Cost-effectiveness analysis of a screening programme

Iris Lansdorp-Vogelaar, PhD

Department of Public Health

Erasmus MC, Rotterdam

Criteria of Wilson and Jungner (Bull World Health Organ. 1968)

Box 1Wilson and Jungner classic screening criteria[1]

1. The condition sought should be an important health problem.

2. There should be an accepted treatment for patients with recognized disease.

3. Facilities for diagnosis and treatment should be available.

4. There should be a recognizable latent or early symptomatic stage.

5. There should be a suitable test or examination.

6. The test should be acceptable to the population.

7. The natural history of the condition, including development from latent to declared disease, should be adequately understood.

8. There should be an agreed policy on whom to treat as patients.

9. The cost of case-finding (including diagnosis and treatment of patients diagnosed) should be economically balanced in relation to possible expenditure on medical care as a whole.

10. Case-finding should be a continuing process and not a "once and for all" project.

Why cost-effectiveness analysis?

- People argue that you cannot put a price tag on a human life

- Basic economic problem: wants are infinite, but resources are scarce

- Cost-effectiveness analysis is not meant to put price tag on human life, but rather to ensure that limited resources are spent most efficiently

→ Saving most lives with available resources

Erasmus MC

Definition of cost-effectiveness analysis

- EU: Cost-effectiveness analysis is a decision-making assistance tool. It identifies the economically most efficient way to fulfil an objective. In evaluation, the tool can be used to discuss the economic efficiency of a programme or a project.

- 2nd panel on cost-effectiveness analysis: analytic tool in which costs and effects of a programme and its alternatives are calculated and presented in a ratio of incremental cost to incremental effect.[1]

[1] *Sanders GD, et al. JAMA. 2016*

Erasmus MC

Cost-effectiveness analysis (CEA) of screening

- To determine whether a screening intervention is economically efficient, we compare its costs and effects with costs and effects of all alternatives including doing nothing

- Effects of interventions should be measured in quality-adjusted life-years (QALY) gained.[1]

[1] *Sanders GD, et al. JAMA. 2016*

Erasmus MC

Costs included in CEA of screening

Depends on perspective, but should at least include all relevant medical costs:

- Screening test costs
- Costs of diagnostic follow-up
- Costs of complications
- Costs of overdiagnosis and overtreatment
- Savings from preventing treatment of (late-stage) disease

