Introduction to health economic evaluation:
The case of proton therapy in head and neck cancer

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What is health economic evaluation?

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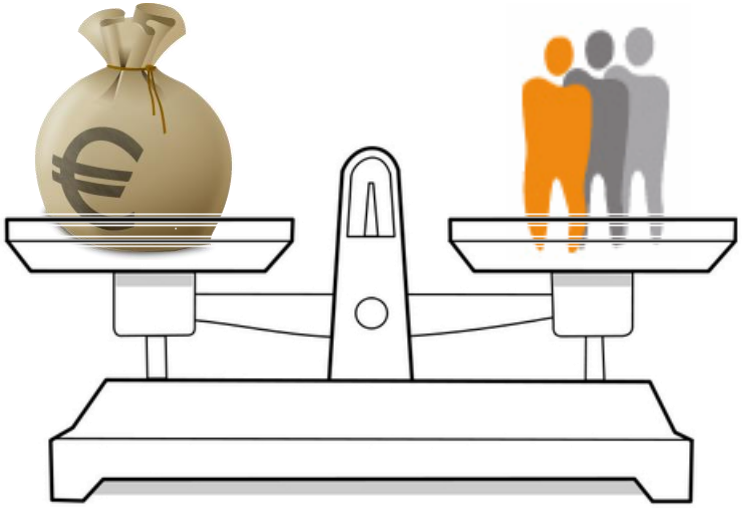
What is health economic evaluation?

- Examines value for money of (innovative) treatments compared with current practice

QALY



Health economic evaluation

- Reimbursement decisions
  - Implies valuing the worth of a QALY
- Example nivolumab for metastatic lung cancer in NL
  - Gain: 3 months
  - €134,000 per QALY gained
  - Budget impact €200 million per year
  - Dutch Health care institute: too expensive (Dec 2015)
    - Minister of Health (Schippers) agreed
  - Dutch Cancer Society: impermissible to restrict access for financial reasons (Dec 2015)

Statement

It is unethical to use economic evaluation to inform reimbursement decisions

(i.e. putting a value to what an additional QALY is allowed to cost)

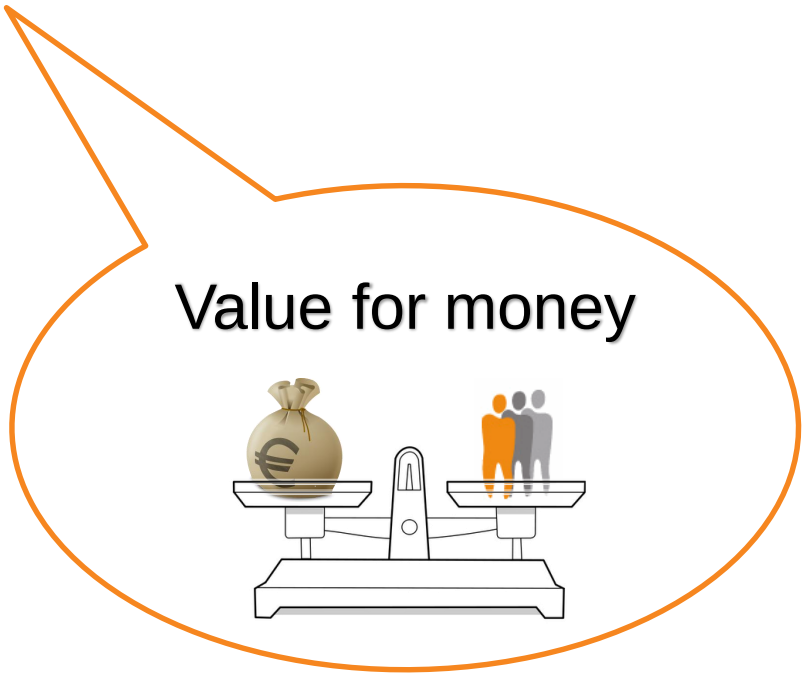
Outline

- Economic evaluation
- Valuating health effects: Quality Adjusted Life Years (QALY)
- Interpretation and relevance of economic evaluation
- Case: proton therapy in head and neck cancer

Economic evaluation

‘The comparative analysis of alternative courses of action in terms of both their costs and their effects’.

(Drummond et al., 1996)



Characteristics of health care evaluations

	Examines only consequences	**Examines only costs**	**Examines both effects and costs**
No comparison	Outcome description	Cost description	Cost-outcome description
Comparison	Efficacy or effectiveness evaluation	Cost analysis	Full economic evaluation

Drummond M et al. Methods for the Economic Evaluation of Health Care Programmes (Fourth Edition). Oxford 2015

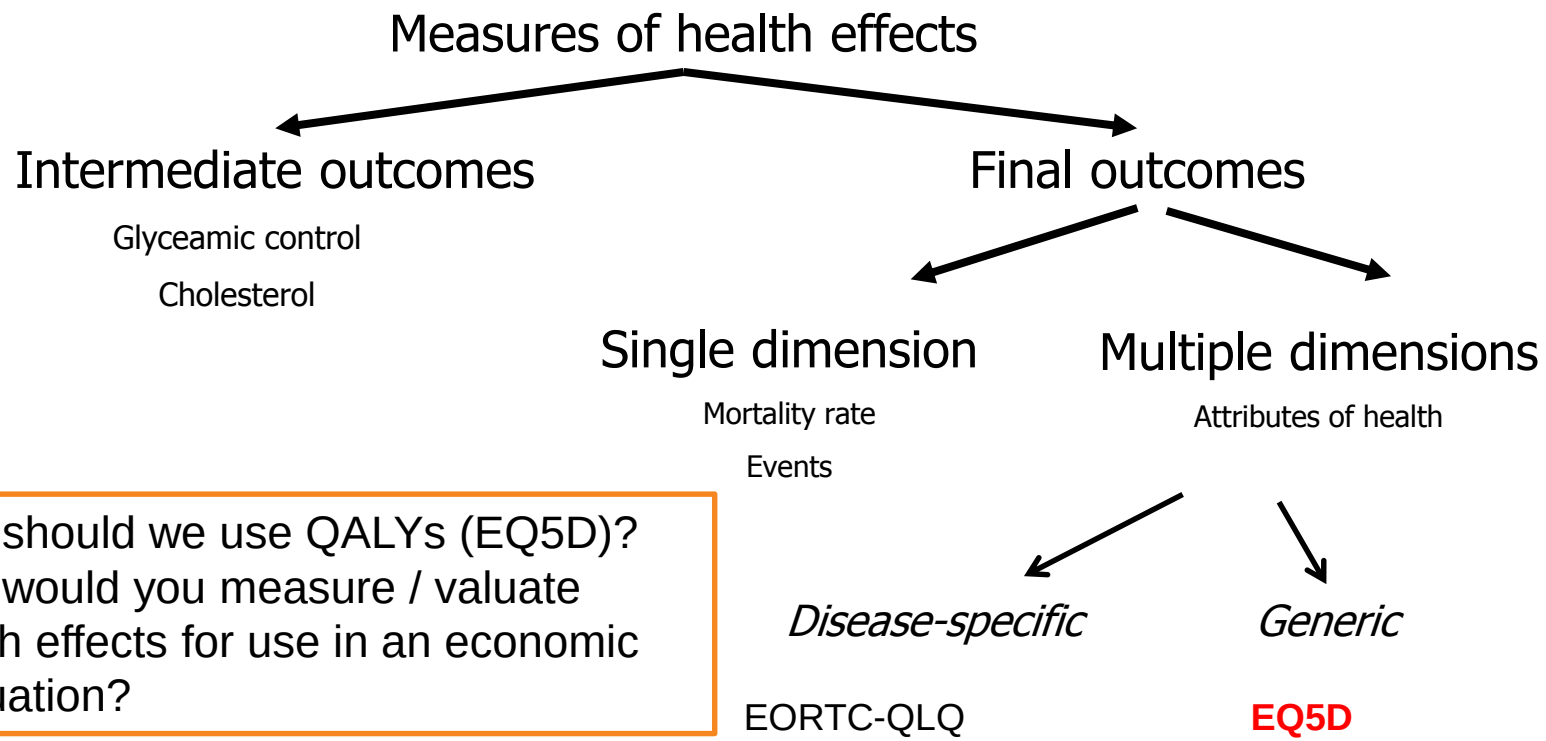
Types of economic evaluation

Types	Evaluation of costs	Evaluation of effectiveness
Cost-minimalisation	Yes	No, equal effectiveness has already been demonstrated
Cost-effectiveness	Yes	Yes, clinical outcom (recurrence, diseas survival, etc)
Cost-utility *(cost-effectiveness)*	Yes	Yes, Quality adjusted life-years: QALY's
Cost-benefit	Yes	Yes, in monetary units

EQ5D

Drummond M et al. Methods for the Economic Evaluation of Health Care Programmes (Fourth Edition). Oxford 2015

Valuating health effects



- Why should we use QALYs (EQ5D)?
- How would you measure / valuate health effects for use in an economic evaluation?

