Canadian Association for Population Therapeutics / Association Canadienne pour la Thérapeutique des Populations Annual Conference

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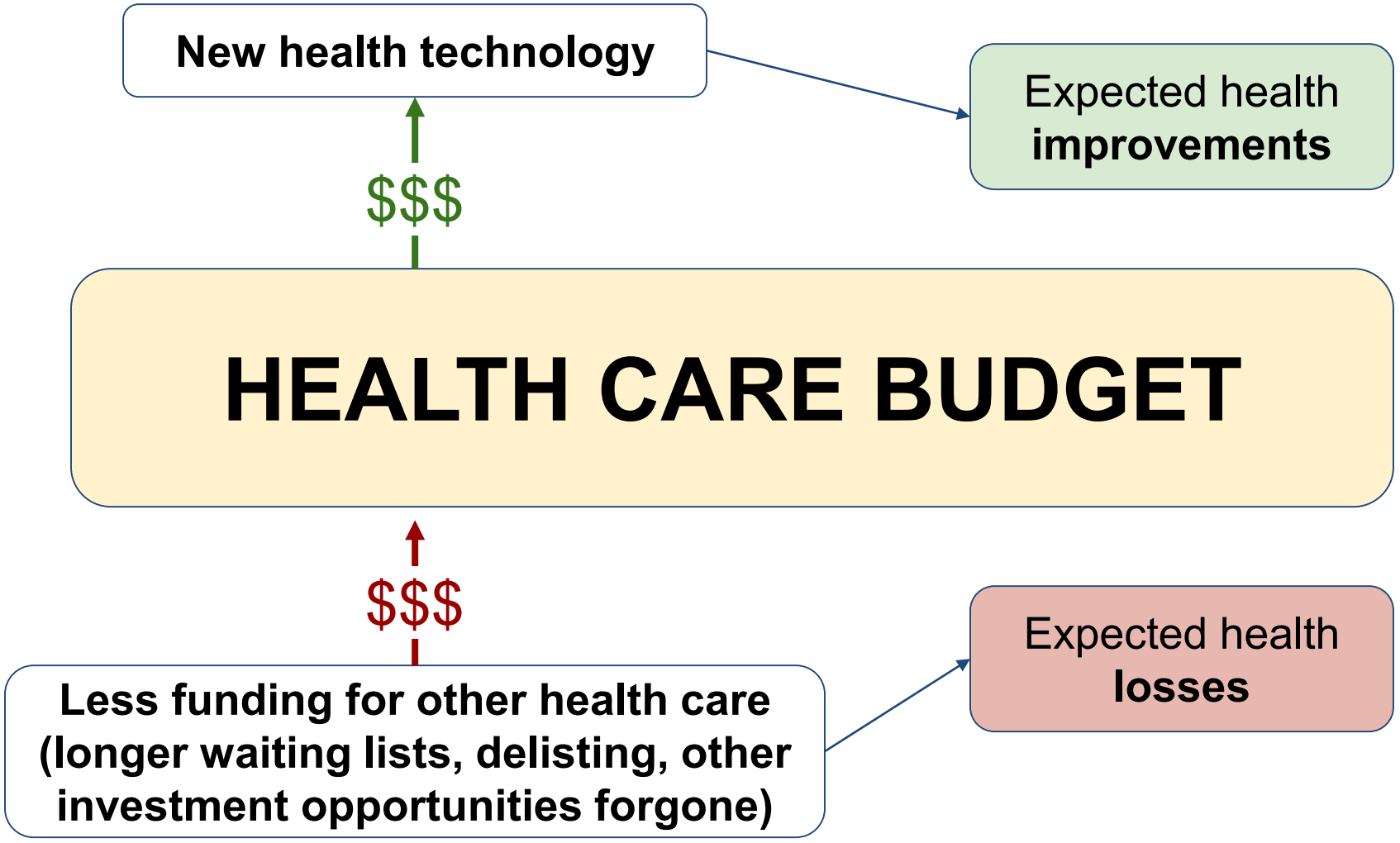
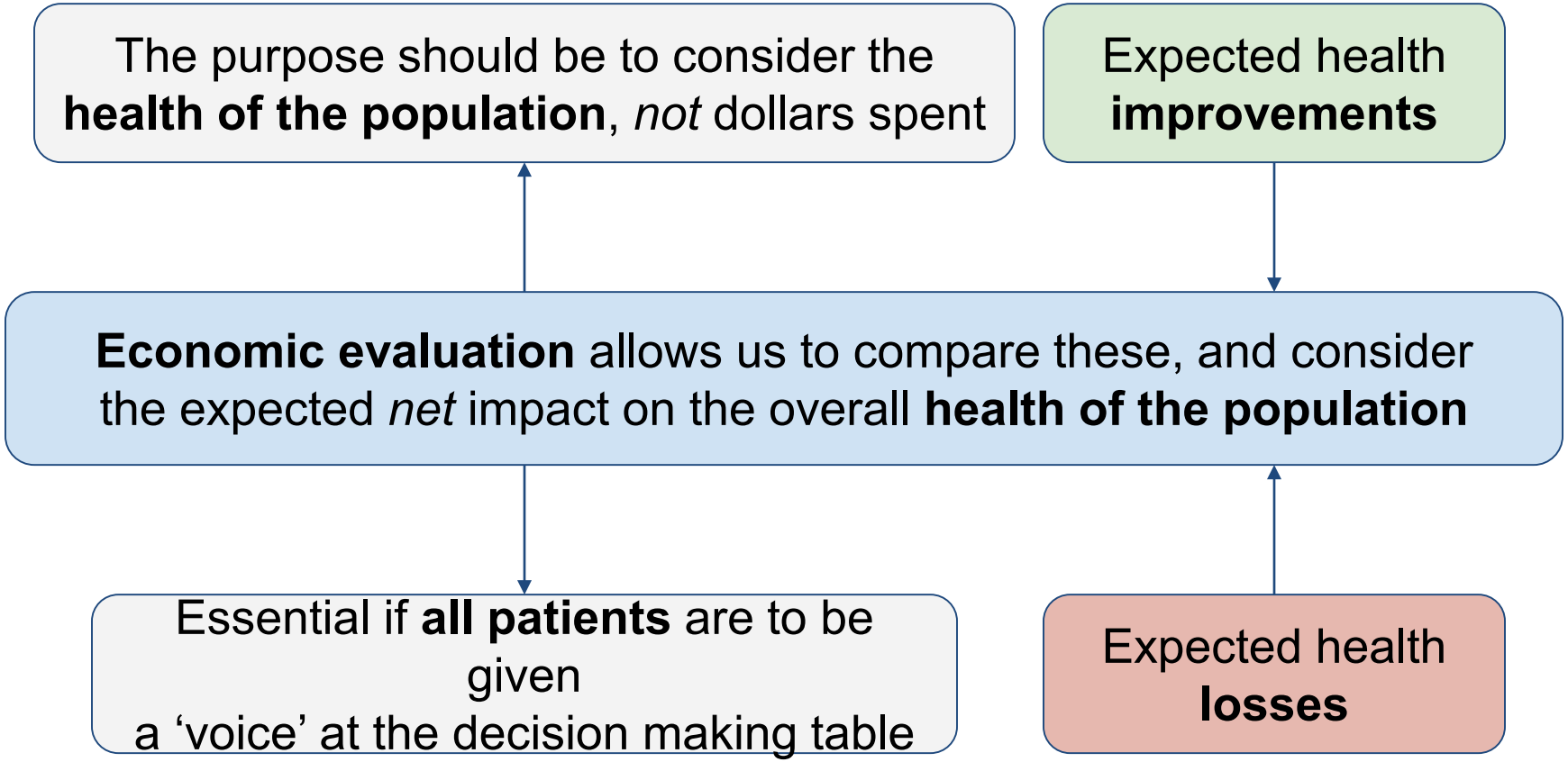
Towards An Evidence Based Approach for CADTH's Cost-Effectiveness Threshold

