Swedish National Institute
of Public Health

A guide to Quantitative Methods in Health Impact Assessment

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Contents

Foreword

THE SWEDISH GOVERNMENT has given the Swedish National Institute of Public Health (SNIPH) the task of both developing methods in Health Impact Assessment (HIA) and supporting the application of HIA at the central, regional and local levels. HIA is related to other similar impact assessment methods, such as environmental impact assessment (EIA), where environmental, rather than health aspects, are the focus.

SNIPH has previously produced a number of reports within this area, including *Vägledning för hälsokonsekvensbedömningar med focus på social och miljömässig hållbarhet* [A guide to health impact assessment as a tool for social and environmental sustainability] (1) and *Health impact assessment of a road traffic project. Case study: Route 73* (2). These reports mainly use qualitative methods, which in most cases are sufficient for an HIA. Some cases however, require the use of quantitative methods because of their complex nature. In other cases, aspects of cost are important elements in an HIA and these aspects are quantitative in nature. As a complement to existing qualitative reports, SNIPH would like to offer this guide to quantitative analysis and methods in HIA. This guide is mainly based on well-known methods from health economic evaluation, but it has been adapted for more general use across public health.

This guide is written for people who work with practical analysis in public health in regional and local authorities and central agencies. It is also useful for decision-makers who may require an HIA.

This guide has been written by Public Health Planning Officers Håkan Brodin and Stephen Hodge.

Sarah Wamala
DIRECTOR-GENERAL

How to use this guide

THIS GUIDE IS intended as an introduction to quantitative methods within HIA. Readers who need to deepen their knowledge in quantitative evaluation methodologies are referred to the literature in the field, such as Drummond et al (3) or to experts in the field. Please contact SNIPH for more detailed information and discussion especially regarding the following issues which may cause problems:

1. It can be appropriate, especially concerning the measurement of Health Related Quality of Life (HRQL) to avoid re-inventing the wheel. Many interview instruments have been designed to measure HRQL. SNIPH can help you to choose an instrument.
2. The measurement of opportunity cost and marginal cost - the real cost, requires specific skills in economics. Experts at SNIPH can help you with this technique.
3. A thorough discussion of decision-analysis is beyond the scope of this guide. As well as possibly being available in your own organisation, expertise within the field is available from academic institutions and SNIPH.

This guide will be updated after discussions with users in order to provide a clearer account with an improved decision-making base. All comments and viewpoints are therefore welcome. They can be directed to:

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Summary

This report is a guidance for quantitative (or numerical) analysis of health impact assessments (HIAs), when such analysis is needed. It is intended to be a complement to other guidance, published by the Swedish National Institute of Public Health (SNIPH), and is based on accepted methods from health technology assessment (HTA).

This report reviews and defines a number of important concepts. It connects HIAs in their context to highlight not only health aspects but also related indicators and determinants.

The report reviews a number of problem areas that may lead to discussions. Firstly, the discussion about ends and means is important to facilitate comparability between different parts of a HIA or between different HIAs in a wider context. Also, discounting is the usual way of comparing costs and health consequences over time. In relation to the concept of discounting it is often necessary also to discuss the magnitude of the social discount rate.

One important aspect of HIAs is if the programme leads to gained or lost lives, for instance in road projects. This report reviews the technique usually applied when such effects need to be compared to other effects, for instance the gained or lost lives as a consequence of changes in the programme level of safety ambition. Another point of discussion related to gained or lost lives is health related quality of life and how this may be quantified in relation to other health effects.

Cost aspects are probably the most common factor in comparing alternative programmes from a quantitative perspective. This report points at important techniques to measure costs based on general economic principles, nationally as well as internationally. Examples of such principles are the conceptof marginal cost and conventions to measure lost production.

Important terms used in this guide

There are a number of important terms used within health economic analysis:

- **PROGRAMME:** all projects, directives, formulated planning and other activities where there are defined goals and participants. Should goals and participants not already have been specified, they ought first to be defined before the HIA starts.

- **RESOURCES:** all means at one's disposal such as money, material, equipment, time, consumables, human effort. Resources are used to achieve goals, aims or objectives.

- **OWNER OR PRINCIPAL:** the person or organisation who decides how resources shall be used. In some cases owner is synonymous with cost centre from accounting terminology. In many cases it can be difficult to define who controls a particular resource, for example when there is not only an owner, but also someone who administers the resource on the owner's behalf. In this case, it is the administrator who decides how the resource shall be used.

- **(HEALTH) EFFECTS:** are the positive and negative (health) impacts/consequences of a programme. The consequences do not necessarily need to be in line with the goals, aims and objectives of the programme. A positive health effect can be something that is "included in the price". Improved physical activity among residents of a neighbourhood may be an uninteded positive effect of a new cycle path to the town centre, the aim of which is to increase transport capability. One type of a negative health effect can be an unanticipated side-effect such as increased air pollution near a newly constructed road.