Drummond M et al. Methods for the Economic Evaluation of Health Care Programmes (Fourth Edition). Oxford 2015

Disease-specific instruments

Pro's

- Clinically sensible & relevant
- Are more responsive for specific impact of a particular disease

Con's

- Do not allow cross-condition comparison
- Limited to comparing treatments within a disease

Generic instruments

Pro's

- Include a broad range of dimensions related to quality of life.
- Capture the impact of co-morbidities and side-effects of a treatment.
- Comparison between different diseases is possible

Con's

- Less sensitive for minor change

Utility

- Preference based
  - Preference an individual/society has for a certain health state
- Utility values
  - 1.00 = perfect health
  - 0.00 = death
  - <0.00 = health states worser than death
- Direct measurment (standard gamble)
- Indirect measurement (multi-attribute questionnaires)
  - e.g. EQ5D
    (most commonly used and preferred by National Health authorities such as NICE and ZiNL)

Euroqol (EQ5D questionnaire)

Mobility

1. No problems walking
2. Some problem walking about
3. Confined to bed

Self-care

1. No problems with self-care
2. Some problems washing or dressing self
3. Unable to wash or dress self

Usual activities

1. No problems with performing usual activities (e.g. work, study, housework, family or leisure activities)
2. Some problems with performing usual activities
3. Unable to perform usual activities

