Does cost-effectiveness analysis discriminate against patients with short life expectancy?

Mike Paulden¹ and Anthony J Culyer²,³,⁴

¹ Toronto Health Economics and Technology Assessment (THETA) Collaborative, University of Toronto, Canada
² Department of Health Policy, Management and Evaluation (HPME), University of Toronto, Canada
³ Department of Economics and Related Studies (DERS) and ⁴ Centre for Health Economics (CHE), University of York, UK

INTRODUCTION

It has been argued that the use of the QALY in CEA by agencies such as NICE discriminates against patients with shorter life expectancy. This paper demonstrates that CEA does not inevitably discriminate against such patients and may sometimes discriminate in their favour.

SUMMARY OF THE PAPER

Suppose that an agency such as NICE must decide whether to recommend a technology and is provided with QALY and cost data for two subgroups of patients: subgroup S and subgroup L. Assume that the patients in both subgroups are identical with the exception that those in subgroup S have a shorter life expectancy of p years, while those in subgroup L have a longer life expectancy of q years, i.e. q > p.

The incremental QALY benefits and costs of the technology are $\Delta t^S$ and $\Delta c^S$ for subgroup S and $\Delta t^L$ and $\Delta c^L$ for subgroup L. For now assume no discounting. The ICERs are therefore $\Delta c^S / \Delta t^S$ for subgroup S and $\Delta c^L / \Delta t^L$ for subgroup L. Denoting the current year as 1, where recommendations are made by comparing these ICERs to a threshold, λ, CEA will discriminate against patients with shorter life expectancy only if

$$\sum_{t=1}^{q} \Delta t^S / \sum_{t=1}^{q} \Delta t^L < \lambda < \sum_{t=1}^{p} \Delta t^S / \sum_{t=1}^{p} \Delta t^L.$$

This is shown opposite. The slopes of $\alpha$ and $\beta$ represent the ICERs for subgroups S and L, while the slope of $\omega e$ represents $\lambda$. The region between the ICERs represents the region of differential cost-effectiveness, or RDCE. Discrimination results only if $\lambda$ lies within the RDCE, as drawn.

Since the subgroups are otherwise identical, the QALYs and costs will differ only between years p and q. The ICER for subgroup S represents a common ratio of costs to QALYs for both subgroups up to year p:

$$\Delta c^S / \Delta t^S = \sum_{t=1}^{q} \Delta t^S / \sum_{t=1}^{q} \Delta t^S = \sum_{t=1}^{p} \Delta t^S / \sum_{t=1}^{p} \Delta t^S.$$

The ratio of costs to QALYs for subgroup L subsequent to the death of subgroup S is defined as the subsequent ratio:

$$\sum_{t=p+1}^{\infty} \Delta t^S / \sum_{t=p+1}^{\infty} \Delta t^L.$$

While the ICER for subgroup S is determined solely by the common ratio, the ICER for subgroup L is determined by both ratios. If these ratios are equal then both subgroups have the same ICER. Critically, discrimination against those in subgroup S requires that the subsequent ratio be lower than the common ratio. This is more likely for technologies with large upfront costs and long term QALY benefits (such as surgery) but less likely for those with relatively flat long term costs and declining QALY benefits (such as long term care for diabetes or rheumatoid arthritis).

This is shown in the figure opposite. The slopes $\alpha$ and $\beta$ represent the common and subsequent ratios. Discrimination against those with shorter life expectancy requires that $\alpha e$ lies above $\omega e$ and that $\beta$ be shallower than $\omega$. Notably, if $\beta$ is steeper than $\omega$ then the RDCE will lie above $\alpha e$ – if, in addition, $\omega e$ lies within the RDCE then CEA will discriminate against patients with longer life expectancy.

In summary, not only is discrimination on the basis of life expectancy not inevitable, but it may sometimes favour those with shorter life expectancy.

CONDITIONS REQUIRED FOR DISCRIMINATION

The slopes of $\alpha$ and $\beta$ represent the ICERs for subgroup S and L, while the slope of $\omega e$ represents $\lambda$. The region between the ICERs represents the region of differential cost-effectiveness, or RDCE. Discrimination results only if $\lambda$ lies within the RDCE, as drawn.

If $\lambda$ lies above the RDCE, then the ICER will lie above $\omega e$, and discrimination against those in subgroup S will sometimes occur. If $\lambda$ lies below the RDCE, then discrimination against those in subgroup S will sometimes occur. If $\lambda$ lies within the RDCE, then discrimination against those in subgroup S will not occur.

MORE ADVANCED ISSUES

Discounting

NICE and similar agencies require that QALYs and costs be discounted in order to account for time preference. Where $\delta$ denotes the discount rate, CEA discriminates against those with shorter life expectancy if:

$$\sum_{t=1}^{q} \frac{\Delta t^S}{(1+\delta)^t} < \lambda < \sum_{t=1}^{p} \frac{\Delta t^S}{(1+\delta)^t}.$$

Since the costs and QALYs which comprise the subsequent ratio are discounted more heavily, the subsequent ratio becomes relatively less influential in determining the ICER for subgroup L. This narrows the RDCE and so reduces the scope for discrimination.

“End of life” treatments

In January 2009, NICE issued supplementary guidance on evaluating technologies satisfying a number of “end of life” criteria, the first being that the life expectancy of patients is “normally less than 24 months”. Where the ICER for such patients is above the threshold, NICE now considers the weight which would need to be applied to their discounted QALYs for the ICER to fall “within the current threshold range”. Suppose that $p < 2 < q$. Where $\Omega$ denotes this weight and $\lambda = \alpha / \Omega$, NICE’s new guidance discriminates against those in subgroup S if:

$$\sum_{t=1}^{\Omega} \frac{\Delta t^S}{(1+\delta)^t} / \sum_{t=1}^{\Omega} \frac{\Delta t^L}{(1+\delta)^t} < \lambda < \sum_{t=1}^{\Omega} \frac{\Delta t^S}{(1+\delta)^t} / \sum_{t=1}^{\Omega} \frac{\Delta t^L}{(1+\delta)^t}.$$

Discrimination against those in subgroup S now requires that both $\Omega e$ and $\Omega L$ (rather than only $\Omega$) lie within the RDCE. Also, if $\Omega e$ lies below and $\Omega L$ lies above the RDCE then patients in subgroup L now face discrimination where previously they did not. This further reduces the scope for discrimination against those with shorter life expectancy.