- **A STATISTICAL LIFE:** A life, any life – an older or younger person, man or woman, regardless of social position, ethnicity etc who has no personal relationship to the observer.

- **QALYS:** Quality Adjusted Life Years. QALYs are a way to compare health effects where the number of calculated years is multiplied by a factor which represents a reduction in health. If health related quality of life is poor, the QALY value will be reduced compared to the same length of life with full health.

- **DALYS:** Disability Adjusted Life Years. The emphasis is on ability or capacity for social participation.

■ **INDIRECT COSTS**: is a term often used in bookkeeping and accounting for costs transferred from other cost centres, for example when general administrative costs are shared among operative/production divisions. In health-oriented studies, indirect costs often also refer to productivity loss, in other words a situation where ill-health leads to an individual being unable to work (5).

Background

HEALTH IMPACT ASSESSMENTS (HIA) are sometimes included in the planning process when a principal – a local or regional authority or a central government agency for example – wants to introduce a new programme. Examples of such programmes include road projects, the expansion of a municipal wastewater plant or changes in chemical regulation legislation. Such programmes are usually focused on an area other than health, but they can cause health problems as a side effect. They can, however, also have both positive and negative effects on health.

Example. During the planning of the new Highway 73 between Stockholm and Nynäshamn, The Swedish Road Administration and the local authority of Nynäshamn discussed the environmental impacts of seven different alternative routes for the new road. Because the section of road is important at both the national and regional levels, holds significant cultural and environmental values, and is the site of many accidents, an HIA was carried out at the same time. An overview of a number of factors related to the social dimension in sustainable development was the main interest in the HIA. These factors included (2):

a) an overview of both the environmental and social dimensions of sustainable development, in other words, reference was made both to environmental objectives and public health goals.

b) knowledge about how the final decision would affect the health of different population groups such as immigrants, disabled people, children and older people.

c) knowledge about how the final decision would affect gender equality.

The results from this HIA taken together reveal that the "do nothing alternative" where the (then) existing road continued to be used until 2020, led to a significant reduction in social and physical environmental quality. Alternative E involved building a new road between Älgviken and Fors, by-passing Landfjärden, with the result that the existing road could be freed from through traffic and become a local road. The result would be significant improvements in social and physical environmental quality, with children being the biggest winners. Older people, the chronically ill, disabled people and professional drivers would also receive health benefits. The established negative consequences included a certain infringement in residential areas and in outdoor recreation areas. In conclusion, Alternative E was recommended, as it was considered to contribute to increased health status among both vulnerable groups and the population as a whole.

When are quantitative health impact assessments needed?

It was relatively easy to reach the conclusion in the example above – Alternative E was superior. A general assessment can often be enough to determine which health effects are the most important in the different alternatives. It can also be easy to see if a health effect is more important than another. But if this assessment is difficult to carry out, for example where the differences are assessed to be approximately similar, or when the conclusions from different alternatives are difficult to interpret, there is often no other option to differentiate them than to undertake a detailed quantitative assessment. For many programmes is it is likely that an HIA needs to weigh up *both* positive and negative health effects.

> **Example.** In a project similar to the one outlined above it is conceivable that one group experiences the same change in a different way to another group in the general population. Families with small children probably experience improved transport networks positively. Another group, for example older people, is possibly negatively affected, for example through increased noise and disturbance from traffic. In certain cases the project group can undertake a broad assessment, where it is clear that the new road will primarily pass through a newly-built residential area with a younger population, and thus primarily lead to a positive change. If such an assessment is difficult to make, but important effects are involved, the project group must investigate the problem in greater depth, for example through detailed demographic analysis or surveys of the intensity of the impact of noise.

Who is this guide written for?

The following guide is written for people who need to undertake quantitative assessments in association with HIAs, but who are not professionals within the field. This report is divided into different problem areas. Each problem area consists of two parts, the first being a problem-focussed overview from the project manager's or decision-maker's point of view. The second part is more technical and is written for the person who will undertake the practical calculation tasks. It is hoped that the guide can function without the need for more qualified assistance. It aims to assist in the identification of common measurement problems in HIA and to provide advice about how to overcome these problems.

When quantitative comparisons are being made it is important to follow an accepted method so that important effects are not lost in the analysis *and* so that effects are evaluated in a way that allows them to be compared with similar assessments. This guide is generally consistent with standard works within health economic evaluation or *Health Technology Assessment* (3, 4).

Determinants of Health

IN MANY CASES it can be difficult to estimate direct health effects. It may, therefore, be necessary to estimate *determinants of health* – intermediate factors related to society, living conditions and lifestyle factors which are known to affect human health. If a complete analysis of costs and effects is desirable, this needs to be done with focus on the costs required to bring about a change in determinants of health – not a change in health directly. A separate analysis may be carried out after this to clarify the magnitude of the relationship between a determinant of health and health itself.

