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Opportunity costs and cost-effectiveness thresholds

PERSPECTIVES

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The introduction of new treatments in Norway is based on opportunity costs, which are intended to contribute to the use of cost-effective interventions. In a new white paper on priority setting in the Norwegian health sector, the Norwegian Parliament (*Storting*) has requested that the Government produce a more robust estimate of opportunity costs based on Norwegian data. What does this mean?

Before new treatments are introduced in Norway, they should, as a general rule, be assessed in accordance with the Regulation on Priority Setting (1). The current priority-setting criteria seek to 'maximise health and coping in the population, fairly distributed' (2). The purpose of the assessment is to ensure that new treatments do not displace existing interventions that provide greater health benefits using the same amount of resources. The health that is displaced when a new treatment is introduced is known as the *opportunity cost*. In Norway, a treatment is considered cost-effective if the cost per quality-adjusted life year (QALY) for the new intervention is lower than a specified threshold, which in Norway is based on the principle of opportunity costs (2, 3).

The Storting has asked the Government to investigate a more reliable estimate of the opportunity cost for the health and care services, based on Norwegian data (4). In this article we will explain *cost-effectiveness* and *opportunity costs*, with the aim of encouraging broader participation in the debate on cost-effectiveness, thresholds and opportunity costs, which forms the basis of the system for health technology assessments.

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Priority setting in practice

Decisions on the public funding of medicines are made either by the Norwegian Medical Products Agency or the Decision Forum in the national system for the introduction of new health technologies, depending on whether the medicine is funded through the National Insurance Scheme or the specialist health service. Decisions are based on an assessment of the priority-setting criteria of expected health benefit, resource use and severity. This is carried out through a 'health technology assessment', in which cost-effectiveness analysis is a key tool for applying the priority-setting criteria in practice (5). In these analyses, models are developed to estimate costs and health outcomes for a given patient population, both for the new treatment and for a comparator, with long-term consequences included (often over a lifetime). As a general rule, the new treatment is compared with the treatment it is expected to replace.

In Norway, health outcomes are measured in quality-adjusted life years (QALYs) (6, 7). QALYs account for the effects of treatment on both life expectancy and health-related quality of life over the patient's lifetime. Measuring health in QALYs allows comparisons of interventions across disease areas (8). Costs, or the monetary value of resources, are measured in monetary units (NOK, EUR, USD, etc.).

Which costs, and to some extent health outcomes, are included in the analysis depends on the perspective adopted (9, 10). In Norway, an extended healthcare sector perspective is applied, meaning that the analysis mainly includes costs

borne by the health service, but travel costs and informal care may also be taken into account (9).

The cost-effectiveness model compares the present value of the total costs and QALYs over a patient's lifetime for each comparator treatment: the difference in costs divided by the difference in QALYs. In other words, the additional cost per additional QALY is calculated, also referred to as the incremental cost-effectiveness ratio (ICER):

$$ICER = \frac{Cost\ of\ the\ new\ treatment - Cost\ of\ the\ old\ treatment}{Effect\ of\ the\ new\ treatment - Effect\ of\ the\ old\ treatment}$$

Opportunity cost and cost-effectiveness

A new treatment may have similar, greater or fewer health benefits and/or costs compared with current treatment. For example, if a new treatment is less costly and more effective than the current treatment, it is considered cost-effective (dominant), as health outcomes are improved while resources are freed up for other interventions that may also have health benefits. However, it is common for new and more effective treatments to entail higher costs. The additional costs must then be financed with resources that would otherwise have been used elsewhere in the health service. Consequently, the introduction of the new treatment will result in some individuals receiving less care or losing access to a service altogether.

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In an analysis from a healthcare sector perspective, a treatment is generally considered cost-effective if the additional costs generate greater health gains than the extent of the health losses associated with healthcare services that are displaced. In this case, the ICER, i.e. the additional cost per additional QALY, must be lower than the cost per QALY of the displaced services. It is the authorities who set the willingness-to-pay for a QALY (the threshold). This threshold may reflect various factors, but when set to represent the cost per QALY of displaced services, it represents an opportunity-cost-based threshold.

Opportunity costs can be explained in several ways that essentially mean the same thing: they are the health that is displaced when new treatments are introduced within a fixed budget; they are the health benefits that patients could have gained if resources had been allocated to their best alternative use; or, in other words, the health benefits yielded for the last krone spent in the health service.

Illustration of opportunity cost

Suppose that the health service only offers treatments 1, 2, 3 and 4 to four patient groups with conditions A, B, C and D. Each condition has only one treatment option, such that the alternative to treatment is 'no treatment'. The average cost per QALY has been assumed and calculated for all treatments, compared with no treatment (Table 1). The treatments can be ranked from the lowest to the highest cost per QALY.

Table 1

Hypothetical example of a health service offering four treatments for four different conditions, ranked from the lowest to the highest cost per QALY compared with no treatment.

