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

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“In every case QALYs... favour those with the greater life expectancy regardless of age”

John Harris (2005), “Nice and not so nice”
Journal of Medical Ethics: 31, p.685



Possible implications?

- If **QALYs** discriminate against those with shorter life expectancy, surely it follows that **cost-effectiveness analysis (specifically cost-utility analysis) discriminates against patients with shorter life expectancy?**
- Furthermore, surely it follows that **those agencies which practice CEA (such as NICE) *in turn* discriminate against those with shorter life expectancy?**



Take home message

CEA does not necessarily discriminate against patients with shorter life expectancy and it can sometimes even discriminate in their favour



Why is that?

- It is the *incremental* QALY benefit from treatment that matters in CEA, *not* the expected ‘remaining’ QALYs in a patient’s life
- CEA also considers *incremental costs*, which will *generally* be greater for patients who live longer (ICER not necessarily lower)



A simple model

- 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**: subgroups S and 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.* $q > p$
- For now assume **no discounting**



The costs, QALYs and ICERs

- The incremental QALY benefits and costs of the technology are denoted as:
 - Δh^S and Δc^S for subgroup S
 - Δh^L and Δc^L for subgroup L
- The ICERs are therefore:
 - $\Delta c^S / \Delta h^S$ for subgroup S
 - $\Delta c^L / \Delta h^L$ for subgroup L