Example. Public health is dependent upon many factors in society. In order to guide the effort towards improved public health, the Swedish government has formulated eleven "objective domains" which group the determinants of health. These policy areas/determinants of health were presented in *Folkhälsopolitisk rapport 2005* which SNIPH submitted to the government during 2005.

One of these eleven domains is *Participation and influence in society,* which includes seven determinants of health, of which *democratic participation* is the first (see Figure 1).
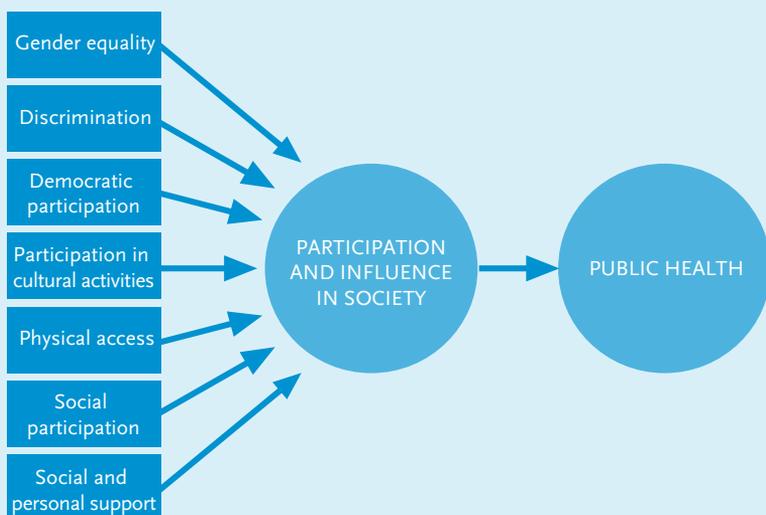

Figure 1. Determinants of health for Participation and influence in society

Changes in determinants of health can be measured with the aid of a number of indicators. Figure 2 shows the determinant of health *Democratic participation*, which has two measurable indicators: *Electoral participation rates* and *Proportion of first-time voters*.
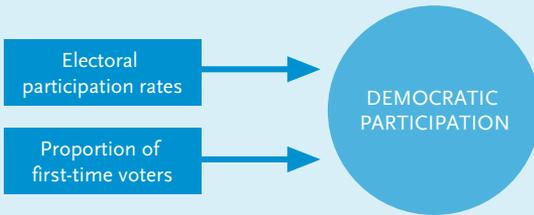
Figure 2. Indicators for the determinant of health – democratic participation

The costs required to bring about changes in determinants of health are difficult to calculate. The analysis requires an advanced statistical model, as a determinant of health not only affects public health, but also affects other policy areas. In some cases even a positive influence on public health can be assumed to have a negative effect on another policy area, such as economic or regional development policy for example.

Problem areas 1-8

1. Differentiating aims, objectives and means

It is more rule than exception that the health consequences of an activity or programme are of lesser importance than the overall aim that a principal wants to achieve. Nonetheless it is possible that the health consequences are so significant that a re-assessment of the aims and objectives of a programme becomes necessary. It can help to carefully differentiate between aim and means when making such an assessment. In all programme evaluations *means* are the resources that are used to achieve something. The *aim* is what is to be achieved. Problems around assessment can for example, occur during times of increased financial constraint. In these situations it becomes easy to see saving money and keeping to budget as the aim. This is not however, an aim in and of itself. Cost-saving measures should only ever be a means to an end.

> **Example.** In the planning of the reconstruction of Route 73 (see page 10) improvement of the traffic situation was the primary aim. A secondary objective (even though important) was to reduce the number of fatal accidents on the road corridor. The lives saved are an effect, a secondary objective, and not a resource in the meaning that they can be used.
>
> Human beings and human health have an intrinsic value. Today practically all people in Sweden have access to health and medical care regardless of their financial situation or their ability to work or to pay tax. This has not always been the case. During his reign, the Swedish king Gustav Vasa (1496 - 1560), built his own hospital to ensure the health of the army rather than out of any sense of intrinsic human worth. The first public hospitals with access in Sweden based on common rights, were not built until the mid-eighteenth century. Plantation owners also maintained the health of their slaves, but mainly for the same reasons as Gustav Vasa maintained the health of his army.

To see patients as a resource that carry out productive activities is a mindset that we distance ourselves from today. Our current ethical position is based on the intrinsic value of human life and health, especially if the mindset of humans as productive resources is used as the only basis in decision-making around access to health and medical care.

Reduced medical care, ambulance journeys and accident cases, frees up resources for other uses. These resources can be redirected to provide medical care for other patients in the health care system.