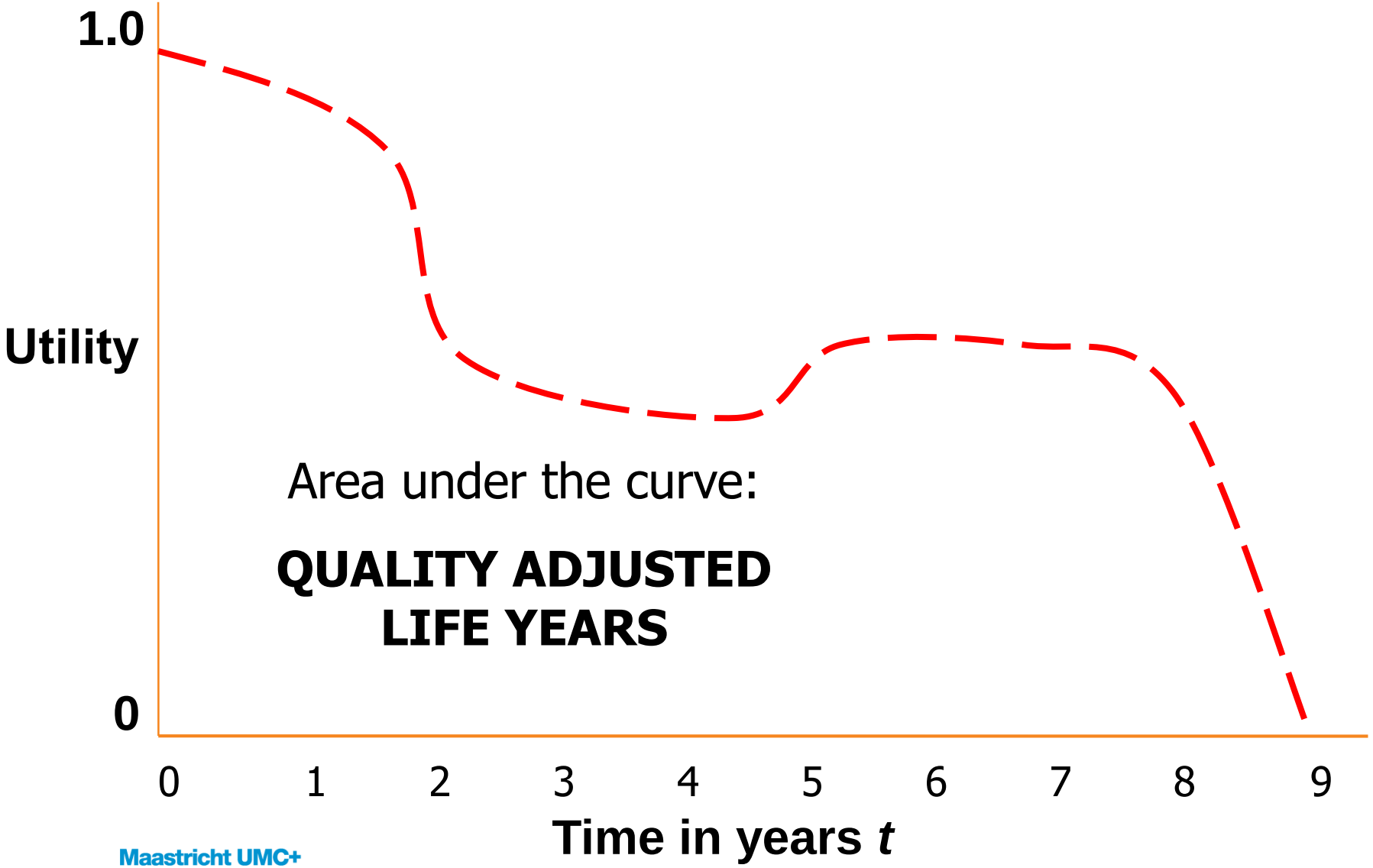
Pain/discomfort

1. No pain or discomfort
2. Moderate pain or discomfort
3. Extreme pain or discomfort

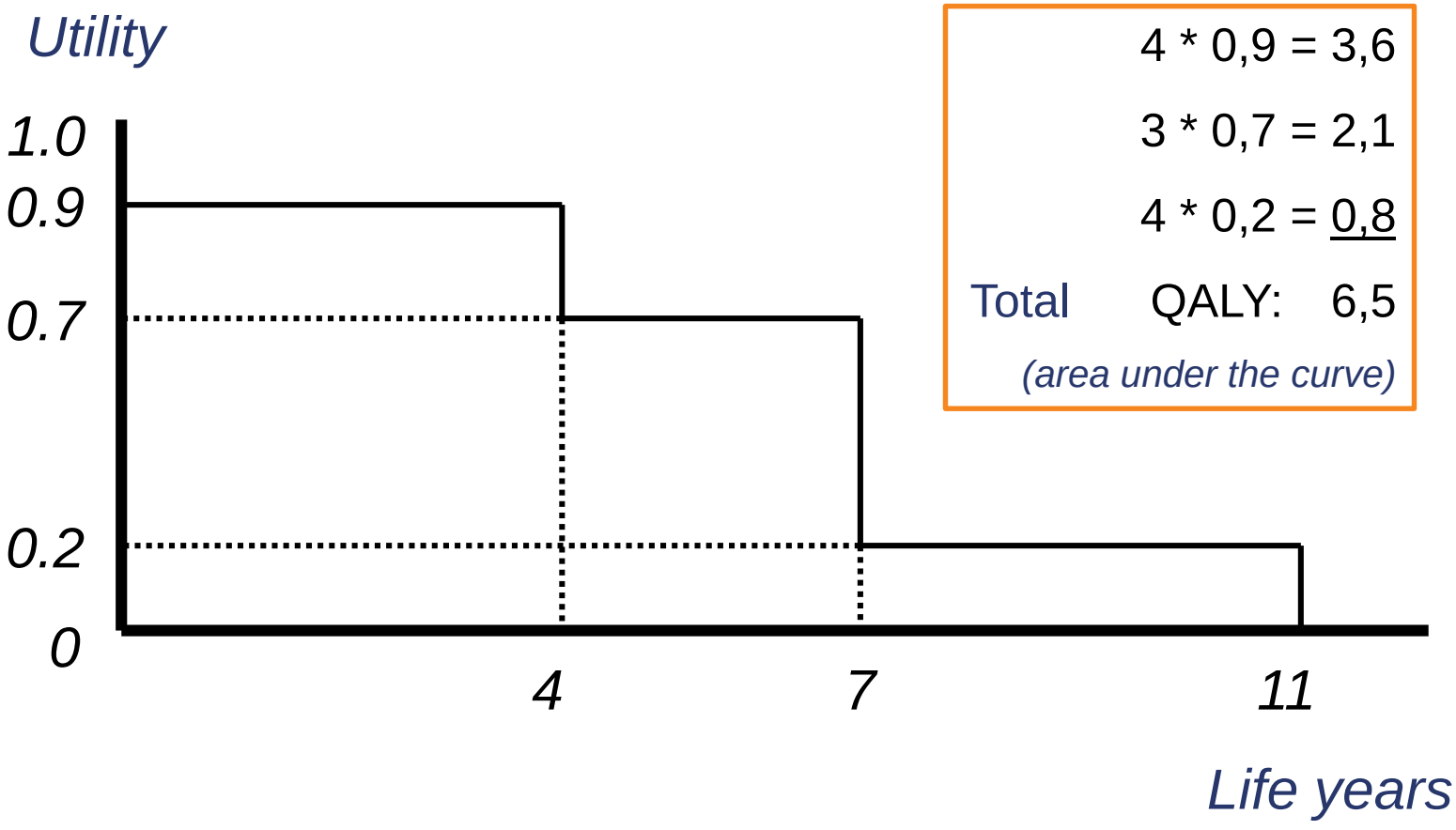
Anxiety/depression

1. Not anxious or depressed
2. Moderately anxious or depressed
3. Extremely anxious or depressed

From a utility to a QALY…



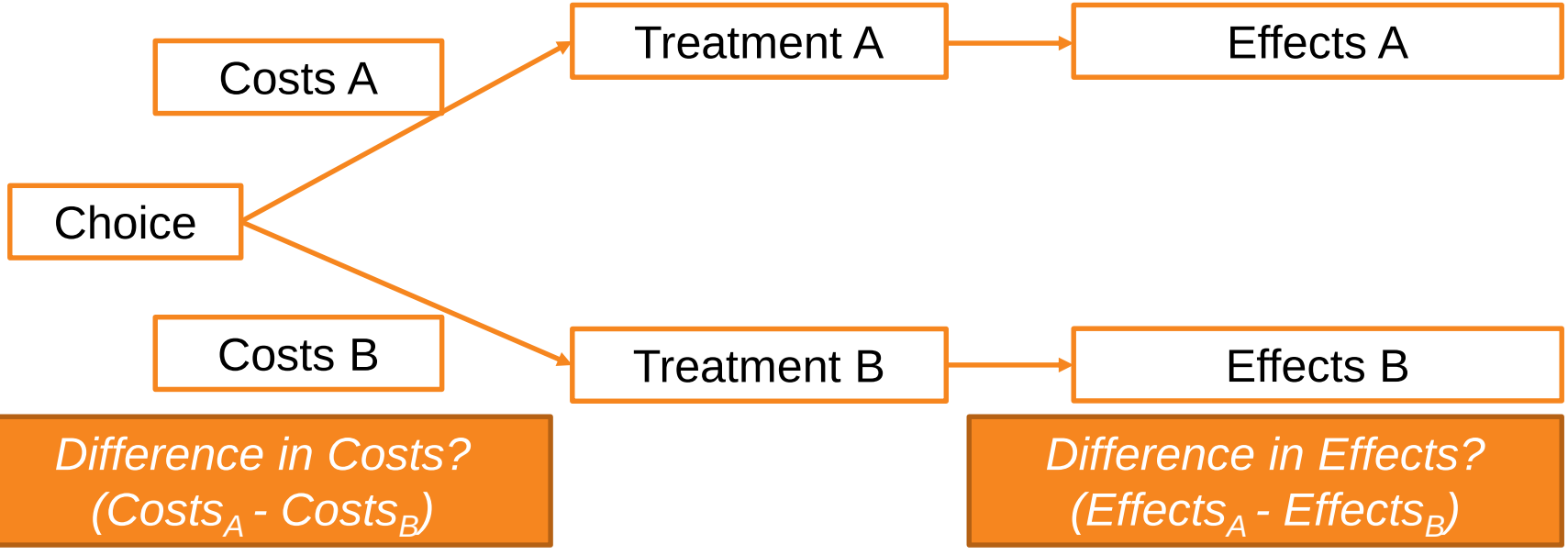
Quality Adjusted Life Year



Interpretation of economic evaluations

Incremental cost-effectiveness ratio (ICER):

$$\frac{Costs_A - Costs_B}{Effects_A - Effects_B}$$



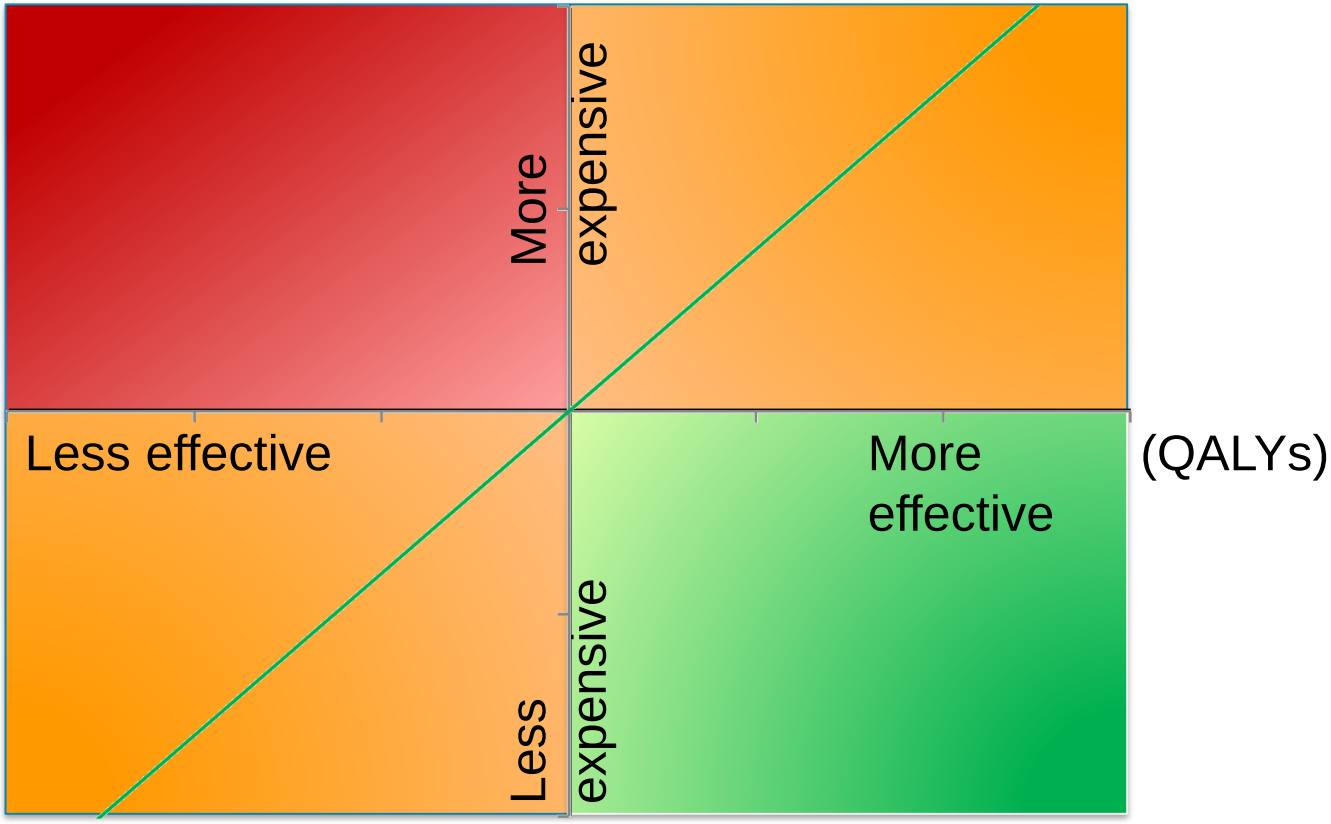
Interpretation of economic evaluations

	Costs	QALYs
Treatment A	€ 15,000	6.50
Treatment B	€ 6,000	6.35
Increment	€ 9,000	0.15

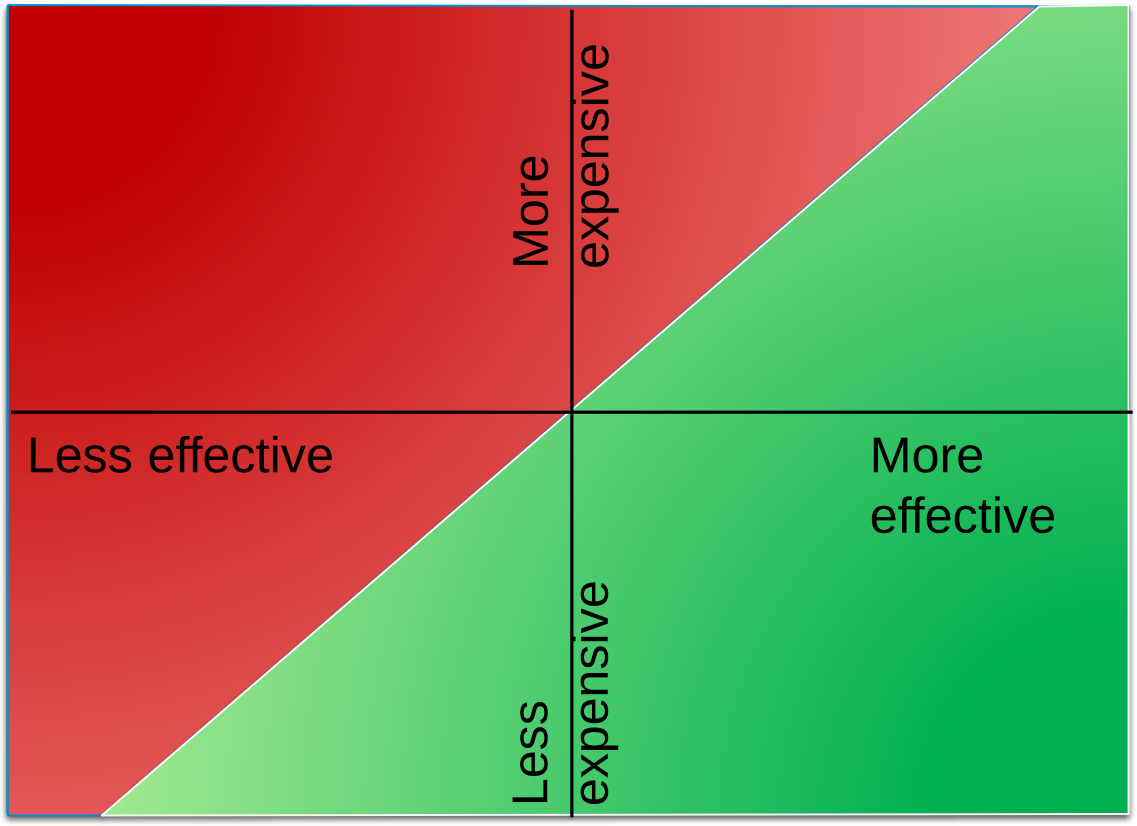
The costs of an additional QALY gained (ICER):