National Landscape Panel at CAPT 2022
18 October 2022, Toronto

Mike Paulden, PhD, Associate Professor,
School of Public Health, University of Alberta

Why is economic evaluation important?


New health technology
Expected health improvements
$$$
HEALTH CARE BUDGET
$$$
Less funding for other health care (longer waiting lists, delisting, other investment opportunities forgone)
Expected health losses


The purpose should be to consider the **health of the population**, *not* dollars spent
Expected health **improvements**
Economic evaluation allows us to compare these, and consider the expected *net* impact on the overall **health of the population**
Essential if **all patients** are to be given a 'voice' at the decision making table
Expected health **losses**

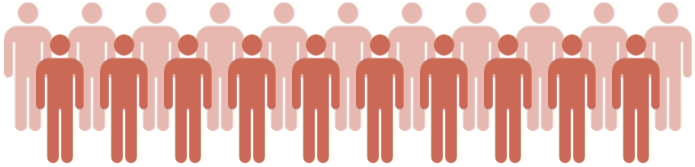
Expected health **improvements**

A treatment is considered **cost-effective** if its reimbursement is expected to **improve** the overall health of the population

Expected health **losses**

Expected health **improvements**

A treatment is considered **not** cost-effective if its reimbursement is expected to **diminish** the overall health of the population



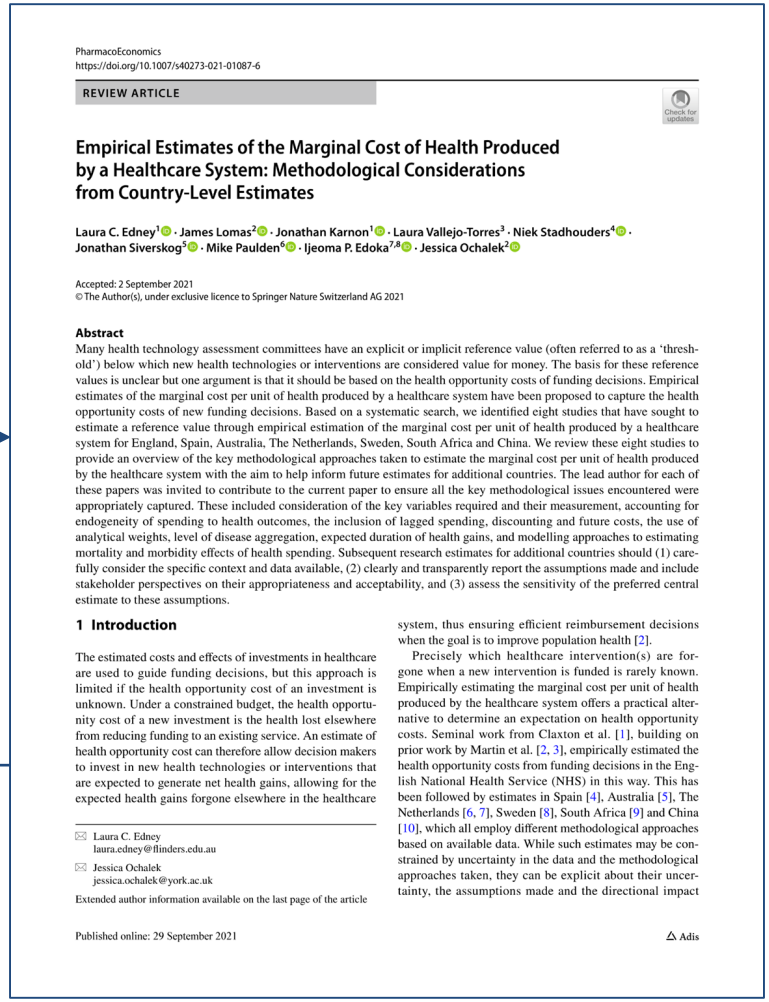
Expected health **losses**

Determining an evidence based cost-effectiveness threshold

How much **health loss** arises from the incremental cost of new technologies (i.e. the **health opportunity cost**)?