Sometimes investments in medical care benefit health care personnel but not the patient. One example that isn't completely unusual is the investment in mechanised bed lifts in geriatric wards which reduce injury and increase quality of life among staff, but do not lead to an improvement for the patients. This is a better use of the human resource 'personnel', but it does not contribute to reaching the aim.

Saving resources can never be a goal in itself. To maintain a goal with fewer resources is known as increased effectiveness and can be an improvement. To reduce resources at the cost of reduced service is, on the other hand, often just a loss.

2. Comparing costs and effects over time

Costs which occur at different points in time ought to be recalculated to a common point in time. As soon as a decision is made to use resources in a certain programme they become unavailable for other uses and should therefore be compared, preferably with reference to the decision-making moment. Costs which are known (or can be expected) to occur in the future, must therefore be adjusted to a *present value*.

> **Example**. The improvement of cycle and pedestrian paths in a neighbourhood (to hinder mopeds) can be done in two ways. In case **A** an intensive programme of works to improve the paths with gates and signage is carried out over a year. In case **B** a less intensive programme of works is carried out each year, but over a five-year period (see Table 1).
>
> In both cases the effect is the same. The local authority determines that it takes a certain amount of time to bring about behavioural change, but that this change gradually begins to take place as soon as the programme commences. The total effect on moped riding is thus determined to be the same in both cases after five years. The total cost for the works remains unchanged, €21 622 in both cases (€1 = SEK9.25, 2007 prices). Which alternative should be selected?

Many would find it hard to choose as both alternatives cost the same and have the same effect. Others would think that case **B** is better as the costs can be divided up over five years (€4 324 per year). This is also what should be recommended, but for a specific reason: Suppose that the housing company divides the cost equally over the five years. The €1 729 difference in the first year is then made available for other useful purposes, to the benefit of neighbourhood residents, during the second year €1 513 and so on. If the effects of the programme start to yield results in terms of changed traffic patterns anyway, it is therefore beneficial to delay the costs for as long as possible.

> Just how much the local residents and other stakeholders prefer in Alternative **B** can be calculated in advance if the *social discount rate* is known. Table 1 shows the nominal amounts. The rate is represented as r.

Year	A Actual=Nominal Cost	B	
		Nominal Cost	Actual Cost
1	€ 21 622	€ 4 324	€ 4 324
2		€ 4 324	€ 4 118
3		€ 4 324	€ 3 922
4		€ 4 324	€ 3 736
5		€ 4 324	€ 3 558
Present value, €	€ 21 622	€ 21 622	€ 19 658

Table 1. Cost comparison between improvements according to case A, works completed during one year and B, works spread out over five years.

What is a social discount rate?

A truism which has been transformed into economic practice is that *it is a general human behaviour to choose to delay expenses as long as possible, just as it is preferable to enjoy the benefits as soon as possible*. If choice is possible, there is a rule that says that delaying a cost of €100 for one year reduces the cost to €95 kronor in today's value. It is therefore beneficial to delay the cost.

If bank interest is a few percent it is even more beneficial. It is noteworthy that this social discount rate is a general human phenomenon which has nothing to do with the organisation of the economy or banks. Muslim banks that neither charge interest on loans, nor pay interest on savings still have the same social discount rate as others, approximately 5 percent. The amount of interest varies somewhat with personal tastes and development. It is sometimes claimed that small children have a high discount rate (they want to have everything now), while students (who can wait a long time for a good job) have a low discount rate.

Should effects that occur in the future also be discounted?

While there are logical reasons for discounting costs that occur in the future, what is the situation with effects? Should they also be discounted? Many people would answer yes.

Example I. A traffic safety programme is under discussion. Two alternatives **A** and **B** can be chosen to build a new road (2). **A** would result in one death per year being prevented over twenty years (without disability or other injuries) while **B** would result in the prevention of twenty deaths in the first year and none in the following nineteen. The cost of building the road is the same in both alternatives. Which programme should be chosen?

Many would probably say that **A** and **B** are equivalent. The same number of lives can be saved in both cases and they cost the same to save. But others would say that it is better to save human lives now instead of waiting in some cases up to twenty years. They would therefore prefer alternative **B** over **A**.

A logical analysis also supports the latter scenario.

It is better to save a statistical life today than a statistical life tomorrow. The value of a benefit is reduced if it occurs tomorrow.

Example II. If costs are discounted but effects are not, it is thinkable that a new hospital building is more economically advantageous if it delayed for a year (in other words, the same number of lives can be saved but the costs delayed), and when the first year of delay has passed, it is even more advantageous if it is delayed for another year and so on and so on. This is inappropriate, and it is the reason why effects should also be discounted.