Treatment	Condition	Cost per QALY compared with no treatment
1	A	50 000
2	B	100 000
3	C	200 000
4	D	275 000

A new treatment, Treatment 5, is now being assessed for condition A. If Treatment 5 is introduced, it will replace Treatment 1. Treatment 1 therefore constitutes the comparator in the cost-effectiveness analysis. Table 2 shows the results of the hypothetical cost-effectiveness analysis. Treatment 5 leads to a greater health benefit than Treatment 1 (3.5–3.0 = 0.5 QALYs), but also has a higher cost per patient (NOK 400,000 – NOK 150,000 = NOK 250,000). This results in an ICER of NOK 500,000 per additional QALY.

$$\text{ICER} = \frac{\text{NOK } 400{,}000 - 150{,}000}{3.5 - 3.0 \text{ QALY}} = \text{NOK } 500{,}000$$

Table 2

Cost-effectiveness analysis of Treatment 5 (note that the average cost per patient is not the same as the cost per QALY in Table 1). ICER = incremental cost-effectiveness ratio.

Treatment	Condition	Average cost per patient	Average no. of QALYs per patient	Difference in cost (ΔC)	Difference in QALYs (ΔQ)	ICER (ΔC/ΔQ)
1	A	150 000	3.0	-	-	

Treatment	Condition	Average cost per patient	Average no. of QALYs per patient	Difference in cost (ΔC)	Difference in QALYs (ΔQ)	ICER (ΔC/ΔQ)
5	A	400 000	3.5	250 000	0.5	500 000

Is Treatment 5 cost-effective, given what we know about the health service in Table 1? To answer this question, the ICER of NOK 500,000 must be compared with the opportunity cost threshold. But what is the opportunity cost threshold in this case? The premise of the analysis is that the healthcare budget is fixed. This means that if Treatment 5 is introduced, one or more of Treatments 1–4 must be wholly or partly displaced in order to finance the new treatment. In this example, we also assume that displacing a single treatment is sufficient to fund the new treatment. When choosing which of these four treatments to displace, we should start with the treatment(s) with the highest cost per QALY. In Table 1, this is Treatment 4, for which the health service is expected to obtain 1 QALY per NOK 275,000 invested.

In this example, we also assume that it is not possible to improve health outcomes by expanding the use of Treatments 1–3, which have a lower cost per QALY, rather than using Treatment 4. When deciding whether Treatment 5 should be adopted, 1 QALY per NOK 275,000 therefore represents the best alternative use of resources. One QALY per NOK 275,000 is thus the opportunity cost. Since Treatment 5 costs NOK 500,000 per QALY, the treatment is not cost-effective.

Consequences of non-cost-effective treatment

The consequences of adopting Treatment 5 are illustrated in Figure 1. The figure shows incremental costs (y-axis) and incremental QALYs (x-axis) compared with Treatment 1 (the origin). Treatment 5 gives an additional 0.5 QALYs at an additional cost of NOK 250,000, represented by the point on the red line. The red line represents all treatments with an ICER of NOK 500,000 per additional QALY compared with Treatment 1. The blue line indicates an ICER of NOK 275,000 per additional QALY, which is the opportunity cost threshold in this example (Treatment 4, condition D). No treatments above the blue line are cost-effective.