Requires **empirical** analysis

Peer-reviewed estimates of the incremental cost required to lose **one quality-adjusted life year (QALY) of population health** (i.e. marginal productivity)



PharmacoEconomics
https://doi.org/10.1007/s40273-021-01087-6

REVIEW ARTICLE

Empirical Estimates of the Marginal Cost of Health Produced by a Healthcare System: Methodological Considerations from Country-Level Estimates

Laura C. Edney[1] · James Lomas[2] · Jonathan Karnon[1] · Laura Vallejo-Torres[3] · Niek Stadhouders[4] · Jonathan Siverskog[5] · Mike Paulden[6] · Ijeoma P. Edoka[7,8] · Jessica Ochalek[2]

Accepted: 2 September 2021

Abstract
Many health technology assessment committees have an explicit or implicit reference value (often referred to as a 'threshold') below which new health technologies or interventions are considered value for money. The basis for these reference values is unclear but one argument is that it should be based on the health opportunity costs of funding decisions. Empirical estimates of the marginal cost per unit of health produced by a healthcare system have been proposed to capture the health opportunity costs of new funding decisions. Based on a systematic search, we identified eight studies that have sought to estimate a reference value through empirical estimation of the marginal cost per unit of health produced by a healthcare system for England, Spain, Australia, The Netherlands, Sweden, South Africa and China. We review these eight studies to provide an overview of the key methodological approaches taken to estimate the marginal cost per unit of health produced by the healthcare system with the aim to help inform future estimates for additional countries. The lead author for each of these papers was invited to contribute to the current paper to ensure all the key methodological issues encountered were appropriately captured. These included consideration of the key variables required and their measurement, accounting for endogeneity of spending to health outcomes, the inclusion of lagged spending, discounting and future costs, the use of analytical weights, level of disease aggregation, expected duration of health gains, and modelling approaches to estimating mortality and morbidity effects of health spending. Subsequent research estimates for additional countries should (1) carefully consider the specific context and data available, (2) clearly and transparently report the assumptions made and include stakeholder perspectives on their appropriateness and acceptability, and (3) assess the sensitivity of the preferred central estimate to these assumptions.

1 Introduction

The estimated costs and effects of investments in healthcare are used to guide funding decisions, but this approach is limited if the health opportunity cost of an investment is unknown. Under a constrained budget, the health opportunity cost of a new investment is the health lost elsewhere from reducing funding to an existing service. An estimate of health opportunity cost can therefore allow decision makers to invest in new health technologies or interventions that are expected to generate net health gains, allowing for the expected health gains forgone elsewhere in the healthcare system, thus ensuring efficient reimbursement decisions when the goal is to improve population health [2].

Precisely which healthcare intervention(s) are forgone when a new intervention is funded is rarely known. Empirically estimating the marginal cost per unit of health produced by the healthcare system offers a practical alternative to determine an expectation on health opportunity costs. Seminal work from Claxton et al. [1], building on prior work by Martin et al. [2, 3], empirically estimated the health opportunity costs from funding decisions in the English National Health Service (NHS) in this way. This has been followed by estimates in Spain [4], Australia [5], The Netherlands [6, 7], Sweden [8], South Africa [9] and China [10], which all employ different methodological approaches based on available data. While such estimates may be constrained by uncertainty in the data and the methodological approaches taken, they can be explicit about their uncertainty, the assumptions made and the directional impact

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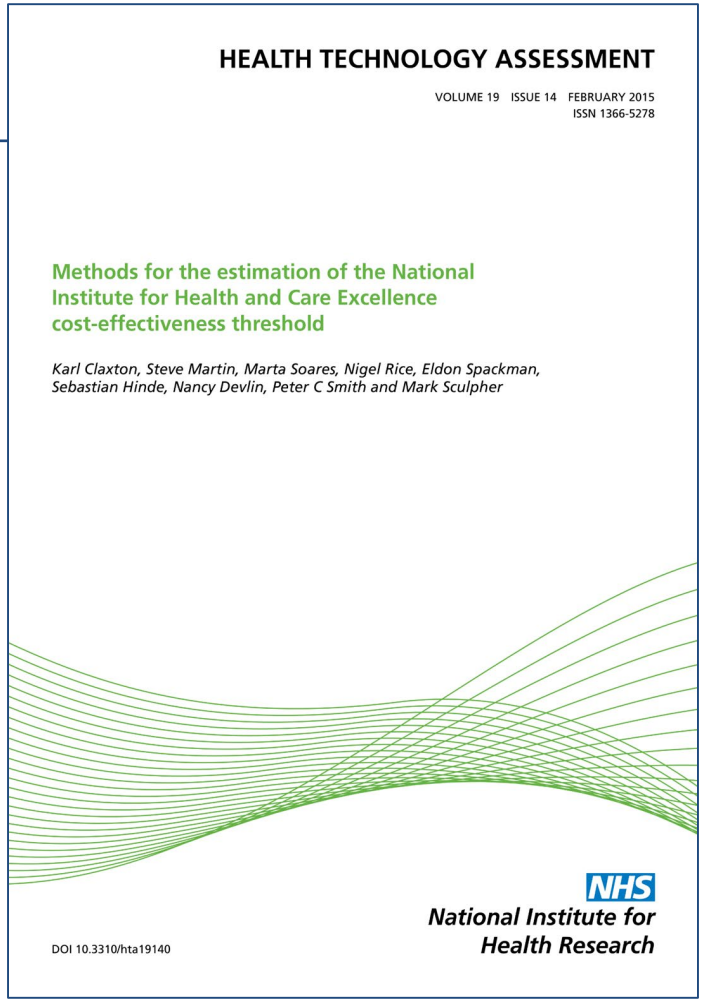
Published online: 29 September 2021

England
(University of York)
£12,936 per QALY (2008 GBP)



England
(University of York)
£12,936 per QALY (2008 GBP)

Spain
(University of Las Palmas de Gran Canaria)
€24,870 per QALY (2012 EUR)

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DOI: 10.1002/hec.3633

RESEARCH ARTICLE

WILEY Health Economics

Estimating a cost-effectiveness threshold for the Spanish NHS

Laura Vallejo-Torres[1,2,3] | Borja García-Lorenzo[1,4] | Pedro Serrano-Aguilar[1,3,5]

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Funding information
Ministry of Health, Social Services, and Equality

Abstract
The cost of generating a quality-adjusted life year (QALY) within a National Health Service provides an approximation of the average opportunity cost of funding decisions. This information can be used to inform a cost-effectiveness threshold. The aim of this paper is to estimate the cost per QALY at the Spanish National Health Service. We exploit variation across 17 regional health services and the exogenous changes in expenditure that took place as a consequence of the economic crisis over 5 years of data. We conduct fixed effect models and use an instrumental variable approach to test for potential remaining endogeneity. Our results show that health expenditure has a positive and significant effect on population health, with an average spending elasticity of 0.07. This translates into a cost per QALY of between 22,000€ and 25,000€. These values are below the cost-effectiveness threshold figure of 30,000€ commonly cited in Spain.