Some of the studies that have investigated people's understanding of delayed costs and effects show however that people experience discount rates for costs and benefits differently. Lazaro (6) summarises the discussion. Lazaro sees a tendency towards a polarisation in the discussion between those who support and those who do not support discounting. Despite this polarisation, Lazaro notes that most commentators consider that costs and benefits should be discounted in the same way and with the same discount rate – in most cases between 3 and 5 per cent.

Present costs and future benefits

The determination of costs and benefits is particularly difficult in preventative programmes. The costs are faced now but the benefits occur in the future. How can the costs and benefits be compared? In a typical case concerning prevention:

1. A well-known and proven method (**P**) exists to prevent a group of people (**G**) from ill-health or death (**S**). If a proven method of prevention doesn't exist, there is no prerequisite for prevention.
2. The cost for screening and preventative measures targeted to group (**G**) should not be high. Secondary prevention, i.e. the prevention of relapse into illness (**S**) is probably cheaper than primary prevention because the large costs involved in screening and identifying risk groups are avoided.
3. A well-known and proven method (**B**) exists to treat the illness that (**G**) suffer if prevention is not implemented. Results from treatment can be complete recovery or a partial improvement after the illness. If a treatment doesn't exist, then prevention is the only available alternative.
4. The timescale is important. The time between the implementation of (**P**) and the health outcome (**S**) should not be too long. The social discount rate is often between 3 and 5 per cent. The precise rate is decided through policy processes of an appropriate authority or a Central Bank for example. If no clear policy decision exists, choose 5 per cent, and thereafter undertake a *sensitivity analysis*

to check if the final result is greatly affected with a rate of either 4 or 6 per cent. Outline this analysis in the final report.

5. There are also a number of people (**H**), who will suffer from health outcome (**S**) even if they have received a preventative intervention. (**H**) should be a considerably smaller group than (**G**),

The translation from a nominal cost (**D**) happening t years into the future, until now (N = *present value*), can be calculated with the formula:

$$N = D \ \frac{1}{(1+r)^t}$$

> **Example.** If a cost of €1.76 million can be saved ten years from now (the value of a saved life in ten years, see problem area 3, page 19), and the fixed discount rate is four per cent, according to the formula above:
>
> $$16{,}3x \ \frac{1}{(1+0{,}04)^{10}}$$
>
> In other words N = €1.19 million in present value. It should be noted as previously discussed that this is not a compensation for inflation or bank interest during the ten years, but rather an assessment that something does not occur immediately, but after a long wait. Inflation and bank interest should be added to the social discount rate.

One of the most important questions in an HIA is whether ill-health can be prevented. There is an ongoing discussion about whether money spent on prevention is money well spent, with the following alternatives being offered:

a) Seek and identify people in risk groups for preventative interventions. Both searching and prevention cost money (in general most expensive)
b) Invest in opportunistic screening to identify people in risk groups who come into the health care system for other reasons
c) Invest in secondary prevention, in other words prevent relapse or chronic illness for those people already affected by a particular illness or injury
d) Invest the same resources in treating people when they actually become sick (in general the least expensive).

It is worth repeating that if no proven, efficient, evidence-based prevention method (**P**) exists, it is difficult to justify investing resources in an activity that does not lead to a result. Heartfelt hope that (**P**) will help is not sufficient to justify the spending of these resources. Studies that show that people can dramatically reduce their weight in the course of one or two years presently provide no evidence that regular dieting methods have any effect over five years' time. This requires another type of treatment, for example cognitive behavioural therapy.

3. Assigning a price to the loss of, or the saving of, a human life

This heading is somewhat misleading as it is doubtful if it is possible to put a price on a human life. From a philosophical point of view this means that there has to be an owner of this human life, for example a slave owner. But it is not the ethically based value of a human life that we are interested in here. What we would rather know is *what we are willing to pay as citizens to save a statistical life, i.e. a person unknown to us.*

Valuing a life saved can be different in different situations. Many people think it is more important to save someone from a painful death than from a peaceful death during sleep. Some people think it is more important to save children than older people. Others hold the opposite view that it is more important to save older people than children. Others think it is important to save those who 'deserve' to live, rather than say, criminals. There are many different aspects to this problem, which is the reason why the term *statistical life* has been created, to avoid putting a price on the life of a specific person. An average cost that many people use in Sweden for the collective will to save a statistical life is € 1.76 million. This cost was calculated in 2001 (7) but as at December 2006, had not been re-calculated to take inflation into account.

If we can save ten lives per year on roads with the help of a particular systemic arrangement of traffic lanes, we can equate this to a value up to € 17.6 million, which can later be put against the cost to build this lane system.