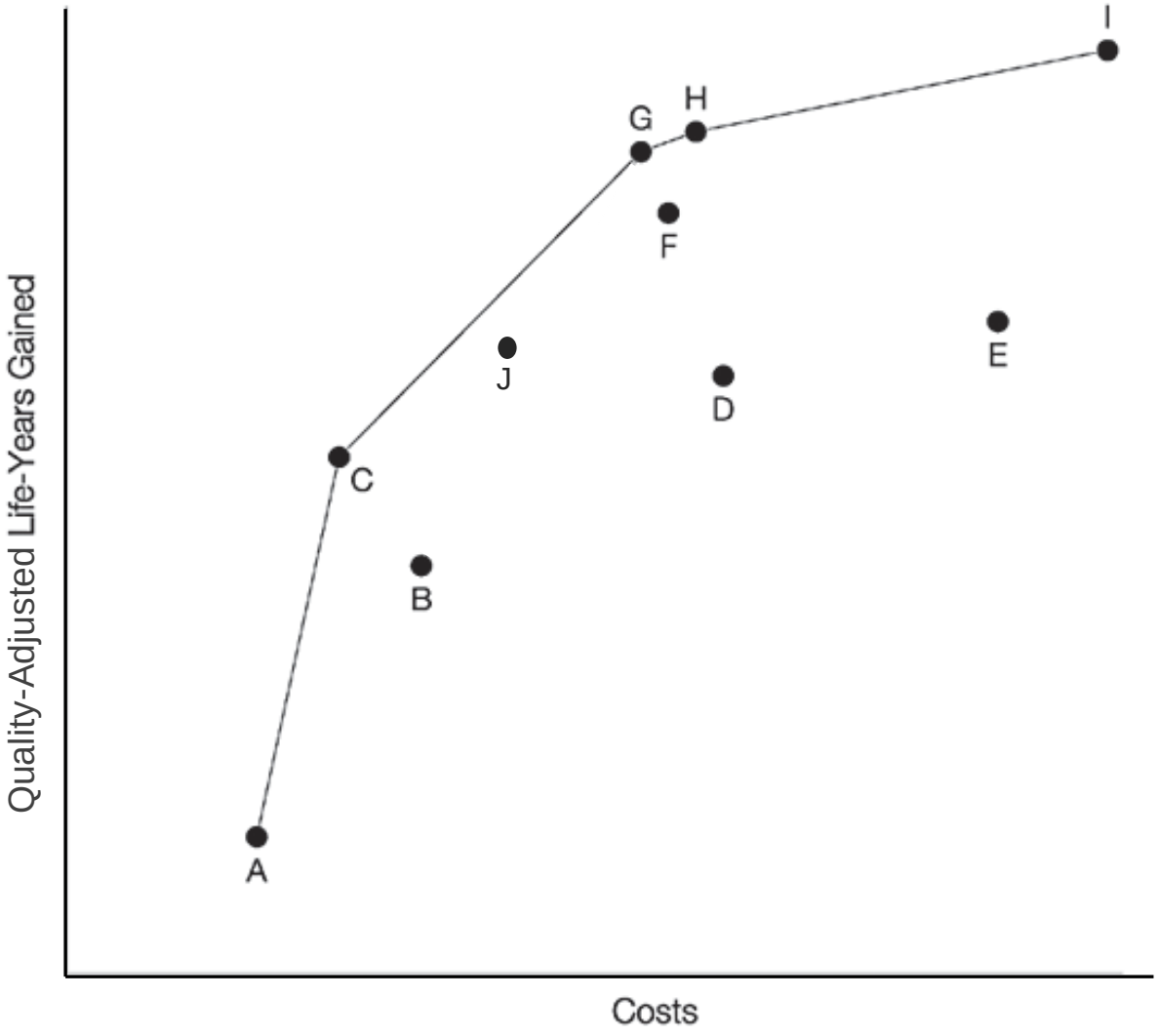
Erasmus MC

Components of QALY gained with screening

- Life-years gained because of prevented cancer death
- Increase in quality of life because of less-invasive disease and treatment
- Decrease in quality of life because of
  - screening (burden and worry)
  - diagnostic follow-up
  - complications
  - treatment (earlier detection and overdiagnosis)

Erasmus MC

How does cost-effectiveness analysis work?



Based on Mark, DH. Visualizing cost-effectiveness, JAMA 2002

Erasmus MC

Which strategy to pick

- The efficient strategy with the most QALY gained, for which the incremental cost-effectiveness ratio (ICER) is lower than a pre-determined willingness-to-pay (WTP) threshold

- For the Netherlands this WTP is €20,000 per QALY gained, in the US $50,000-$100,000 per QALY gained

- WHO recommendation: WTP of 1-3 times the General Domestic Product (GDP)

Erasmus MC

Why incremental cost-effectiveness analysis?

- An example:
  - Screening with a new test (stool DNA) costs $700,000 and gains 60 QALYs
  - Screening with the established test (iFOBT) costs $100,000 and gains 80 QALYs
  - Costs per QALY gained are $12,000 for stool DNA compared to no screening, and would be acceptable according to the WTP
  - However, the established tests gains more QALYs and costs less

- Therefore it is VERY important to compare an intervention to its alternatives!