KEYWORDS
cost-effectiveness, health care spending, QALY, threshold

1 | INTRODUCTION

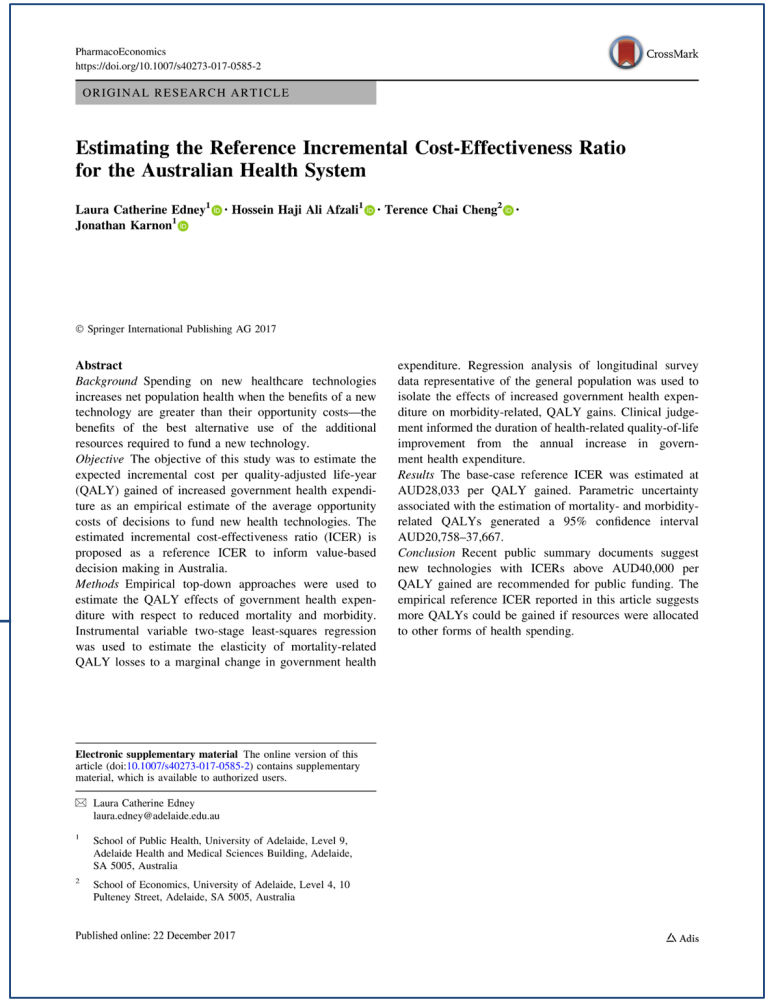
Cost-effectiveness analysis results are usually summarised by the incremental cost-effectiveness ratio (ICER), defined as the incremental cost divided by the incremental effectiveness of two competing alternatives, using quality-adjusted life years (QALYs) as the measure of effectiveness. However, cost-effectiveness analysis evidence supplied as the incremental cost per QALY gained of competing health technologies is not enough to ultimately make adoption or otherwise recommendations on the basis of cost-effectiveness. For decision making, the ICER of a technology needs to be compared with a value that indicates the maximum amount considered acceptable to be paid for health gains in the health system, that is, the cost-effectiveness threshold. This value is unknown in most health care systems.

A recent review of studies estimating a cost-effectiveness threshold identified 38 studies (Vallejo-Torres et al., 2016). The studies were driven by different views as to what the threshold ought to represent. The two main conceptual perspectives are that the threshold should reflect (a) society's monetary valuation of health gains or (b) the opportunity cost resulting from the disinvestment required to adopt a new technology (Baker et al., 2011). A consultation among experts conducted in Spain concluded that both approaches should be explored in order to inform a cost-effectiveness threshold

England
(University of York)
£12,936 per QALY (2008 GBP)

Spain
(University of Las Palmas de Gran Canaria)
€24,870 per QALY (2012 EUR)

Australia
(University of Adelaide)
$28,033 per QALY (2012 AUD)



PharmacoEconomics
https://doi.org/10.1007/s40273-017-0585-2

CrossMark

ORIGINAL RESEARCH ARTICLE

Estimating the Reference Incremental Cost-Effectiveness Ratio for the Australian Health System

Laura Catherine Edney[1] · Hossein Haji Ali Afzali[1] · Terence Chai Cheng[2] · Jonathan Karnon[1]

Abstract
Background Spending on new healthcare technologies increases net population health when the benefits of a new technology are greater than their opportunity costs—the benefits of the best alternative use of the additional resources required to fund a new technology.
Objective The objective of this study was to estimate the expected incremental cost per quality-adjusted life-year (QALY) gained of increased government health expenditure as an empirical estimate of the average opportunity costs of decisions to fund new health technologies. The estimated incremental cost-effectiveness ratio (ICER) is proposed as a reference ICER to inform value-based decision making in Australia.
Methods Empirical top-down approaches were used to estimate the QALY effects of government health expenditure with respect to reduced mortality and morbidity. Instrumental variable two-stage least-squares regression was used to estimate the elasticity of mortality-related QALY losses to a marginal change in government health expenditure. Regression analysis of longitudinal survey data representative of the general population was used to isolate the effects of increased government health expenditure on morbidity-related, QALY gains. Clinical judgement informed the duration of health-related quality-of-life improvement from the annual increase in government health expenditure.
Results The base-case reference ICER was estimated at AUD28,033 per QALY gained. Parametric uncertainty associated with the estimation of mortality- and morbidity-related QALYs generated a 95% confidence interval AUD20,758–37,667.
Conclusion Recent public summary documents suggest new technologies with ICERs above AUD40,000 per QALY gained are recommended for public funding. The empirical reference ICER reported in this article suggests more QALYs could be gained if resources were allocated to other forms of health spending.

Electronic supplementary material The online version of this article (doi:10.1007/s40273-017-0585-2) contains supplementary material, which is available to authorized users.