> **Example**. A preventive drug treatment to prevent one death in a risk group costs € 1 per risk group member per day. The total *nominal cost* for one patient is therefore € 365 per year, or € 3650 over a ten year period. Over the ten year period however, the *present cost* (see the example on page 11), would be € 365 for year zero, € 351.0 for year 1, € 337.5 for year 2 and so on until the real cost decreases to € 246.6 in year 10, giving a total present value of € 3325.5.
>
> One life saved by the treatment is nominally worth € 1.76 million (see page 13). Let us assume that the life saved by this treatment could be saved anytime between year zero and 10. The mean present value is therefore € 1.46 million. For the treatment to be an example of money used wisely, no more than 529 patients (529.8 x € 3325.5 = € 1.46 m) should be treated with, the preventive drug over the ten year period if no more than one life is saved.

4. Assigning a price to ill-health

Judging whether a person is a little or very sick is perhaps not so hard, but to determine whether a change in environmental factors (for example) leads to a small change in health status for one group of people compared with another group can be difficult. This problem with measurement regularly occurs within pharmaceutical research, so methods for comparing health status in people have been developed that employ burdening test individuals. The term *health related quality of life* has become the dominant principle for such comparisons and it comprises health related physical and psychological welfare related aspects of life. Because long-term illnesses need to be compared to short-term ones, the term/measure *Quality Adjusted Life Years (QALYs)* has been constructed. A QALY is a product of the number of years a person lives, adjusted for the reduction in quality of life caused by an illness that the person experiences. Another measure/term has been developed in association with QALY which instead compares functional status rather than health status, *Disability Adjusted Life Years (DALYs)*. This measure is much often in public health as it is enumerates the number of years of life adjusted for reduced functional status which does not have to be illness related.

In the QALY measure, full quality of life is attributed at 1.0. A health status which is so painful or awful that a person would prefer to be dead is attributed 0.0. Observe however that it is not a dead person that is measured as 0.0, but only a health status comparable with being dead. Studies are most often concerned only with health-related quality of life. This means that the value of a complete year with complete health-related quality of life (or complete health = 1.0) equals 1 QALY. If health-related quality of life is lower, for example 0.8, and a two-year period is calculated, the health effect is reduced to 0.8 x 2 = 1.6 QALYs instead of years with full quality of life.

This way of calculating quality of life can be significantly simplified if existing survey or interview instruments (which have calculated QALY orientated health-related quality of life for a reference population for a range of illnesses) are used. These instruments are in many cases available in many languages. EQ-5D and SF-36 are two instrument that are widely used worldwide.

DALYs measure the absence of disability or the loss of social participation for a larger group of people. The measure was developed by the World Health Organisation (WHO) and the World Bank in order to compare the burden of illness in different countries. The same underlying technique is used as that in the QALY case above, in other words a life-course with and without disability, where any disability increases the quantitative value from 0.0 which is the value/weighting ascribed to full function. It should be noted that full function has a value of 0.0 for DALYs while full function is rated at 1.0 for QALYs.

In WHO's survey of DALYs, many health statuses are scored very close to zero. The common cold is rated at 0.007 while arthritic hips with constant pain is valued at 0.2 and difficult states such as dementia have a value of 0.8.

Example. Assuming that the life expectancy for a Swedish man or woman is 82 years and at 35 years a person is involved in a traffic accident. This accident leads to comprehensive fractures and mobility difficulties for the remainder of the person's life, with a disability weighting of 0.1. At 60 years of age the person dies of a heart attack. The number of DALYs lost due to the traffic accident are therefore (60-35) x 0.1 = 2.5 DALYs. Furthermore, 22 years of life are lost from the occurrence of the heart attack until the expected average life expectancy (5).

Calculating national DALY losses requires the use of more schematic base data (and its assumptions) which conforms to international or national agreements. Based on these assumptions, Peterson and colleagues have concluded that the current burden of illness in Sweden is somewhat greater than 2 million DALYs. Because it includes great uncertainties, the total figure is maybe not as interesting as its apportionment by sex, age groups and illness groups which probably gives and indication of where interventions can best be targeted to give the greatest health benefits.

The calculation of DALYs is complicated and requires great skill which lies outside the scope of this paper. Readers are referred to expert advice if appropriate assumptions about DALY losses cannot be undertaken in a straightforward way, for example from Peterson's and Allebeck's reports (5, 8). In Appendix 1 of Peterson et al's report (5) there is a detailed list of DALY weightings for a range of diagnoses.

5. What is the real HIA cost or HIA benefit of a programme?

Costs are different depending on how the question is asked and who is answering it. "The real/universal cost" can often not be found, instead it must be calculated anew each time. If you ask how much it costs to run a particular car, you get different answers depending on whether the question concerns city driving or country driving. Different answers are also given if costs associated with repairs and wear and tear are included, and if the fixed price (whether the car is driven or not) for taxes and insurance is included. It is not always certain that the "total cost" is wanted, in other words the sum of all the enumerated cost headings.