€9000 / 0.15 = €60,000

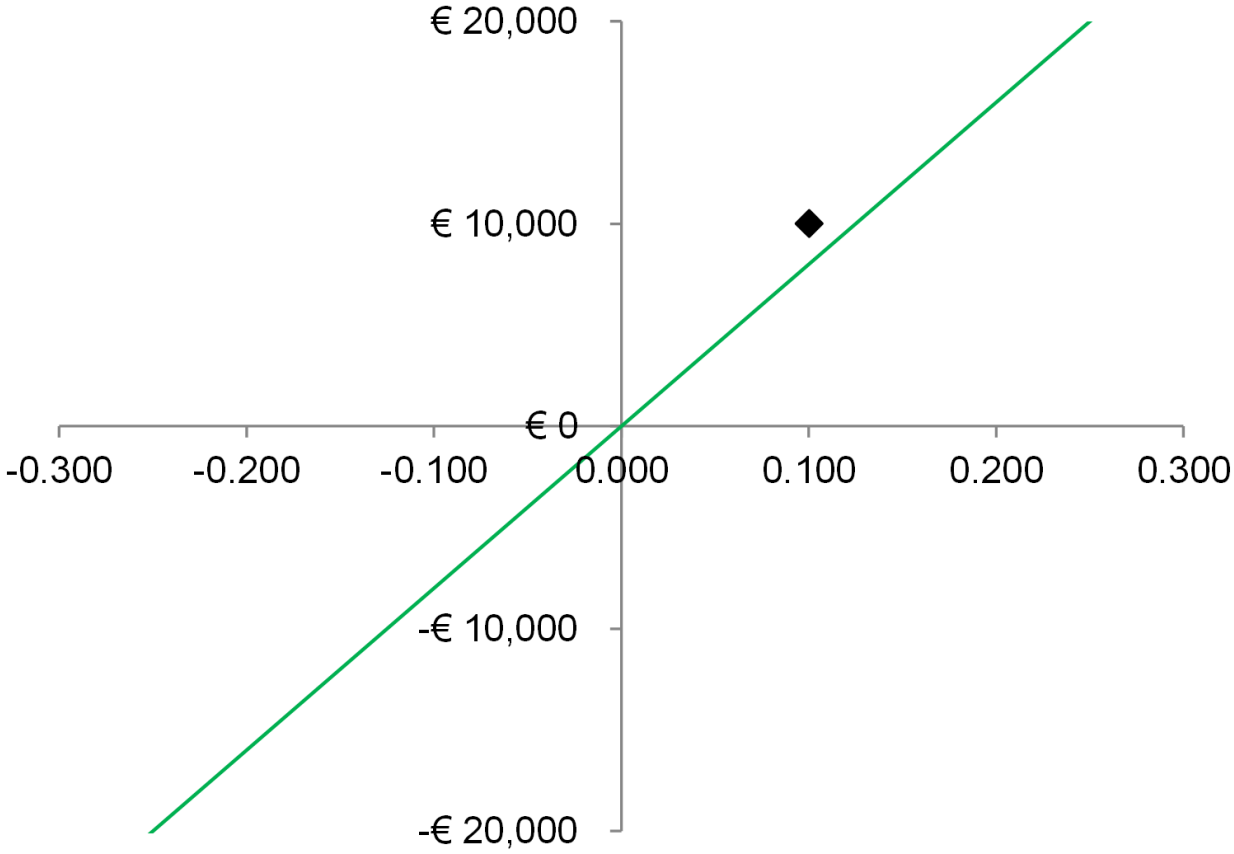
Cost-effectiveness plane



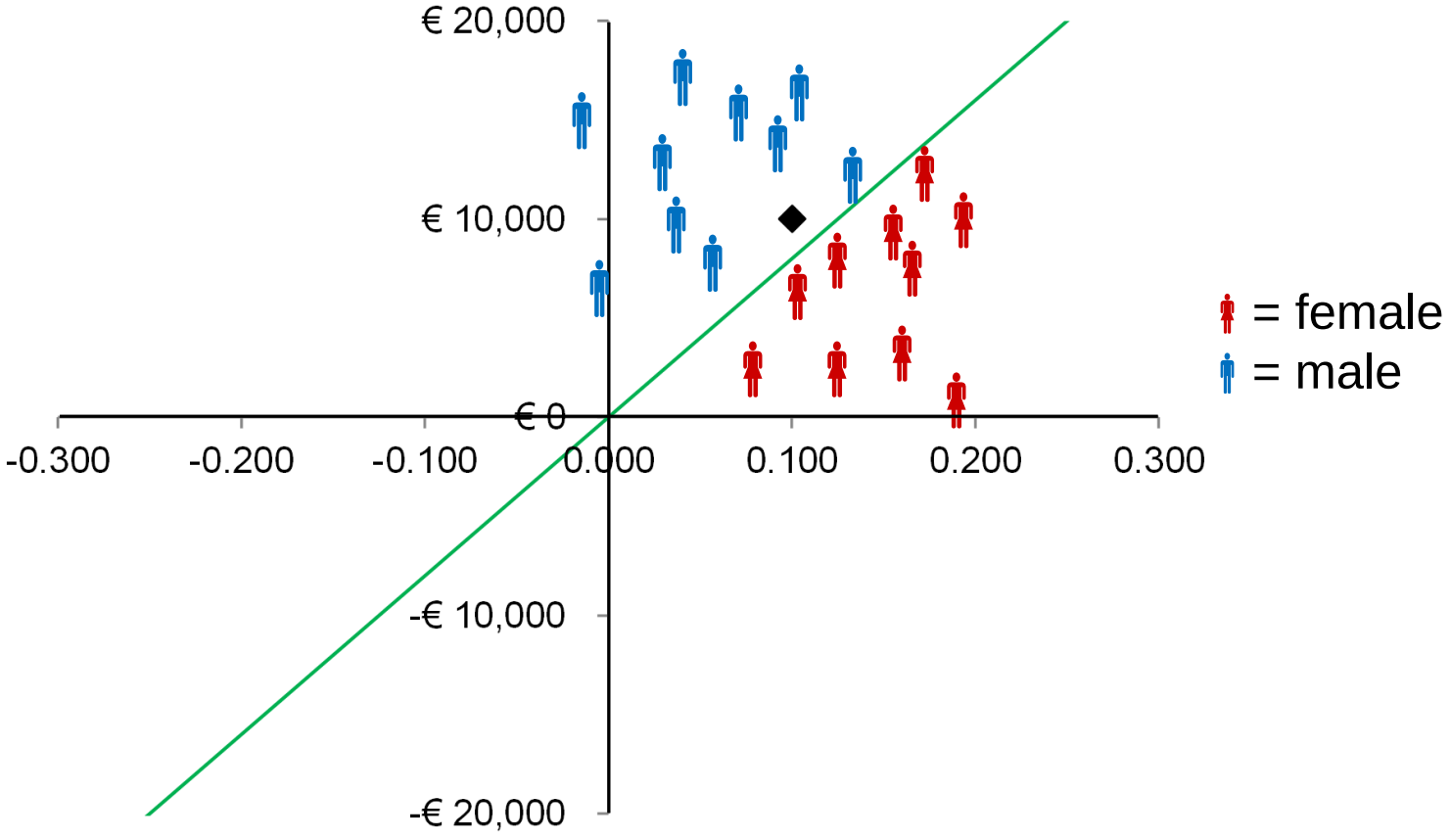
Cost-effectiveness plane



Cost-effectiveness plane



Cost-effectiveness plane



Relevance of economic evaluations

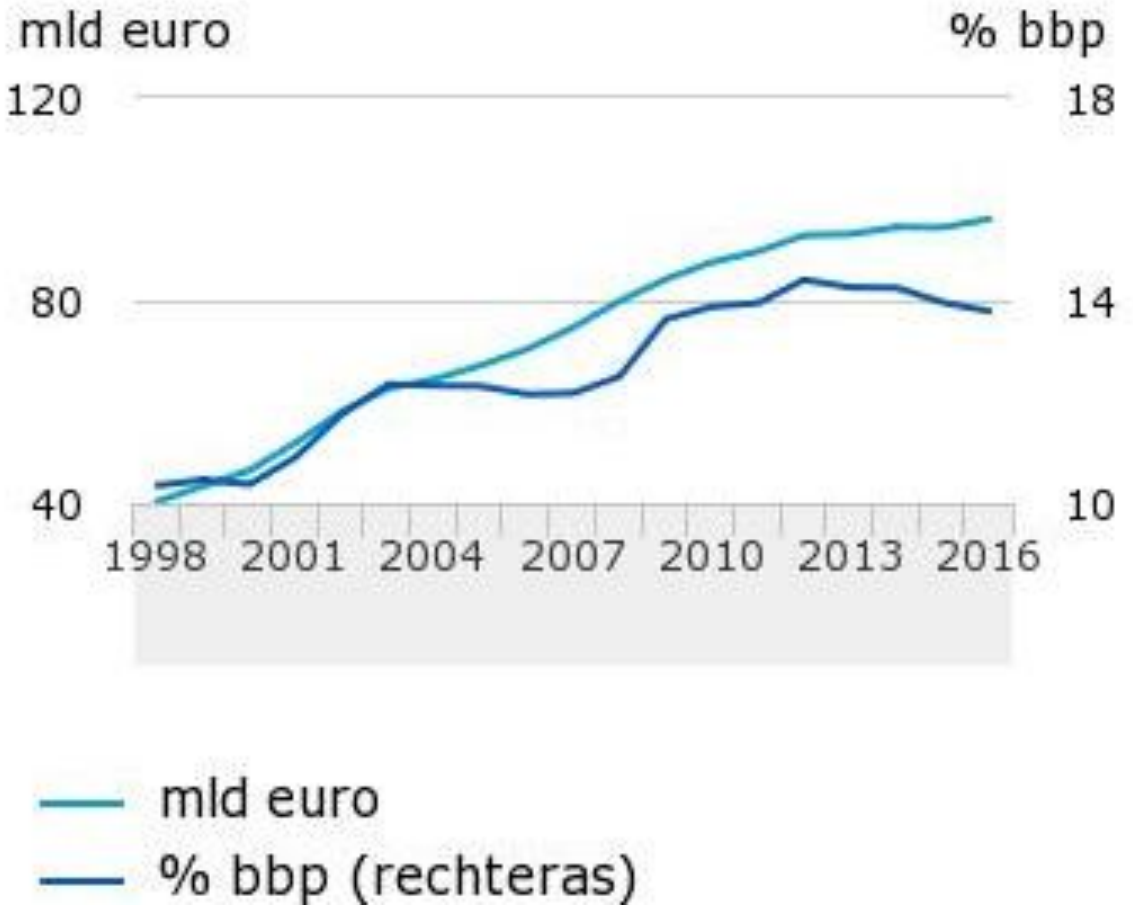
- Why should we care about these assessments?