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Published online: 22 December 2017

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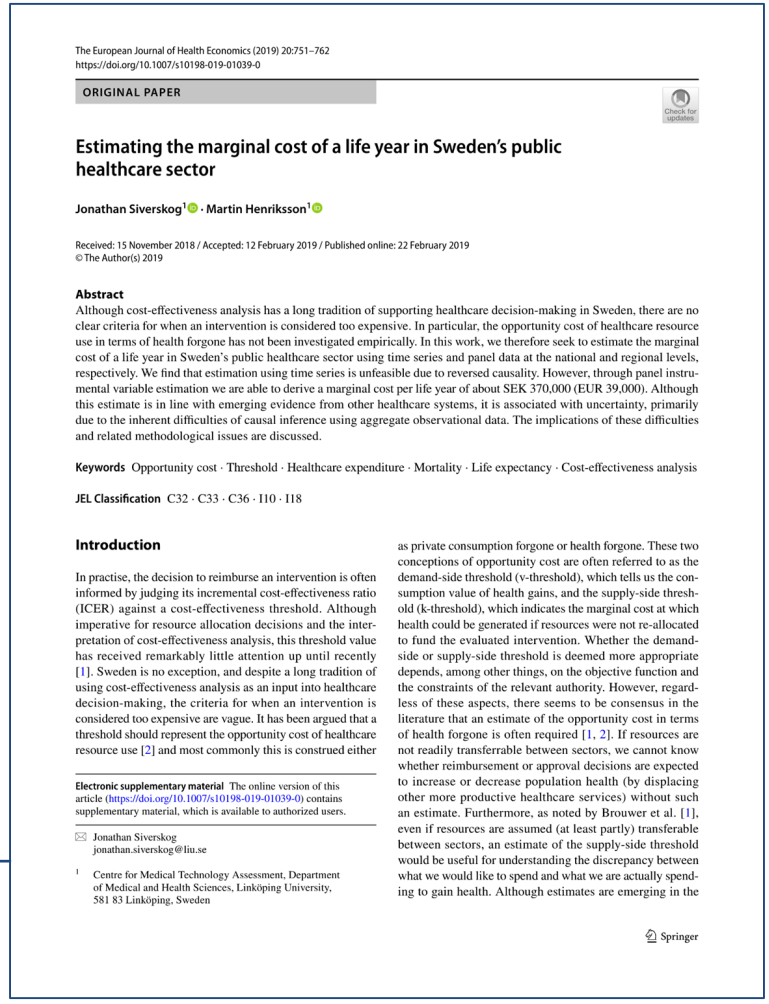
England
(University of York)
£12,936 per QALY (2008 GBP)

Spain
(University of Las Palmas de Gran Canaria)
€24,870 per QALY (2012 EUR)

Australia
(University of Adelaide)
$28,033 per QALY (2012 AUD)

Sweden
(Linköping University)
183,539 kr per QALY (2016 SEK)



The European Journal of Health Economics (2019) 20:751–762
https://doi.org/10.1007/s10198-019-01039-0

ORIGINAL PAPER

Estimating the marginal cost of a life year in Sweden's public healthcare sector

Jonathan Siverskog[1] · Martin Henriksson[1]

Received: 15 November 2018 / Accepted: 12 February 2019 / Published online: 22 February 2019

Abstract
Although cost-effectiveness analysis has a long tradition of supporting healthcare decision-making in Sweden, there are no clear criteria for when an intervention is considered too expensive. In particular, the opportunity cost of healthcare resource use in terms of health forgone has not been investigated empirically. In this work, we therefore seek to estimate the marginal cost of a life year in Sweden's public healthcare sector using time series and panel data at the national and regional levels, respectively. We find that estimation using time series is unfeasible due to reversed causality. However, through panel instrumental variable estimation we are able to derive a marginal cost per life year of about SEK 370,000 (EUR 39,000). Although this estimate is in line with emerging evidence from other healthcare systems, it is associated with uncertainty, primarily due to the inherent difficulties of causal inference using aggregate observational data. The implications of these difficulties and related methodological issues are discussed.

Keywords Opportunity cost · Threshold · Healthcare expenditure · Mortality · Life expectancy · Cost-effectiveness analysis

JEL Classification C32 · C33 · C36 · I10 · I18

Introduction

In practise, the decision to reimburse an intervention is often informed by judging its incremental cost-effectiveness ratio (ICER) against a cost-effectiveness threshold. Although imperative for resource allocation decisions and the interpretation of cost-effectiveness analysis, this threshold value has received remarkably little attention up until recently [1]. Sweden is no exception, and despite a long tradition of using cost-effectiveness analysis as an input into healthcare decision-making, the criteria for when an intervention is considered too expensive are vague. It has been argued that a threshold should represent the opportunity cost of healthcare resource use [2] and most commonly this is construed either as private consumption forgone or health forgone. These two conceptions of opportunity cost are often referred to as the demand-side threshold (v-threshold), which tells us the consumption value of health gains, and the supply-side threshold (k-threshold), which indicates the marginal cost at which health could be generated if resources were not re-allocated to fund the evaluated intervention. Whether the demand-side or supply-side threshold is deemed more appropriate depends, among other things, on the objective function and the constraints of the relevant authority. However, regardless of these aspects, there seems to be consensus in the literature that an estimate of the opportunity cost in terms of health forgone is often required [1, 2]. If resources are not readily transferrable between sectors, we cannot know whether reimbursement or approval decisions are expected to increase or decrease population health (by displacing other more productive healthcare services) without such an estimate. Furthermore, as noted by Brouwer et al. [1], even if resources are assumed (at least partly) transferable between sectors, an estimate of the supply-side threshold would be useful for understanding the discrepancy between what we would like to spend and what we are actually spending to gain health. Although estimates are emerging in the

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s10198-019-01039-0) contains supplementary material, which is available to authorized users.