The same applies for nearly all activities and operations, for example health impacts from an agency or organisational perspective. There is a large risk that problems occur when trying to compare different costs or benefits in different programmes. Agreement has therefore been reached about a standardised method that is used in socioeconomic calculations. An *alterative cost argument* is followed which means that costs within an HIA as in many other contexts should be documented according to what could have been achieved had the current resources been put to better use in a different context. As a part of this point of principle, *marginal costs* are used as a measure of the real cost. Marginal cost is that cost which changes if the use of resources is decreased or increased by a small margin.

> **Example.** Assume that an environmental project means that a wastewater treatment plant is built in a certain municipality and that the facility is thereafter used by the municipality's inhabitants.
>
> a) The costs for building the wastewater treatment plant should not always be calculated in the programme in the same way as the running costs. The former costs remain unchanged despite the growth or decline of the population served. It is a *fixed cost*. Furthermore, the construction costs will vary depending on which time perspective is used. In other words, the construction costs can be spread out over the number of years that the plant is expected to operate.
>
> b) The most important cost to investigate is, on the other hand, the real cost of operations. The costs should be calculated at its real value before state contributions, subsidies or taxes (in other words, the marginal costs) as these are transfers (the transfer of resources between different stakeholders, and not real costs for the municipality.

The fees that local residents pay is often lower than the real cost. The charge is often the result of a political decision and therefore does not necessarily follow a real cost analysis. The real cost however, remains in the municipality's expenses. It doesn't disappear, but rather must be met by taxes in another way.

Accordingly, it is clear from the above that cost-related data cannot always be taken from one resource (for example, labour power) directly from the principal's cost accounting. An estimate must be made of that which could have been undertaken with the resources if used in a different and better project. One example that is often raised is that the alternative cost for a nurse is not her salary. The alternative

cost is rather what she performs. If the nurse is undertaking a certain amount of the administrative assistant's duties, the management must have come to the conclusion that this is more urgent than the direct patient care duties the nurse could have performed instead.

To conclude the discussion on cost calculations, the following terms (in order of importance) can be of assistance:

DIRECT COSTS are those costs which actually change if the activity is increased or decreased.

INDIRECT COSTS are:
a) Such costs which are divided among the productive divisions without having a natural or direct association with any of them. These costs are more often called *shared costs*. Example: The cost of a Hospital Director is independent of the number of beds at the hospital. This costs is often divided (in the same way as general administration as it is usually called) among the different clinics or even wards, either in relationship to the number of beds, or the number of staff members that work in the clinic or ward in question.
b) Production loss, as discussed in Problem area 7, see page 25.

FIXED COSTS are those that do not change when production activities change. These costs concern retaining capacity, which is common in activities such as railway construction and maintenance, power production and emergency services. Consult a professional economist if there are doubts regarding the calculation of fixed costs.

6. Managing many different benefits/effects in HIA.

Reality is rarely simple. Health Impact Assessments seldom involve simple outcomes. The lucidity of the results of a programme may be low, especially if a long chain of events is dependent upon assumptions about percentages and prices for many complex cost or health impacts. Undertaking a *multiple decision analysis* may be helpful in such cases. In such an analysis assumptions about probabilities and costs can be described and varied simultaneously in order to see how they affect the final result.

Decision-trees

Figure 3 shows a typical decision-tree and a hypothetical example of a road construction project. The choice is between a two or three lane road, and the aim is to study the health impacts of both alternatives. The number of people (p1-p6) whose deaths (or disability) are prevented will depend on what configuration the road has. Both alternatives can (deleted text) lead to three major/primary types of health outcome:

1. Saved lives with full health compared with the current road.
2. Saved lives but with reduced health.
3. Death.

Positive and negative effects are set out in the far right section of the figure after each branch. In this case, negative effects are described as costs, primarily consisting of medical, health and rehabilitation costs. The positive effects are described as health gains in the form of QALYs. The number of saved lives due to the reform must thus be ascribed the value that people give to a statistical life. Deaths are calculated as zero value, in other words, no health gain at all, only costs.
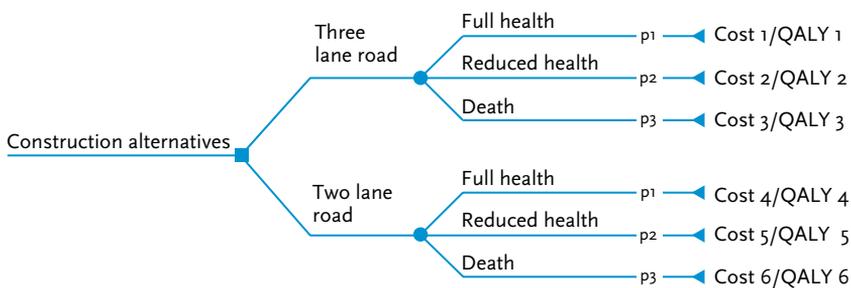

Figure 3: Example of a decision tree used for road construction planning.