Dutch Health care expenses

2016: €96 bln

(€27 bln hospital costs)

13.8% of GDP

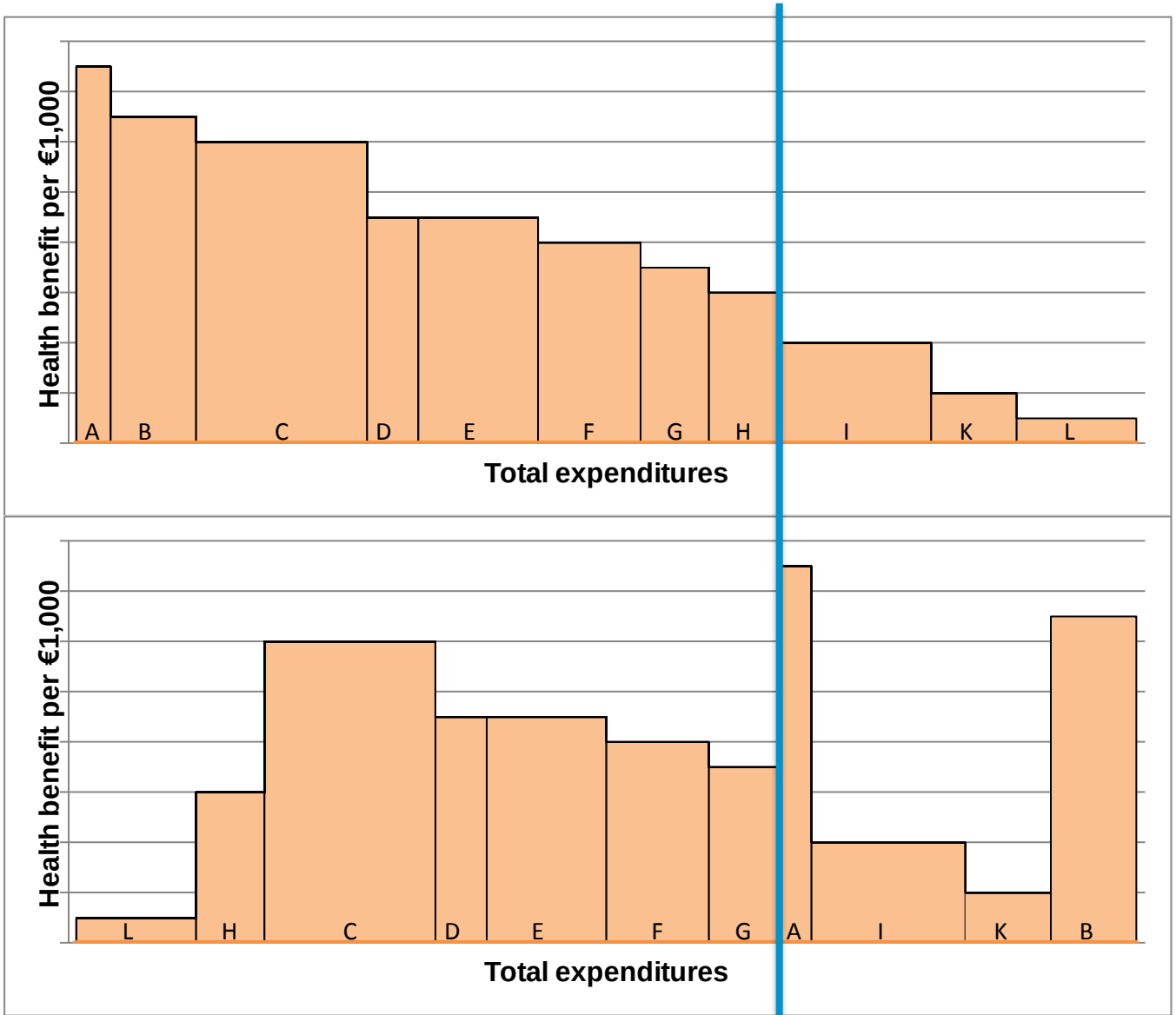


Dutch Health care expenses (2012)

Health care resources are scarce

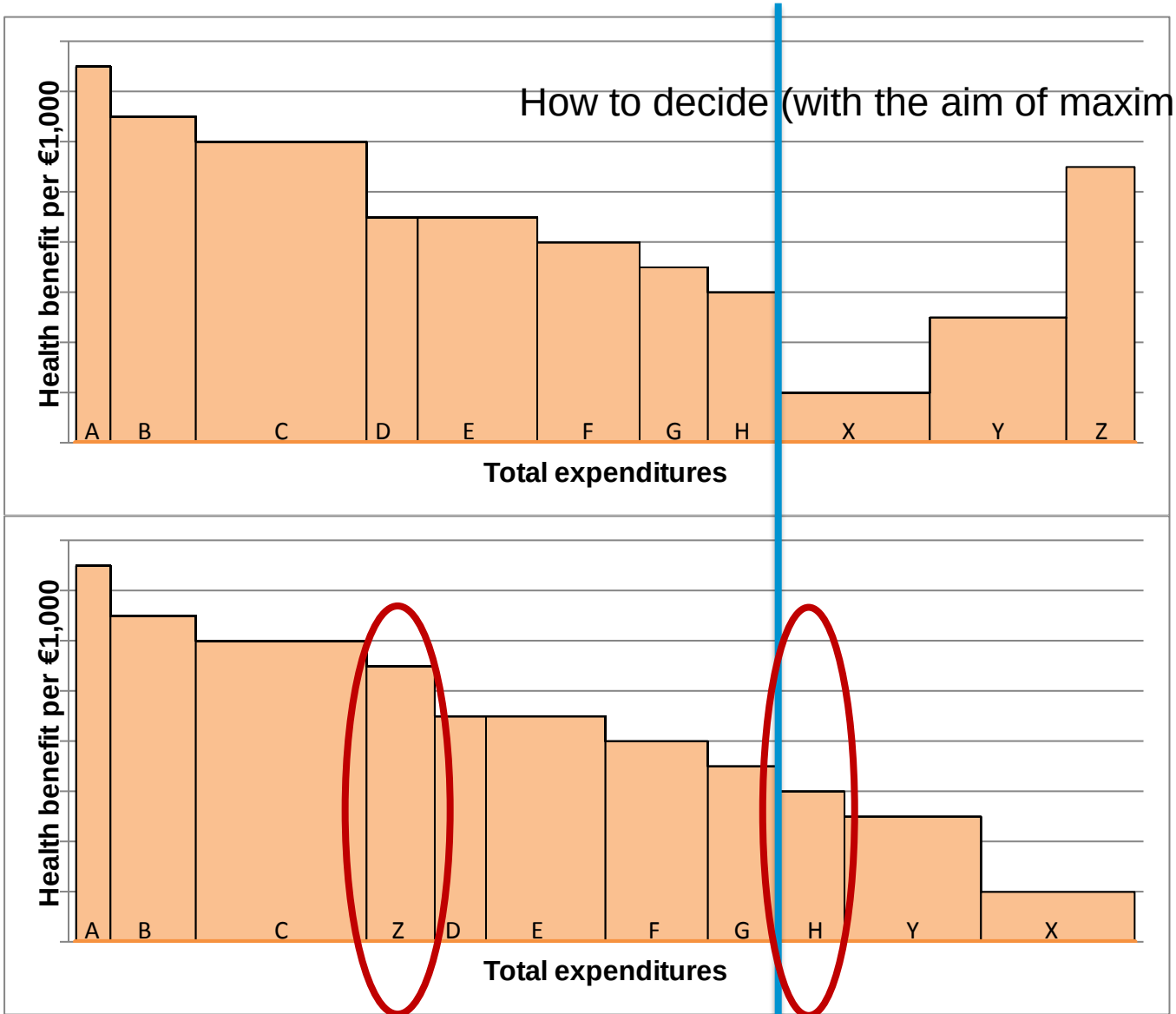
- Health care budget is finite
  - Large numer of innnovations entering the market
  - Reimbursing all → displacement of available
  - Decisions need to be made
    - Often health maximization is one major obective
      (i.e. generating as much health as possible with available budget)

Cost-effectiveness threshold



Cost-effectiveness threshold

How to decide (with the aim of maximizing health)?



