Does CADTH’s Use of 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 “in every case” against those with shorter life expectancy, doesn’t it follow that cost-effectiveness analysis (CEA), and specifically cost-utility analysis, also discriminates in every case against patients with shorter life expectancy (through its use of the QALY)?

- In turn, doesn’t it follow that agencies which practice CEA (including CADTH) discriminate against those with shorter life expectancy in every case in which they consider the results of a CEA as part of their decision making?
Take home messages

• Cost-effectiveness analysis, as practiced by CADTH, does not discriminate “in every case” against patients with shorter life expectancy, and in some cases it can even discriminate in their favour.

• Such discrimination is more likely for technologies with largely upfront costs and long term QALY benefits, and less likely for technologies with flat long term costs and flat or declining QALY benefits.

• CADTH’s use of a relatively high discount rate reduces the likelihood of such discrimination.
Why is this?

• 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.

• Together this implies that the **ICER is not necessarily higher for patients with shorter life expectancy**.

• Even in cases where the ICER *is* higher, discrimination in **CADTH’s recommendations** is not inevitable.

• Discounting at a *higher* rate reduces the likelihood of discrimination, and CADTH’s current 5% discount rate is (unjustifiably) high by international standards.
A simple model

- Suppose that an agency such as CADTH 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:
  - $\Delta h^S$ and $\Delta c^S$ for subgroup $S$
  - $\Delta h^L$ and $\Delta c^L$ 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 (\( \lambda \)), CEA will discriminate against patients with shorter life expectancy if:

\[
\frac{\Delta c^L}{\Delta h^L} < \lambda < \frac{\Delta c^S}{\Delta h^S}
\]
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:
  - \( \Delta h^S = \sum_{t=1}^{p} \Delta h_t^S = \Delta h_1^S + \Delta h_2^S + \cdots + \Delta h_p^S \)
  - \( \Delta c^S = \sum_{t=1}^{p} \Delta c_t^S = \Delta c_1^S + \Delta c_2^S + \cdots + \Delta c_p^S \)
  - \( \Delta h^L = \sum_{t=1}^{q} \Delta h_t^L = \Delta h_1^L + \Delta h_2^L + \cdots + \Delta h_p^L + \cdots + \Delta h_q^L \)
  - \( \Delta c^L = \sum_{t=1}^{q} \Delta c_t^L = \Delta c_1^L + \Delta c_2^L + \cdots + \Delta c_p^L + \cdots + \Delta c_q^L \)
A slightly more complex condition

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

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

\[
\frac{\Delta c^S}{\Delta h^S} = \frac{\sum_{t=1}^{p} \Delta c^S_t}{\sum_{t=1}^{p} \Delta h^S_t} = \frac{\sum_{t=1}^{p} \Delta c^L_t}{\sum_{t=1}^{p} \Delta h^L_t}
\]
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”:

$$\frac{\sum_{t=p+1}^{q} \Delta c_t^L}{\sum_{t=p+1}^{q} \Delta h_t^L}$$
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.
ICER for subgroup $S$ and common ratio

Cost-effectiveness threshold ($\lambda$)

Subsequent ratio

ICER for subgroup $L$
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

• It can also be demonstrated that:
  • A higher discount rate *always reduces* the scope for discrimination on the basis of life expectancy (in *either* direction)
  • NICE’s amended guidance on appraising “end-of-life” treatments *increases* the scope for discrimination *in favour* of those with shorter life expectancy
Cost-effectiveness threshold for “end of life” treatments ($\lambda^S$)

Cost-effectiveness threshold ($\lambda$)

ICER for subgroup $L$ (no discounting)

ICER for subgroup $L$ (with discounting)

Subsequent ratio (with discounting)

Subsequent ratio (no discounting)

*With discounting the common ratio is represented by the dotted line only; without discounting the common ratio is extended by the bold line.

**With discounting the RDCE is represented by the left shaded region only; without discounting the RDCE is represented by both shaded regions.
Take home messages

• Cost-effectiveness analysis, as practiced by CADTH, does *not* discriminate “in every case” against patients with shorter life expectancy, and in some cases it can even discriminate *in their favour*

• Such discrimination is *more likely* for technologies with largely upfront costs and long term QALY benefits, and *less likely* for technologies with flat long term costs and flat or declining QALY benefits

• CADTH’s use of a *relatively high discount rate* reduces the likelihood of such discrimination
But what of Harris’s statement?

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

- In CEA, **incremental** QALYs and costs matter
- **So even if true**, it does **not** logically follow that: “In every case CEA... favours those with the greater life expectancy regardless of age”
Addendum: NICE’s Recent Discounting Amendment

- NICE recently amended its guidance to recommend differential discounting in certain circumstances.
- The amendment states that differential discounting (at rates of 1.5% for health and 3.5% for costs) should be applied where: “treatment effects are both substantial in restoring health and sustained over a very long period (normally at least 30 years)”
- Otherwise health and costs are discounted at 3.5%
- O’Mahony and Paulden (forthcoming) note a number of problems with the amendment, including potential for discrimination on the basis of life expectancy.
Comparing CADTH to NICE

• Arguably, CADTH’s methods present less scope for discrimination on the basis of life expectancy:
  • CADTH’s base case discount rate is higher (5% vs. 3.5%)
  • CADTH does not impose differential discounting in some cases, subject to arbitrary criteria which may discriminate
  • CADTH does not separately consider “end of life” treatments
  • CADTH does not have a fixed cost-effectiveness threshold

• That said...
  • CADTH’s discounting methodology is nothing to be proud of: poorly cited and 5% is far too high (Paulden & Claxton 2011)
  • By not having a threshold, CADTH may not be appropriately considering the opportunity cost of its recommendations