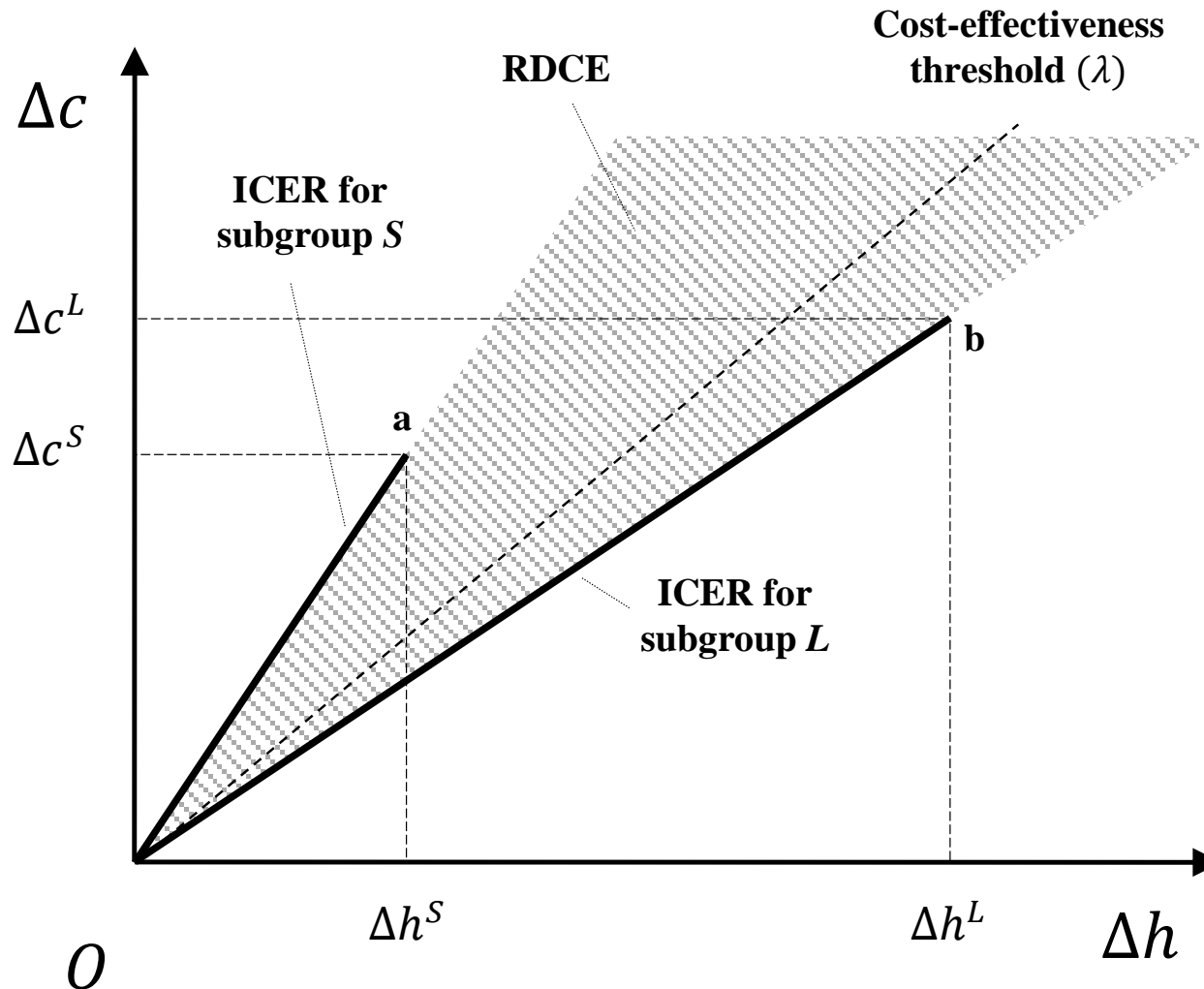
A condition for discrimination

- Where recommendations are made by comparing each ICER to a **threshold** (λ), CEA will discriminate against patients with **shorter life expectancy** if:

$$\Delta c^L / \Delta h^L < \lambda < \Delta c^S / \Delta h^S$$



The “region of differential cost-effectiveness” (RDCE)



But...

- It is unclear for what technologies this condition is more likely to hold



Expanding our expressions

- We will now expand our expressions of the costs and QALYs to account for time
- Denoting the current year as 1:
 - $\Delta h^S = \sum_{t=1}^p \Delta h_t^S = \Delta h_1^S + \Delta h_2^S + \dots + \Delta h_p^S$
 - $\Delta c^S = \sum_{t=1}^p \Delta c_t^S = \Delta c_1^S + \Delta c_2^S + \dots + \Delta c_p^S$
 - $\Delta h^L = \sum_{t=1}^q \Delta h_t^L = \Delta h_1^L + \Delta h_2^L + \dots + \Delta h_p^L + \dots + \Delta h_q^L$
 - $\Delta c^L = \sum_{t=1}^q \Delta c_t^L = \Delta c_1^L + \Delta c_2^L + \dots + \Delta c_p^L + \dots + \Delta c_q^L$



A slightly more complex condition

- Where recommendations are made by comparing each ICER to a **threshold** (λ), CEA will discriminate against patients with shorter life expectancy if:

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



The “common ratio”

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

$$\Delta c^S / \Delta h^S = \sum_{t=1}^p \Delta c_t^S / \sum_{t=1}^p \Delta h_t^S = \sum_{t=1}^p \Delta c_t^L / \sum_{t=1}^p \Delta h_t^L$$



The “subsequent ratio”

- Meanwhile, the ratio of costs to QALYs for subgroup L *subsequent* to the death of subgroup S is defined as the “subsequent ratio”:

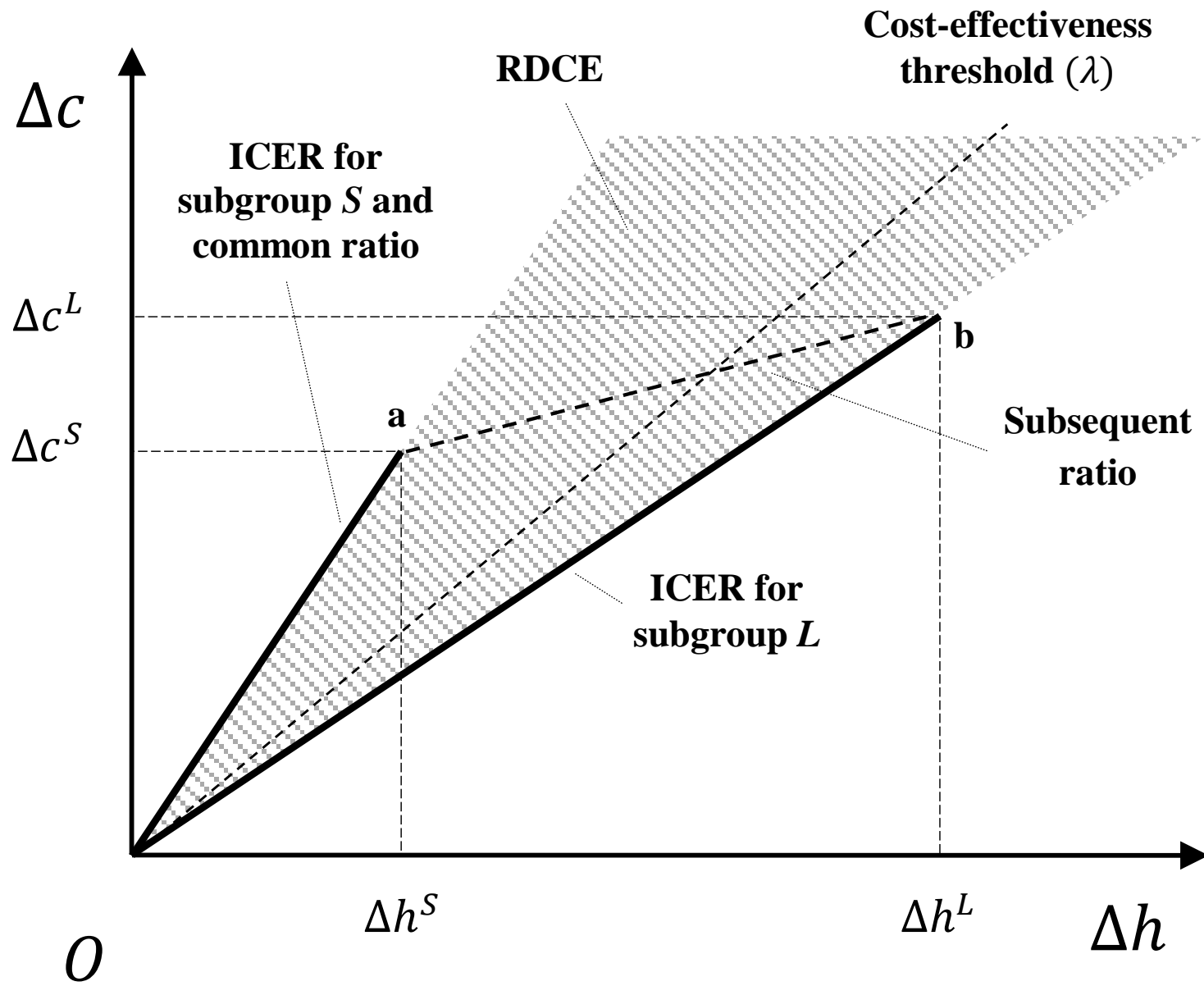
$$\sum_{t=p+1}^q \Delta c_t^L / \sum_{t=p+1}^q \Delta h_t^L$$