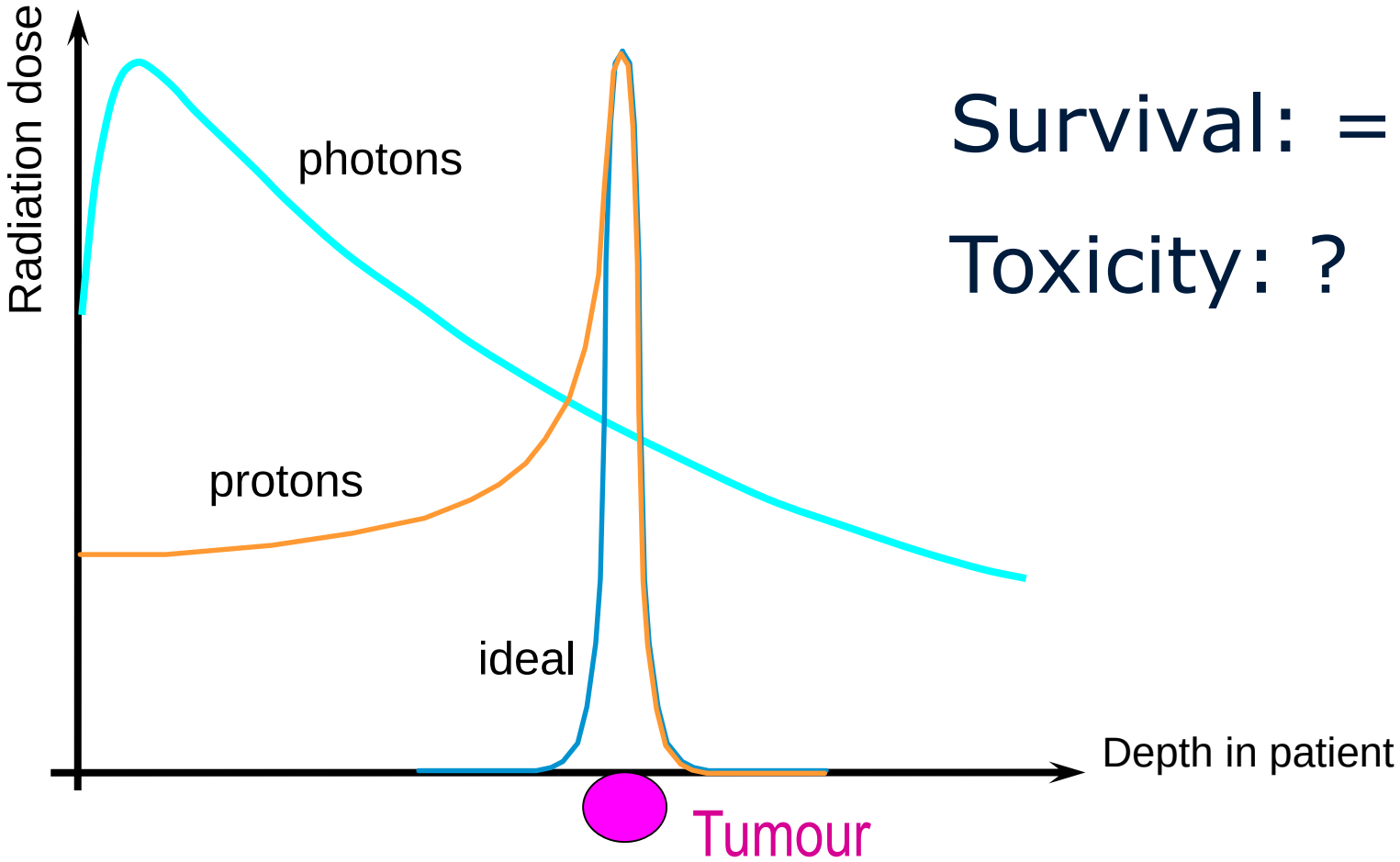
Cost-effectiveness threshold

- Cost-effectiveness threshold to maximize health
- Culyer 2016 et al:
  - Failure to set threshold involves avoidable deaths and morbidity
  - Setting threshold too high/low as well

What is a QALY worth?

- NICE: £30,000-£50,000/QALY
- RVZ (2006): up to €80,000/QALY (depending on disease burden)
- Emperical work:
  - Claxton et al (HTA 2015): £12,936 per QALY
  - Van Baal (symposium Feb 9th, 2017): €41,000 per QALY
- However, other aspects can also be taken into consideration for reimbursement: (public) opinion, ethical, legal aspects
- Dakin et al (OHE 2013) on NICE decision making
  - Cost-effectiveness alone correctly predicted 82% of decisions
  - Potential other factors: end of life criteria, uncertainty, publication date, clinical evidence, only treatment, paediatric population, patient group evidence, appraisal process, orphan status, innovation and use of probabilistic sensitivity analysis
  - At £40,000 per QALY 50% chance of NICE rejection

Proton therapy in head and neck cancer



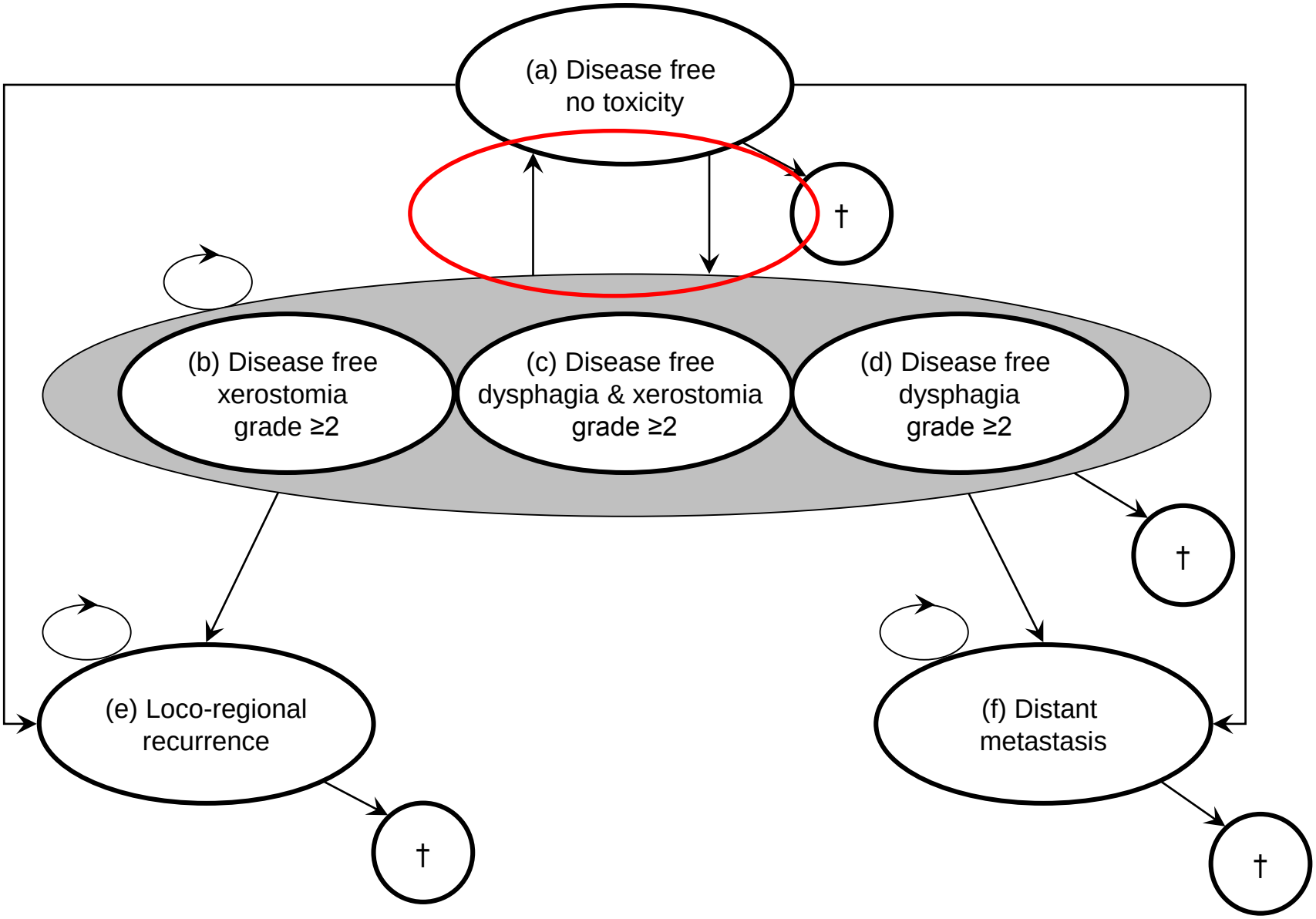
Survival: =

Toxicity: ?