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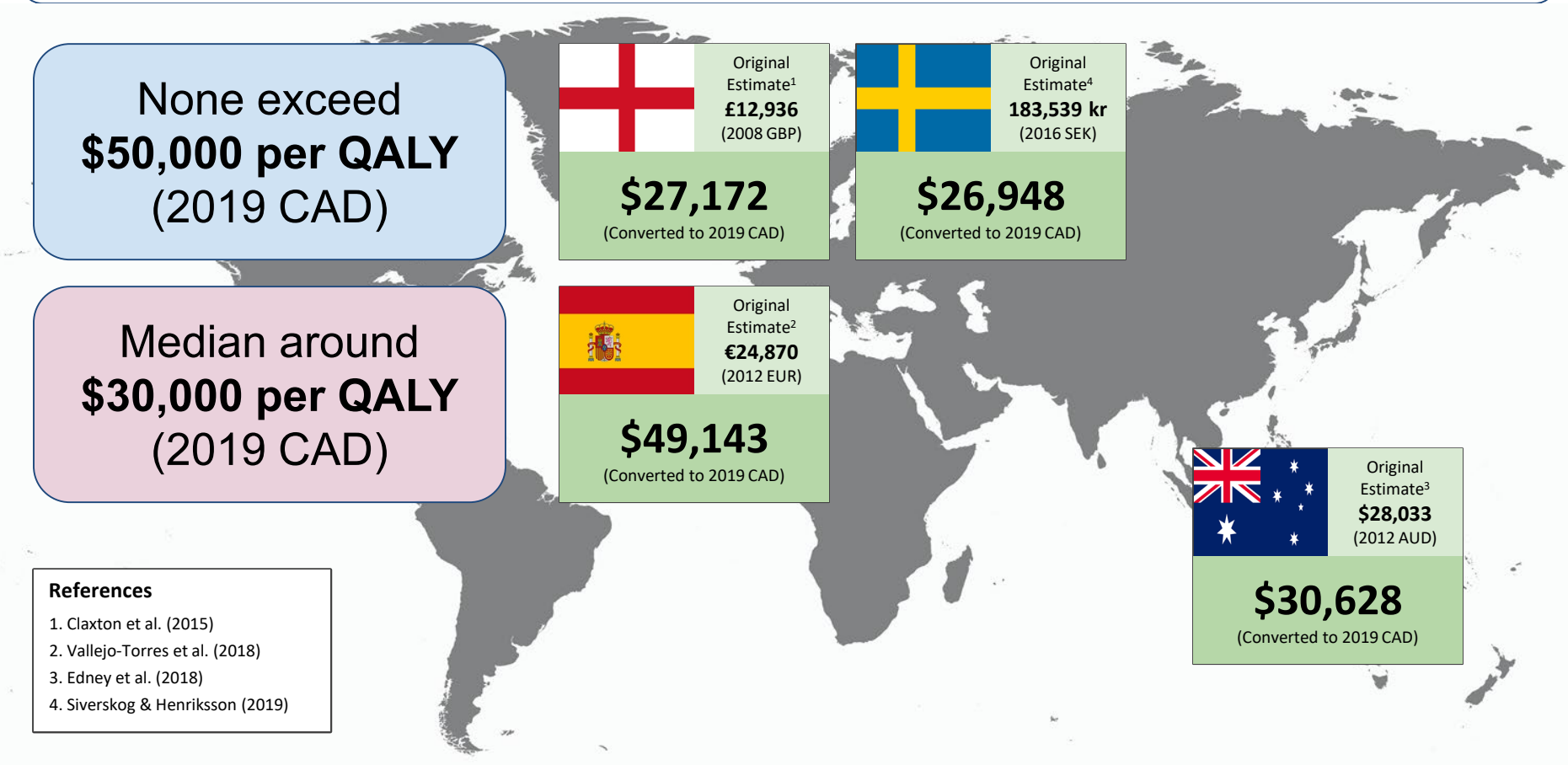
Marginal productivity (health opportunity cost) for public health care systems in PMPRB11 countries (per QALY, converted to 2019 CAD)



None exceed
$50,000 per QALY
(2019 CAD)

Median around
$30,000 per QALY
(2019 CAD)

Original Estimate[1]
£12,936
(2008 GBP)

$27,172
(Converted to 2019 CAD)

Original Estimate[4]
183,539 kr
(2016 SEK)

$26,948
(Converted to 2019 CAD)

Original Estimate[2]
€24,870
(2012 EUR)

$49,143
(Converted to 2019 CAD)

Original Estimate[3]
$28,033
(2012 AUD)

$30,628
(Converted to 2019 CAD)

References

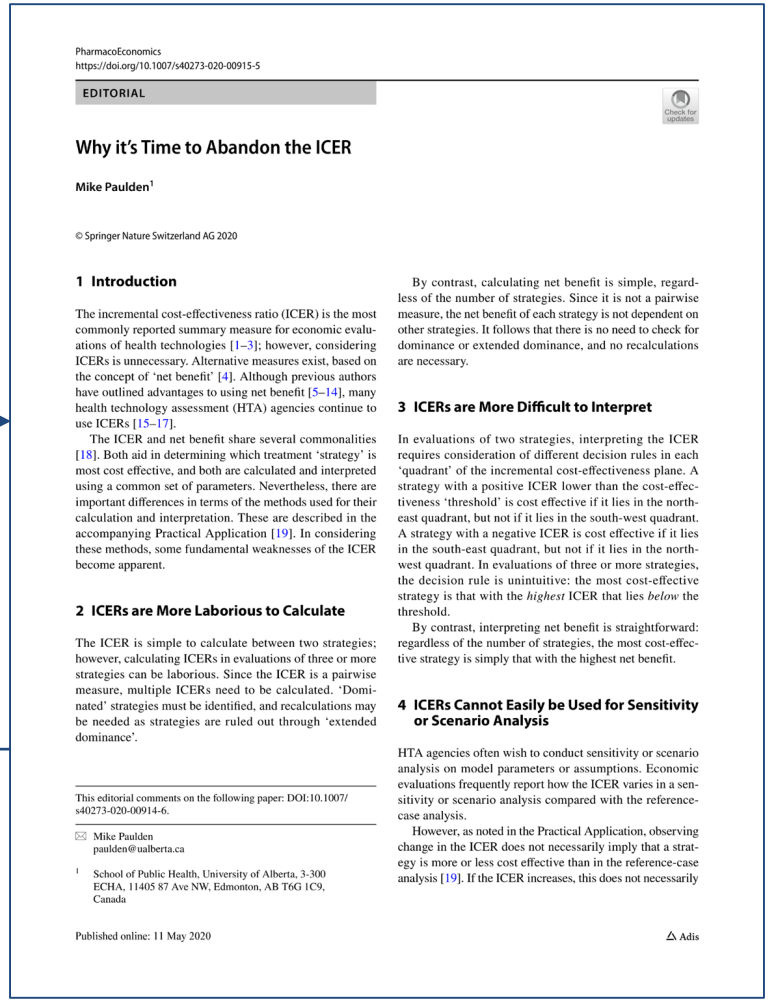
1. Claxton et al. (2015)
2. Vallejo-Torres et al. (2018)
3. Edney et al. (2018)
4. Siverskog & Henriksson (2019)

Moving on from ICERs: estimating the impact on net population health

Conventionally, the **ICER** for each technology is compared to the **cost-effectiveness threshold**

Unnecessarily restrictive

The **same information** can be used to estimate the **net impact on population health**, which a decision maker can trade off with other considerations of value



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https://doi.org/10.1007/s40273-020-00915-5

EDITORIAL

Why it's Time to Abandon the ICER

Mike Paulden[1]

1 Introduction

The incremental cost-effectiveness ratio (ICER) is the most commonly reported summary measure for economic evaluations of health technologies [1–3]; however, considering ICERs is unnecessary. Alternative measures exist, based on the concept of 'net benefit' [4]. Although previous authors have outlined advantages to using net benefit [5–14], many health technology assessment (HTA) agencies continue to use ICERs [15–17].