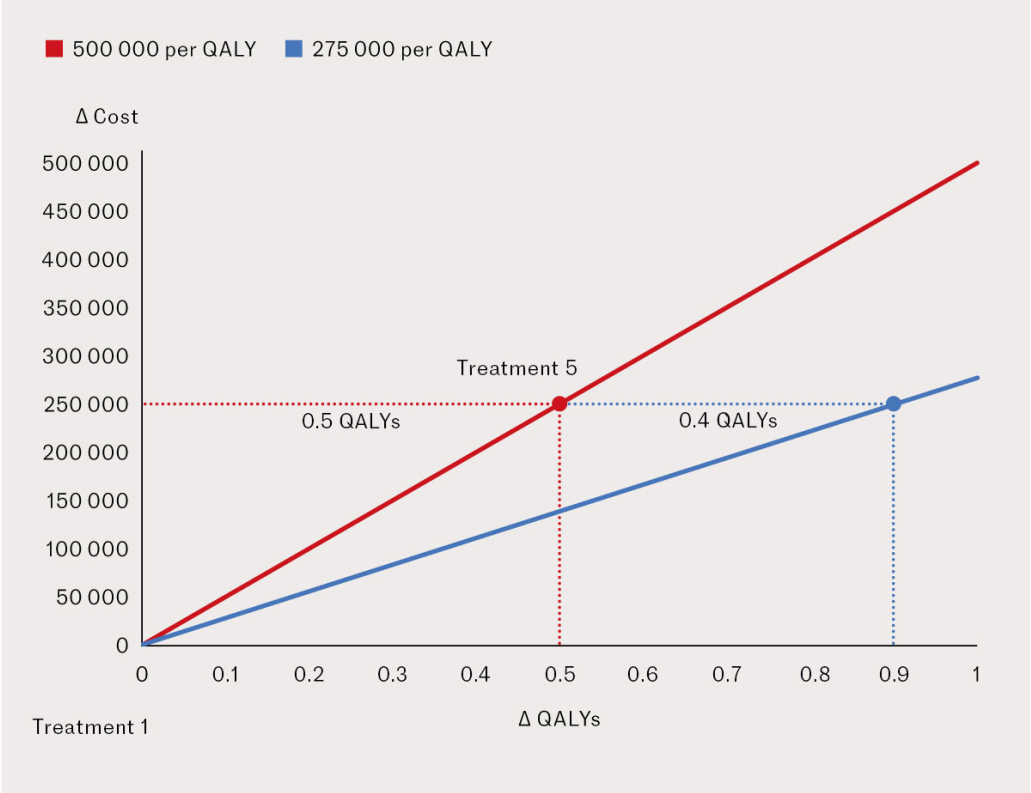

Figure 1 Illustration of the health loss associated with introducing Treatment 5, which has an incremental cost-effectiveness ratio (ICER) above the opportunity cost threshold compared with Treatment 1. The health loss is represented by the blue dotted horizontal line. For the same cost as Treatment 5, the health service could obtain an additional 0.4 QALYs.

Given the fixed budget, Treatment 5 will be funded by reducing the use of the least cost-effective treatment, namely Treatment 4. For NOK 250,000, the health service obtains 0.9 QALYs from *Treatment 4* (equivalent to 1 QALY per NOK 275,000), illustrated by the blue dot in Figure 1. For the same NOK 250,000, the health service obtains only 0.5 QALYs from Treatment 5 (equivalent to 1 QALY per NOK 500,000, see Table 2), illustrated by the red dot in Figure 1.

Funding Treatment 5 therefore entails a health loss of 0.4 QALYs per patient for each NOK 250,000 spent on Treatment 5. In Figure 1, this loss is represented by the blue dotted horizontal line. The more the ICER exceeds NOK 275,000, the steeper the red line and the greater the health loss associated with introducing Treatment 5. Conversely, if Treatment 5 has an ICER below NOK 275,000 per QALY, it will result in an improvement in total population health and will therefore be considered cost-effective.

Estimating opportunity cost

Not everything in the health service can be classified as an intervention or a treatment, and for many interventions, the health effects (measured in QALYs) or costs are unknown. There is no exhaustive list of interventions comparable to that shown in Table 1, and no systematic way of reducing the least cost-effective interventions.

Furthermore, it is not necessarily the least cost-effective intervention that is displaced; nevertheless, whatever is displaced will represent the opportunity cost. Which interventions are wholly or partly displaced can vary across providers and over time. It is rare for a single intervention, such as Treatment 4, to represent the opportunity cost in national decision-making. Introducing new treatments could cause clinics or primary care services to refrain from hiring an additional nurse, lead health trusts to postpone investments, or prompt hospitals to forgo offering certain treatments. It is assumed that such cuts result in health losses for patients who lose access to treatment, but identifying who is affected, the extent of the loss or when it occurs is challenging.

> ***«It does not necessarily have to be the least cost-effective interventions that are displaced; nevertheless, whatever is displaced will represent the opportunity cost»***

To estimate opportunity cost, the complexity of reality must be simplified. The current Norwegian opportunity cost threshold is based on an estimate for NHS England (11). After conversion, the opportunity cost was initially estimated at NOK 215,000 per QALY and subsequently increased to NOK 275,000 on a discretionary basis (12). This estimate was later used by a working group assessing the severity criterion (13), and the stepwise model proposed by that group is still in use today. The model starts at NOK 275,000 per QALY, with the threshold increasing for more severe conditions. Figure 1 can illustrate the consequences of such a model – namely, the extent to which we are willing to reduce overall population health if it improves the health of patient groups with more severe conditions.

In our view, the current threshold of NOK 275,000 should be interpreted more as a pragmatically determined willingness-to-pay threshold for publicly funded healthcare rather than a threshold derived from opportunity costs. Plans are now being made to develop a more robust estimate of the opportunity costs using Norwegian data (4). As the Storting has decided that the threshold should be based on opportunity costs, it is important that Norwegian analyses are conducted.

> ***«In our view, the current threshold of NOK 275,000 should be interpreted more as a pragmatically determined willingness-to-pay threshold for publicly funded healthcare rather than a threshold derived from opportunity cost»***

However, there will always be uncertainty associated with estimating opportunity costs, and no method will achieve full consensus. The assessment proposed by the Government will, hopefully, shed further light on the methods. A discussion of the methods and estimates based on Norwegian data and analyses could strengthen the legitimacy of the thresholds.

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