Through beginning to specify costs and effects at the right of the figure, we can go back and calculate which branch to the left gives the best outcome in terms of costs per health effect (Cost-benefit analysis): the three lane road or the two lane road.

7. How should productivity losses be priced?

The perspective in an HIA is guided by the aim of the programme of which the HIA is a part. The programme can primarily be *internal* – to make the work of an agency or organisation more efficient. If the programme has a clearly limited internal perspective, then the effects in the HIA may also be limited to the principal's area of responsibility.

The perspective can also be *external*, with an aim directed to the population or parts of it. In this case, the HIA ought also have a social perspective and calculate all effects, no matter where they are felt throughout the country.

An important part of the total social perspective is therefore effects on the labour market – *productivity losses*. How should the effects for an individual be calculated, effects, for example that follow from reduced health status where changed abilities mean difficulties in carrying out their work. Lost net income can then be a natural starting point. Because the employer doesn't get the intended work done and furthermore pays a part of the sickness benefit to the employee, it is reasonable to contemplate other headings/accounting categories when calculating loss of productivity.

There are different ways to calculate productivity losses. The problem with calculating indirect costs is that people can solely be seen as a productive resource – in certain cases even as an asset to, or drain on society. If productivity loss is the only cost (except for treatment costs), some groups may be discriminated against, for example: the unemployed; part-time workers; women (who have lower incomes than men); pensioners, etc. From a public health perspective that is built upon equitable access to health, this approach can be seen as an unethical valuation principle. For these reasons the term *reduction in daily activities* has been proposed to give an average measure of value on this time as if it had been time lost from the full-time labour market.

It also needs to be said that if a cost-benefit analysis involving an evaluation of quality of life is undertaken, such effects as productivity losses could be covered in this measure and thereby the calculation of productivity losses can be avoided.

If productivity loss is determined to be important (despite the concerns raised above) two economic traditions can be followed. The simplest involves the calculation of the net value of lost time at work as described above. The preference for net income (in other words the disposable income) rests on the assumption that the individual themselves chooses which education, weekly working hours etc they shall have. If the individual gives a value to their time at work in a way that differs from the disposable income, they ought to try to change their situation. If the employer also pays a part of the sickness benefit, then this ought to be included as a cost.

Many people are dissatisfied with this simple argument. Koopmanschap et al (9) have designed a calculation method which is usually known as the "friction method". It is based on the cost of the problems that arise both at the workplace and in society generally when ordinary activities cannot be carried out or that other need

to replace sick workers with the economic loss that follows. Both methods have advantages and disadvantages. Which method is chosen probably doesn't matter much as long as a clear indication is given of how calculations were made, and the results are displayed separately from other calculations in the report.

8. How can an HIA be carried out if necessary data is not available?

The simple and orthodox answer to this question is to *not* to undertake an HIA when necessary data is not available, but reality is not so simple. Instead, all HIAs are about presenting a foundation to political decisions. These decisions almost always need to be made whether a decision-making base is available or not. The actual situation requires that the best possible analysis is undertaken to facilitate decision-making. Models are therefore constructed which include collected data plus, when it is necessary, such data that do not come from the current study but rather that (in order of preference) are drawn from: a) similar studies; b) general knowledge about "how it usually is" or; c) educated guesses. A special branch of statistics known as Bayesian analysis is usually used in these cases. It makes the results of the current study more uncertain in certain aspects, but such secondary data can still lead to a proper decision, instead of avoiding undertaking an HIA at all.

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This guide is written for people who work with practical analysis in the public health field at local, regional and central levels. It is also useful for decision-makers who may require a Health Impact Assessment to inform and support important decisions in a range of areas both inside and outside public health.

The Swedish government has given the Swedish National Institute of Public Health (SNIPH) the task of both developing methods in Health Impact Assessment (HIA) and supporting the application of HIA at central, regional and local levels. SNIPH has previously produced a number of reports within this area. These reports mainly use qualitative methods, which in most cases are sufficient for an HIA.

Some cases however, require the use of quantitative methods because of their complex nature. In other cases, aspects of cost are important elements in an HIA and these aspects are quantitative in nature. As a complement to existing qualitative reports, SNIPH offers this guide to quantitative analysis and methods in HIA. Although it is mainly based on well-known methods from health economic evaluation, this guide has been adapted for more general use across public health.

This guide has been written by Public Health Planning Officers Håkan Brodin and Stephen Hodge and is a translation of a Swedish SNIPH report in "Kvantitativa metoder vid hälsokonsekvensbedömningar – en vägledning. R 2007:12".

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