Objective

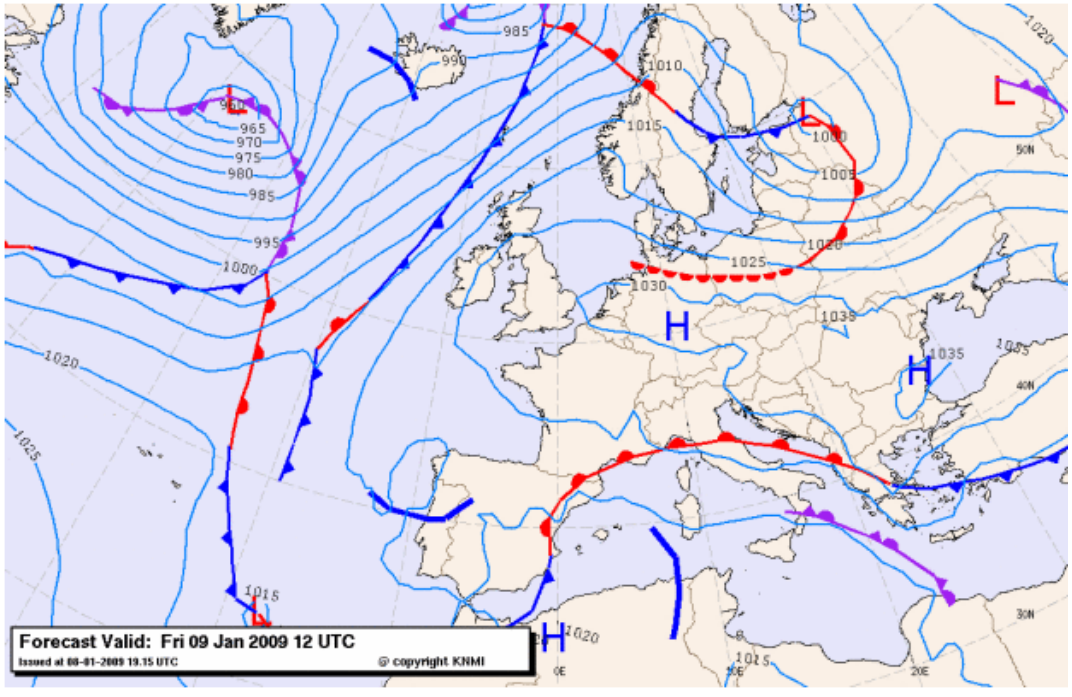
To explore the potential cost-effectiveness of the following strategies:

- Photon therapy for all patients (IMRT)
- Proton therapy for all patients (IMPT)
- Proton therapy only for patients for whom it is cost-effective


(a) Disease free
no toxicity
†
(b) Disease free
xerostomia
grade ≥2
(c) Disease free
dysphagia & xerostomia
grade ≥2
(d) Disease free
dysphagia
grade ≥2
†
(e) Loco-regional
recurrence
†
(f) Distant
metastasis
†

It remains a model

A model is a ‘simple’ reflection of former, current or future reality



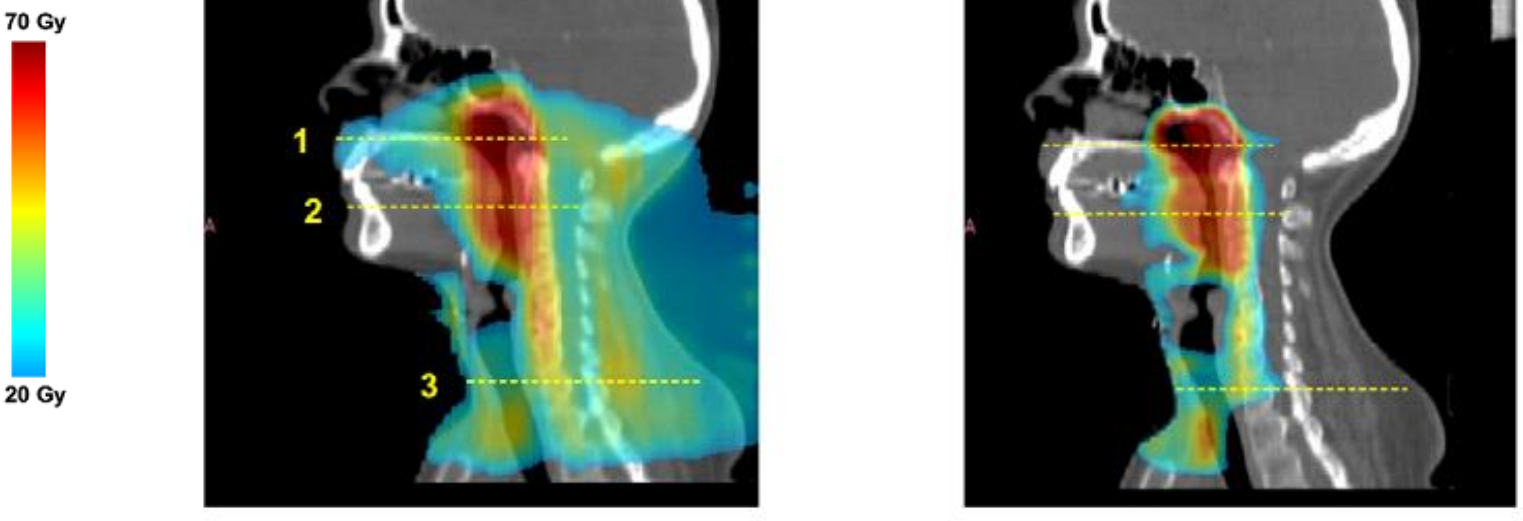
Data sources

Parameter		Source
Probabilities		
	Survival & Recurrence	Literature (assumed equal for both comparators)
	Toxicity	NTCP models combined with planning studies (N=25)
Utility scores		Cross-sectional survey (Ramaekers et al; Oral Oncol 2011 [Accepted])
Costs		Cross-sectional survey and Literature

Exploring effectiveness: toxicity

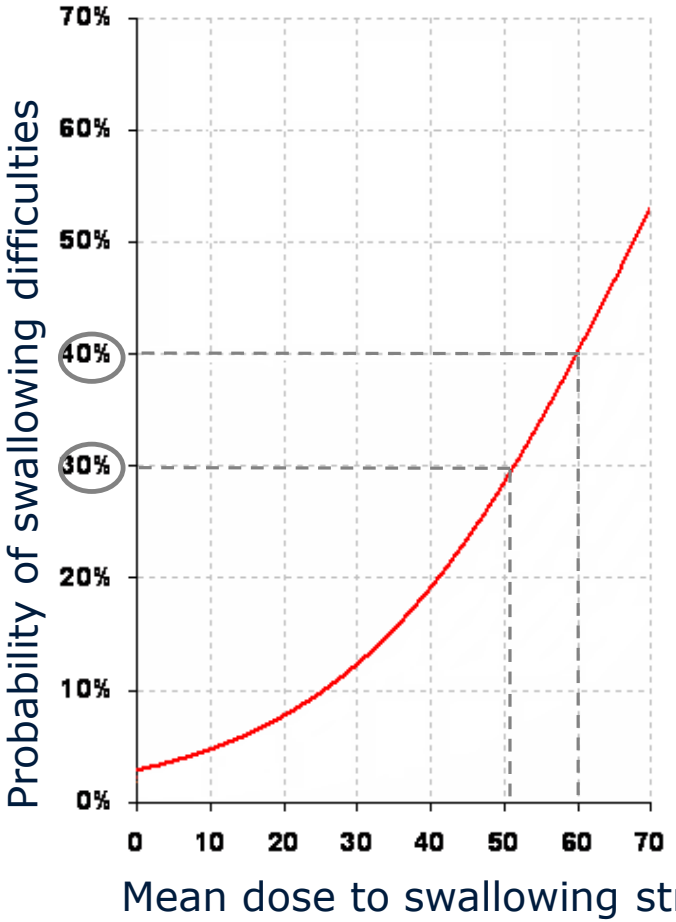
Photons

Protons



Widesott L. et al. IJROBP, 2008;72(2):589-596

Exploring effectiveness: toxicity



Photon radiation

Mean dose to swallowing structure = 60 Gy

- Probability of swallowing difficulties = **40%**

Proton radiation

Mean dose to swallowing structure = 50 Gy

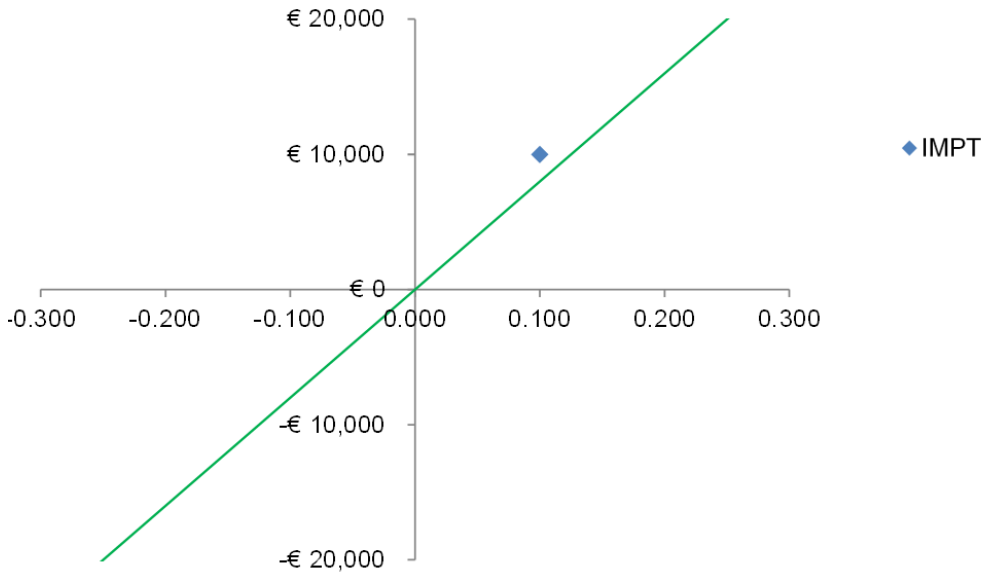
- Probability of swallowing difficulties = **30%**

Treatment costs

Operation	Particle facility		Photon facility	Source
	Combined (carbon-ion and proton)	Proton-only		

Peeters A, Grutters JP, Pijls-Johannesma M, Reimoser S, De Ruysscher D, Severens JL, Joore MA, Lambin P. How costly is particle therapy? Cost analysis of external beam radiotherapy with carbon-ions, protons and photons. Radiother Oncol. 2010 ;95(1):45-53.