The ICER and net benefit share several commonalities [18]. Both aid in determining which treatment 'strategy' is most cost effective, and both are calculated and interpreted using a common set of parameters. Nevertheless, there are important differences in terms of the methods used for their calculation and interpretation. These are described in the accompanying Practical Application [19]. In considering these methods, some fundamental weaknesses of the ICER become apparent.

2 ICERs are More Laborious to Calculate

The ICER is simple to calculate between two strategies; however, calculating ICERs in evaluations of three or more strategies can be laborious. Since the ICER is a pairwise measure, multiple ICERs need to be calculated. 'Dominated' strategies must be identified, and recalculations may be needed as strategies are ruled out through 'extended dominance'.

By contrast, calculating net benefit is simple, regardless of the number of strategies. Since it is not a pairwise measure, the net benefit of each strategy is not dependent on other strategies. It follows that there is no need to check for dominance or extended dominance, and no recalculations are necessary.

3 ICERs are More Difficult to Interpret

In evaluations of two strategies, interpreting the ICER requires consideration of different decision rules in each 'quadrant' of the incremental cost-effectiveness plane. A strategy with a positive ICER lower than the cost-effectiveness 'threshold' is cost effective if it lies in the north-east quadrant, but not if it lies in the south-west quadrant. A strategy with a negative ICER is cost effective if it lies in the south-east quadrant, but not if it lies in the north-west quadrant. In evaluations of three or more strategies, the decision rule is unintuitive: the most cost-effective strategy is that with the *highest* ICER that lies *below* the threshold.

By contrast, interpreting net benefit is straightforward: regardless of the number of strategies, the most cost-effective strategy is simply that with the highest net benefit.

4 ICERs Cannot Easily be Used for Sensitivity or Scenario Analysis

HTA agencies often wish to conduct sensitivity or scenario analysis on model parameters or assumptions. Economic evaluations frequently report how the ICER varies in a sensitivity or scenario analysis compared with the reference-case analysis.

However, as noted in the Practical Application, observing change in the ICER does not necessarily imply that a strategy is more or less cost effective than in the reference-case analysis [19]. If the ICER increases, this does not necessarily

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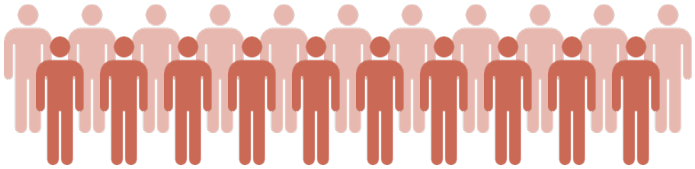
What about equity in the distribution of population health?

Expected health **improvements**

What if some or all of the patients who stand to **benefit** have **characteristics** that we wish to **prioritize**?

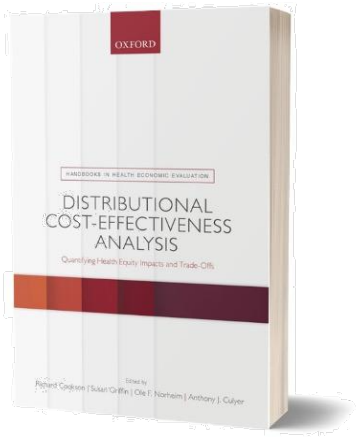


Expected health **losses**

We can use **distributional cost-effectiveness analysis**

Apply **direct equity weights** to QALYs

Distributional Cost-Effectiveness Analysis: Quantifying Health Equity Impacts and Trade-Offs. 2020. *Richard Cookson (ed.), Susan Griffin (ed.), Ole F. Norheim (ed.), Anthony J. Culyer (ed.).* Oxford University Press.



Chapter 14

Direct equity weights

Mike Paulden, James O'Mahony, and Jeff Round

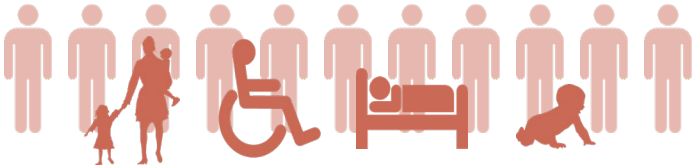
Direct equity weights are indicators of relative importance applied to effects and opportunity costs for specific subgroups of the population—such as people with or without a severe or rare or terminal illness—giving higher priority to some and lower priority to others. This chapter shows how two different forms of direct equity weighting can be used: 'health weighting', in which weights are applied directly to the health-adjusted life year (HALY) effects and opportunity costs on each side of the equity-weighted net health benefit equation; and 'threshold weighting', in which an adjustment is instead made to the cost-effectiveness threshold. The latter approach is a simple approximation to the former, though can be misleading because it fails to account for the distribution of health opportunity costs between people with different equity-relevant characteristics. In effect, threshold weighing is a one-sided form of equity weighting in which equity weights are only applied to benefits but not opportunity costs. The chapter then shows how net equity impact can be plotted on the equity-efficiency impact plane using direct equity weights. The chapter concludes by examining the circumstances under which threshold weighting can be misleading, with the aid of simple hypothetical examples that illustrate the importance of paying careful attention to the distribution of health opportunity costs.

14.1 Introduction

This chapter describes the use of direct equity weights to evaluate and rank decision options. Direct equity weights can be used to give priority to population subgroups based on disease categories, such as people suffering from rare or terminal or severe diseases. For example, national healthcare technology assessment processes in the Netherlands and Norway use direct equity weights that give priority to people suffering from severe diseases with a high burden or morbidity or mortality or both (Franken et al., 2015; Ottersen et al., 2016).