Erasmus MC

Erasmus MC
University Medical Center Rotterdam

Cost-effectiveness of CRC screening

Review of cost-effectiveness of CRC screening worldwide

- Included 56 publications, relating to 32 unique CRC models
  - 14 evaluated CRC screening in North America
  - 10 studies for European countries
  - 5 for Asia
  - 3 for Australia

- Studies differed widely in screening tests evaluated:
  - US and Asian studies generally evaluated many tests
  - European and Australian studies generally focussed on FOBT

Lansdorp-Vogelaar et al., Epi Reviews 2011

Erasmus MC

Cost-effectiveness compared to no screening

- All studies found CRC screening to be cost-effective compared to no screening for all established screening tests (< $60k/LYG)

- Costs/LYG varied widely between studies
  - cost-saving - $56k for annual guaiac FOBT
  - $3.4k-$16k for biennial guaiac FOBT
  - cost-saving - $57k for 5-yearly sigmoidoscopy
  - cost-saving - $34k for 10-yearly colonoscopy

Erasmus MC

Colorectal cancer screening cost-saving?

- Cost-effectiveness of CRC screening seems to have improved over time:
  - Cost-effectiveness ratios in US studies published after USPSTF review were more favorable than those in the review
  - 6 studies found CRC screening to be cost-saving: all were published after 2002

- Dramatic increase in CRC treatment costs may be explanation
  - 2 studies explicitly showed that increase in CRC treatment costs improved cost-effectiveness of screening

Erasmus MC

Most cost-effective strategy?

- 8 models evaluated all 4 screening strategies that have been recommended in US since 1997:
  - annual guaiac FOBT
  - 5-yearly sigmoidoscopy
  - combination of sigmoidoscopy and guaiac FOBT
  - 10-yearly colonoscopy

- Considerable variation in most-cost-effective strategy
  - Colonoscopy: 4 studies
  - combination of sigmoidoscopy and FOBT: 2 studies
  - Sigmoidoscopy / annual FOBT: 1 model each

Erasmus MC

Most cost-effective strategy?

- 3 additional studies evaluated colonoscopy, FOBT and sigmoidoscopy, but not combination

- When only considering these strategies, still considerable variation in most cost-effective strategy:
  - Colonoscopy: 8 studies
  - FOBT: 2 studies
  - Sigmoidoscopy: 2 studies

Erasmus MC

Cost-effectiveness of more recent screen tests - FIT

- 7 studies evaluated FIT screening
- All studies found FIT to be cost-effective compared to no screening, including 4 showing cost-savings
- Half of the studies found FIT to dominate comparator strategies, other half found FIT to be dominated by Hemoccult Sensa
  - Difference result of costs of FIT relative to Hemoccult Sensa (in US: Hemoccult Sensa - $4.50; FIT - $22)

Erasmus MC

Cost-effectiveness of more recent screen tests – Stool DNA and CTC

- 5 models evaluated Stool DNA testing and 8 CT colonography
- Both stool DNA screening and CT colonography were cost-effective compared to no screening
- Stool DNA was dominated in all studies, and CTC in all but one, by the established screening strategies

Erasmus MC

Studies published since review

- Patel, Cancer Control 2015, review on cost-effectiveness in USA: *“When compared with no screening, all CRC screening strategies evaluated in this review were cost-effective. There was disagreement as to which screening strategy was the most cost effective.”*

- Other new studies from North America, Europe and Asia were in line with review findings.

Erasmus MC

Some important developments since review

- Septin 9: cost-effective compared to no screening, but dominated by FIT, unless increased adherence (Ladabaum, CEBP 2013)

- Hybrid strategies:
  - FIT/COLOx1 cost-effective compared to FIT and colonoscopy. (Dinh, Clin Gastro Hepatol 2013
  - Annual FOBT 10 years after negative COL yielded similar LYG with lower costs and complications compared to repeat COL (Knudsen, Ann Intern Med 2012)

Erasmus MC

Conclusion

- Colorectal cancer screening is cost-effective compared with no screening and even cost-saving in some studies
- Studies do not point to one single preferred screening test from a cost-effectiveness perspective
- Cost-effectiveness of CRC screening tests is likely comparable and factors other than cost-effectiveness are more important in decision about CRC screening program
- Except for FIT, more recent tests are not yet cost-effective

Erasmus MC

Erasmus MC
University Medical Center Rotterdam

Thank you for your attention

i.vogelaar@erasmusmc.nl