Cost-effectivenss of proton therapy for head and neck cancer



Ramaekers BL, Grutters JP, Pijls-Johannesma M, Lambin P, Joore MA, Langendijk JA. Protons in head-and-neck cancer: bridging the gap of evidence. Int J Radiat Oncol Biol Phys. 2013 1;85(5):1282-8

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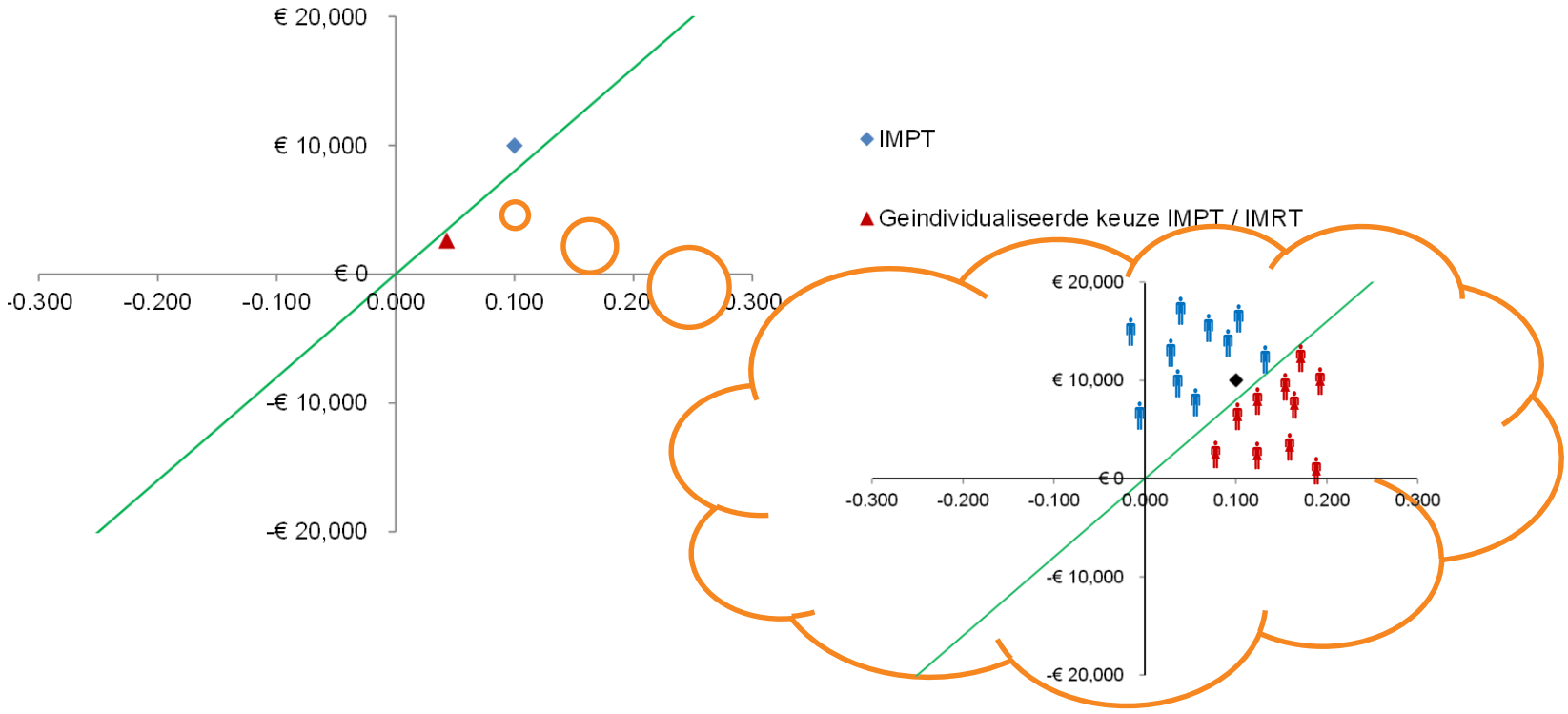

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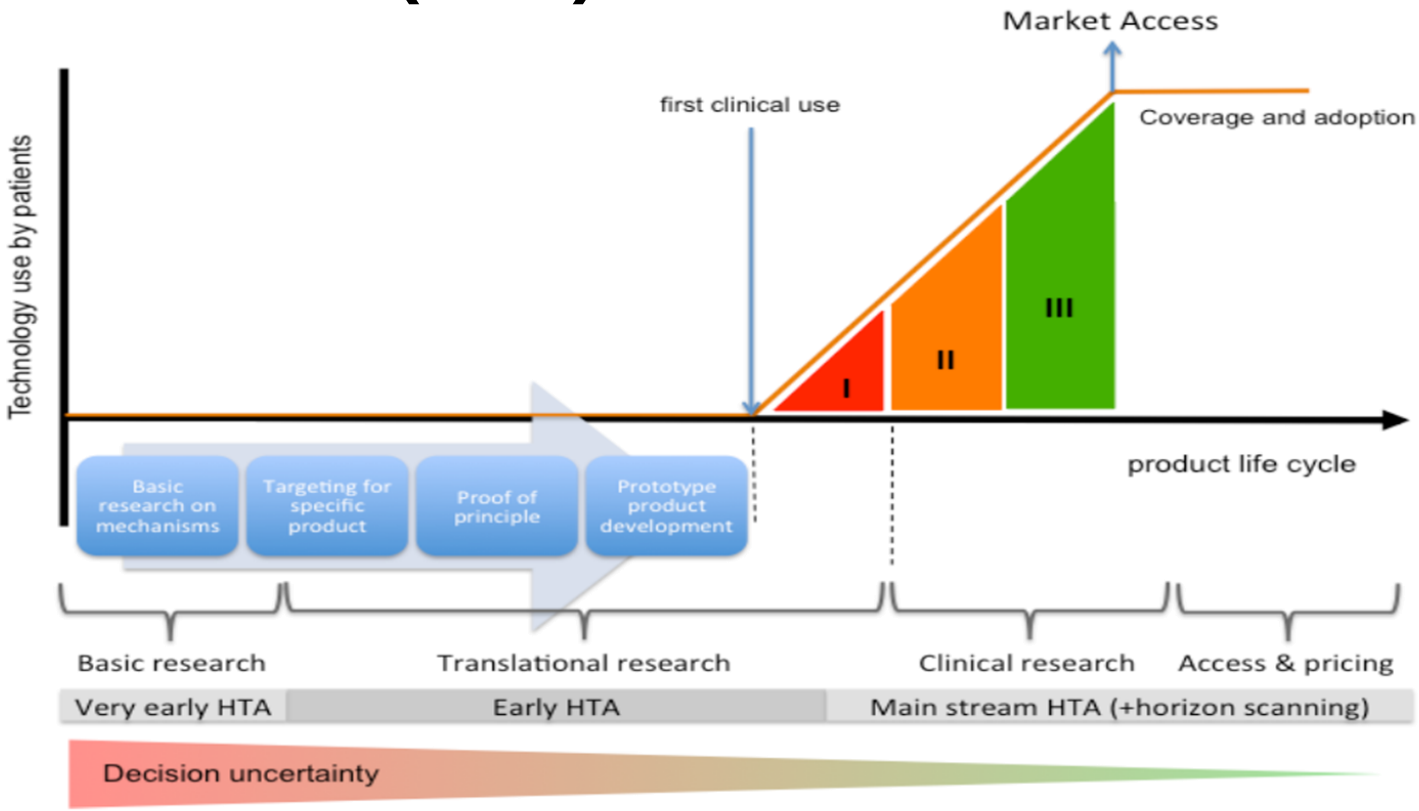
In summary

- Economic evaluation tool to estimate cost per QALY
  - Value for money (ICER)
  - Maximize health with available budget
- Economics is unavoidable because scarcity is unavoidable
- Important to get the threshold right
- Proton therapy cost-effective for selected HNC patients

Final remark on place of economic evaluation (HTA)



Ijzerman MJ and Steuten LMG: Early assessment of medical technologies to inform product development and market access. A review of methods and applications. Applied Health Economics & Health Policy, 2011

Statement

It is unethical to use economic evaluation to inform reimbursement decisions

(i.e. putting a value to what an additional QALY is allowed to cost)

It is unethical **not** to use economic evaluation to inform reimbursement decisions

Thank you for your attention

Questions?

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