Expected health **improvements**

We must **also** consider whether some of the patients who stand to **lose health** have characteristics that we wish to prioritize

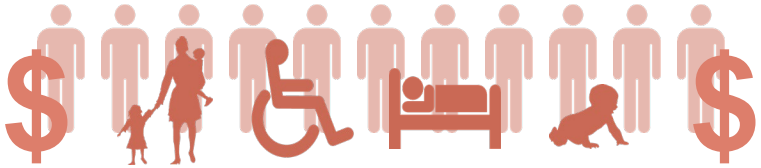


Expected health **losses**

What about a societal perspective?

Expected *societal* **improvements**

If CADTH were to adopt a **societal perspective**, its consideration of opportunity cost would need to be *broader*, encompassing not only health losses but also the **societal implications of those health losses**, including productivity and consumption losses for patients and their caregivers, and impacts on private insurers



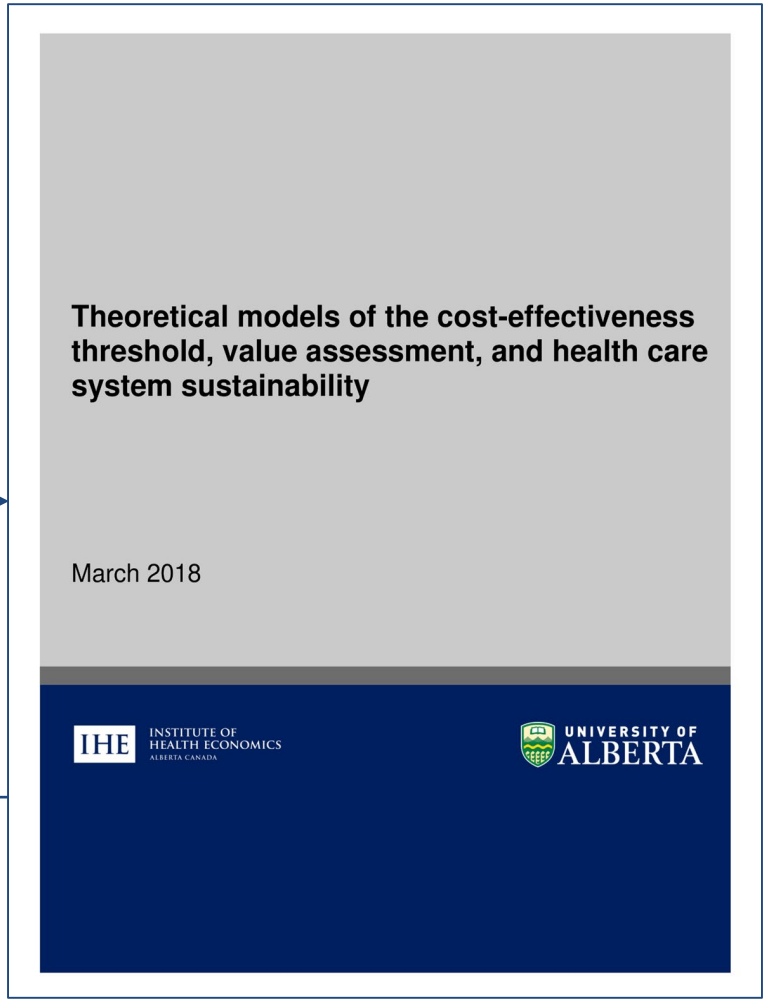
Expected *societal* **losses**

What about demand side estimates of willingness to pay?

‘Demand side’ estimates of **willingness-to-pay** - such as the ‘value of a statistical life’ (VSL) - are frequently *higher* than ‘supply side’ estimates of **health opportunity cost**

Clear **theoretical basis** for this finding

We must be careful not to conflate these different approaches, since using a demand side estimate as a cost-effectiveness ‘threshold’ can **diminish population health**



As a hypothetical example, suppose that a new health technology has an **ICER of $60,000 per QALY**, that the health opportunity cost is estimated to be $30,000 per QALY, and that a 'demand side' estimate of society's willingness-to-pay is $100,000 per QALY

If this demand side estimate were used as CADTH's cost-effectiveness threshold, then CADTH would find the technology to be **cost-effective**

Expected health **improvements**

Yet reimbursing the technology would **diminish population health**, since every incremental $60,000 spent on the technology would result in 1 QALY of health *improvements* but 2 QALYs of health *losses* (since a QALY is forgone for every $30,000 of incremental cost)

Expected health **losses**

Value of expected health **improvements**

The demand side estimate of willingness-to-pay may instead be used to *value* the health improvements *and* health losses: in this case, **the value of health losses is *double* that of health improvements**

Value of expected health **losses**

$100,000
per QALY

Value of expected
health **improvements**

If the demand side threshold were **higher**, it would increase
the value of both the health improvements and health losses,
increasing **the absolute value of the net loss in population health**

Value of expected
health **losses**

$200,000
per QALY

Value of expected
health **improvements**

If the demand side threshold were **higher**, it would increase the value of both the health improvements and health losses, ***increasing*** **the absolute value of the net loss in population health**

Value of expected
health **losses**

Recommendations

1. CADTH and CIHR should support **empirical research** into the health opportunity cost associated with reimbursing health technologies in Canada's public health care systems

2. This would allow CADTH to adopt an **evidence based cost-effectiveness 'threshold'** in future, giving a 'voice' to all patients impacted by its recommendations

3. This 'threshold' should then be used to estimate the **net impact of reimbursement upon population health**, which can be traded off with other important considerations

4. Until such Canadian research is complete, **international evidence from comparator countries does not support any increase in CADTH's current $50,000 per QALY threshold**

Canada's Drug and
Health Technology Agency

At a Population Level, How Do We Choose a Willingness to Pay Threshold?

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Drug reviews at CADTH

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How CADTH uses the ICER threshold

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How CADTH uses the ICER threshold

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Table 7: CADTH Price Reduction Analyses

Analysis	ICERs for trientine vs. no treatment	
Price reduction	Sponsor base case	CADTH reanalysis
No price reduction	46,160	87,676
10%	37,533	73,903
20%	28,120	59,902
30%	18,939	44,136

ICER = incremental cost-effectiveness ratio; vs. = versus.

Source: https://www.cadth.ca/sites/default/files/DRR/2022/SR0680-MAR-Trientine.pdf

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Why $50,000 per QALY

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Challenges

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Conclusions

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Thank You

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