individuals prefer to experience a good (e.g. health care) or consume a product now relative to doing so in the future. That is, you would need to compensate an individual to make it worthwhile for them to delay consuming something today until some specified period in the future. The amount of compensation required reveals an individual's discount rate – or their rate of time preference; how much they prefer current consumption over having that same amount in the future.[4] The higher is an individual's discount rate, the more highly they value consuming a good now

compared with delaying that same consumption for some period into the future.

Consider Mary. I offer her a choice between receiving $1,000 today or a higher sum of money if she waits for 12 months. She tells me I would need to pay her at least $1,100 in 12 months for her to forgo the $1,000 today. By choosing the $1,100 in a year's time to forgo the $1,000 today, Mary has revealed that the present value of the $1,100 in one year's time is $1,000. Mary has a positive rate of time preference. In this example, this is measured by her discount rate of 10% (ie $100 is 10% of $1,000). The value to her today of $1,100 in a year's time is $1,000 (or $1,100/1.1). To persuade Mary to wait one year for the $1,000 we had to offer her an additional 10%. If we only had to offer Mary $1,050 in a year's time, her discount rate would be 5%.

How to Discount

As we have seen from Mary's example, calculating time preferences is relatively straightforward; we estimate the present value of the future costs or benefits by adjusting them using the discount rate. More generally, this can be achieved using the following:

$$Present\ Value\ = \frac{X}{(1+r)^t}$$

Here *X* represents either the cost or benefit we are adjusting, and *t* (*t*=0,1,…, *T*) is the relevant time period. In this case, the current year is assigned the value *t*=0. No discounting is applied to the current year as the relevant costs or benefits are already in present value terms. It is important that the discount rate be applied for each year in which the costs or benefits arise over the entire period of the analysis. Even though a cost or benefit might be the same each year, the effect of discounting is time dependent – the further out we are into the future the lower the present value of that cost or benefit becomes once it is discounted.

The overall effect of discounting and the annual cumulative effect are best illustrated by another example. Consider the simple cost-benefit analysis presented in

Table 1 for an hypothetical cancer screening promotion campaign.

The campaign cost $450 to implement in 2014. However, it delivered a constant increase in the number of people presenting for screening that was valued at $100 per year. In this case the costs of the intervention occur upfront while the outcomes (benefits) accrue slowly over time. Without discounting, the total benefits over five years are $500, outweighing the costs of $450. The conclusion would be that there is a net-benefit to society from this program.

Discounting the benefits decreases the total benefits in today's dollars. At a 5% discount rate, the program still has a small positive benefit (of $5), but, if the discount rate was higher (say 10%) there would be a net loss to society. This example also shows that the present value of the benefits is lower the

Table 1: Hypothetical Cancer Screening Promotion

Year	Costs ($)	Benefits ($) undiscounted	Benefits ($) in 2014 values (r=5%)	Benefits ($) in 2014 values (r=10%)
2014	450	100	100	100
2015		100	95 = $100/(1+0.05)^1$	91 = $100/(1+0.10)^1$
2016		100	91 = $100/(1+0.05)^2$	83 = $100/(1+0.10)^2$
2017		100	86 = $100/(1+0.05)^3$	75 = $100/(1+0.10)^3$
2018		100	82 = $100/(1+0.05)^4$	68 = $100/(1+0.10)^4$
Total		**500**	**455**	**417**
Net Benefit		**50**	**5**	**-33**

Notes: r is the discount rate.
Superscripts represent *t*, being the number of years from the current year – 2014 – to which the numerator is raised to the power of.

further we are from the present year, regardless of the discount rate. Note also that we apply a constant discount rate to all costs and outcomes in all years (5% or 10%). The convention in health economics is that we assume that time preferences are stable over time and over all types or resource use and outcomes, and thus apply the same discount rate to both costs and outcomes throughout an economic evaluation. However, there is debate about this "rule" and some countries have adopted different approaches (see Table 2 below). It is also good practice to conduct a sensitivity analysis of the impact that the choice of discount rate has on the final results. From the example here it can be seen that moving from a zero discount rate for outcomes to a rate of 10% changes our result from one of supporting spending in cancer screening (there is a net-benefit to society) to not supporting such spending (there is a net-cost to society).