The common and subsequent ratios

- 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**





A more intuitive condition

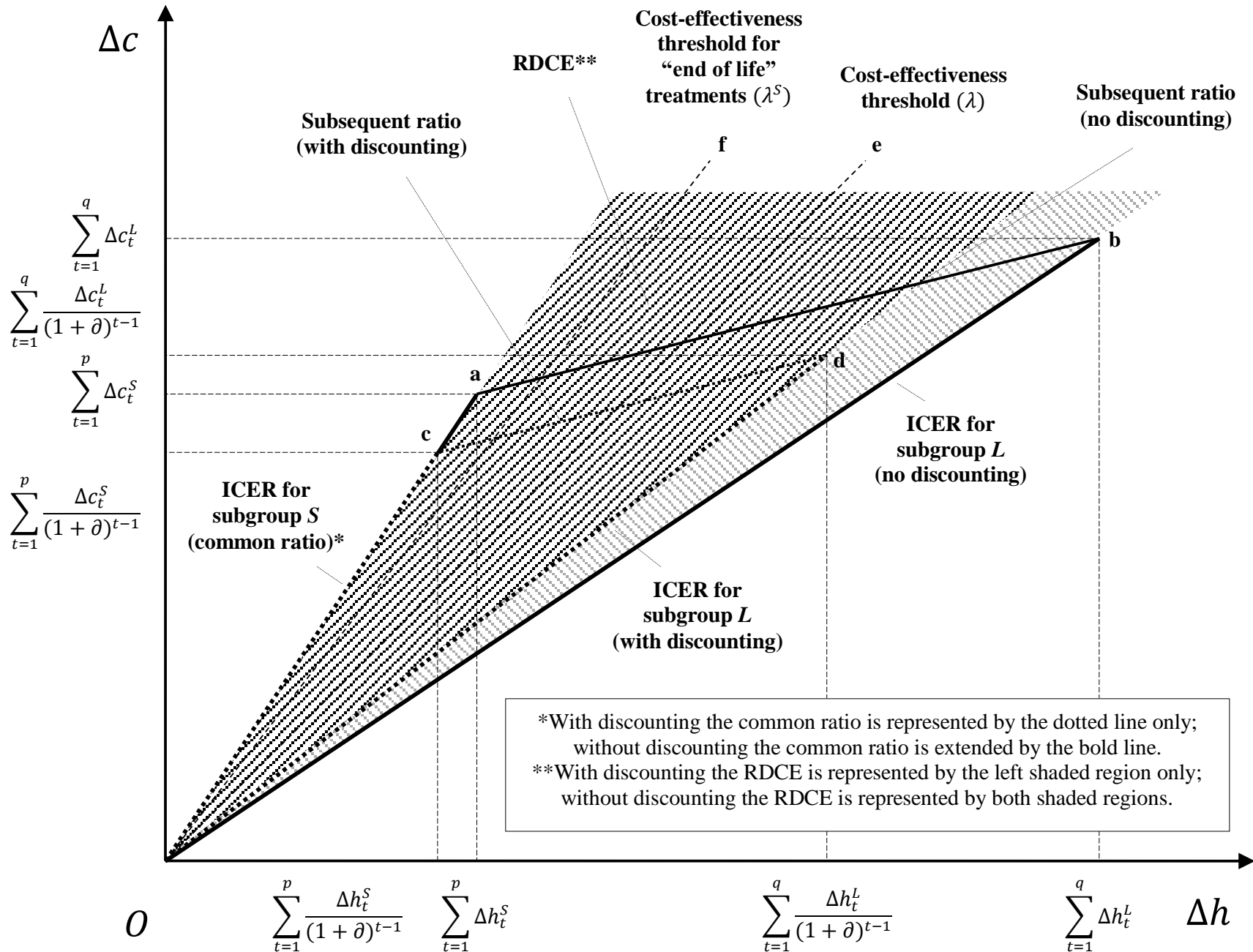
- Discrimination against those with shorter life expectancy **requires** the subsequent ratio to be *lower* than the common ratio
 - This is *more* likely for technologies with **largely upfront costs and long term QALY benefits** (such as surgery or vaccinations)
 - This is *less* likely for technologies with **long term costs and flat or declining QALY benefits** (such as long term care for diabetes)



Taking things further

- In our paper we also show that:
 - **Discounting** always *reduces* the scope for discrimination on the basis of life expectancy (in *either* direction)
 - NICE's recent guidance on appraising “**end-of-life**” treatments *increases* the scope for discrimination *in favour* of those with shorter life expectancy





Take home messages

- CEA does *not* necessarily discriminate against patients with shorter life expectancy, and may sometimes discriminate *in their favour*
- Discrimination against those with shorter life expectancy requires the subsequent ratio to be *lower* than the common ratio
 - This is *more likely* for technologies with largely upfront costs and long term QALY benefits
 - This is *less likely* for technologies with flat long term costs and flat or declining QALY benefits



But what of Harris's statement?

“In every case QALYs... favour those with the greater life expectancy regardless of age”

- It is **incremental QALYs** that matter in CEA
- CEA also takes into account **incremental costs**
- So it does *not* logically follow that “in every case **cost-effectiveness analysis** favours those with the greater life expectancy regardless of age”

Thank you!

For a **PDF copy** of this presentation and a list of references please visit **theta.utoronto.ca/?0178** or scan the barcode with your phone or tablet