Choosing a Discount Rate

What the previous example highlights is that while discounting is relatively straightforward, it has a powerful impact on the conclusions drawn from an economic evaluation. Higher discount rates will result in less favourable results from an economic evaluation where the health outcomes occur in the future and the costs are incurred now (eg a higher cost per quality adjusted life year gained, or a lower net-benefit ratio).

The effect of discounting, and therefore the choice of discount rate is most evident for interventions where most costs are incurred at the beginning and most health outcomes (benefits) occur in the future (e.g. prevention programs such as vaccines), and for interventions expected to produce a long stream of outcomes (and potentially costs) such as interventions for children. Where there are differences in time between when costs are incurred and health outcomes are realised, future outcomes – once discounted –

are assigned a lower value relative to costs. In this case, applying a higher discount rate will result in less favourable outcomes from the economic evaluation than might occur for interventions with the same costs and health outcomes, but where the health outcomes occur closer to the time the intervention is delivered. This means that the decisions made with regard to discounting are very important to the results of the analysis.

In the earlier example, we noted that Mary as an individual had a positive rate of time preference. We can see from the decisions that people make that a positive rate of time preference is the norm. The discount rate we use in economic evaluations aims to capture the social rate of time preference; that is - what is society's preference for consumption today over the future?[5] To invest in future health outcomes, society needs to forgo current consumption, and the discount rate should reflect this opportunity cost.

A related view is that it represents the opportunity cost of investment for private funds in public programs.[5] These can be estimated variously using the real rate of return on investment, real government bond rates (the bond rate minus inflation), or by attempting to directly measure individuals' time preferences across society.[4, 5]

A more pragmatic approach for the analyst is to follow existing guidelines or practice. Within Australia, the choice of discount rate is best addressed by following the guidance for applications to the Pharmaceutical Benefits Advisory Committee and Medicare Services Advisory Committee; use a 5% discount rate. The advantage of this pragmatic approach is that it ensures that all interventions are treated in the same way, and so allows for greater comparability across different evaluations and decisions.

The same discount rate is applied to both costs and outcomes on the premise that they face the same rate of time preference. Using a different discount rate for costs and outcomes is what is known as differential discounting. Some arguments used to support differential discounting (applying a lower discount rate to benefits than to costs) are the need to place more weight on the consumption by future generations relative to the current generation, or that health outcomes (benefits) are intrinsically different from other benefits.[6, 7]

Table 2 presents examples from around the world of guidelines on discounting. In general, most decision makers require or recommend using the same discount rate for costs and health outcomes. The notable exceptions are the Netherlands and France. In the Netherlands, the College Voor Zorgverzekeringen CVZ justified the use of differential discounting on the basis that the population's (healthy) life expectancy is increasing (meaning that the future value of benefits should not be diminished too greatly relative to their present value) [8] In, France a lower discount rate (2%) is used in analyses once the time horizon extends beyond 30 years.[9]

Table 2: Guidelines on Discounting in Selected Countries

Country	Discount rate		
	Costs	Health Outcomes	Sensitivity analysis
Australia (PBAC) [10]	5%	5%	0%
UK (NICE)** [11]	3.5%	3.5%	1.5%
France[9]	4% < 30 years, 2% ≥ 30 years	4% < 30 years, 2% ≥ 30 years	0% to 6%
Netherlands (CVZ)[8]	4%	1.5%	0%
Germany (IQWiG) [12]	3%	3%	0, 5, 7 and 10%
Finland[13]	3%	3%	0%
Portugal[14]	5%	5%	0% for health outcomes
Canada (CADTH)[15]	5%	5%	0% and 3%
New Zealand (PHARMAC) [16]	3.5%	3.5%	0, 5 and 10%

Abbreviations: CADTH denotes Canadian Agency for Drugs and Technologies in Health, CVZ College Voor Zorgverzekeringen, IQWiG Instituts für Qualität und Wirtschaftlichkeit im Gesundheitswesen, NICE National Institute for Health and Care Excellence, PBAC Pharmaceutical Benefits Advisory Committee, PHARMAC Pharmaceutical Management Agency.

For more information

For more information on any part of this factsheet, please contact:

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