The role of health economics in the development, evaluation and commissioning of new technologies

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Outline

- How health economists view healthcare
- Basic questions that need to be answered
- Data needs for economic evaluation
- Worked example
- Interpreting economic evaluation for decision-making
- The role of iterative economic evaluation
- Useful resources

How health economists view health care

Resources:
Staff
Equipment
Drugs

Options:
1) Intervention A
2) Intervention B

Effectiveness
Quality adjusted life years
"Willingness to pay"

Elliott RA, Payne K. Essentials of economic evaluation for health care. Pharmaceutical Press, London. 2005

How health economists choose between different health care interventions

Incremental cost/effectiveness ratio (ICER)

Constructing an economic evaluation

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Incremental Cost-Effectiveness Ratio (ICER)

$$\text{ICER} = \frac{(C_1 - C_0)}{(E_1 - E_0)}$$

C_1 = cost in intervention group
C_0 = cost in control group
E_1 = effect in intervention group
E_0 = effect in control group

Generating ICERs using quality-adjusted life-years (QALYs)

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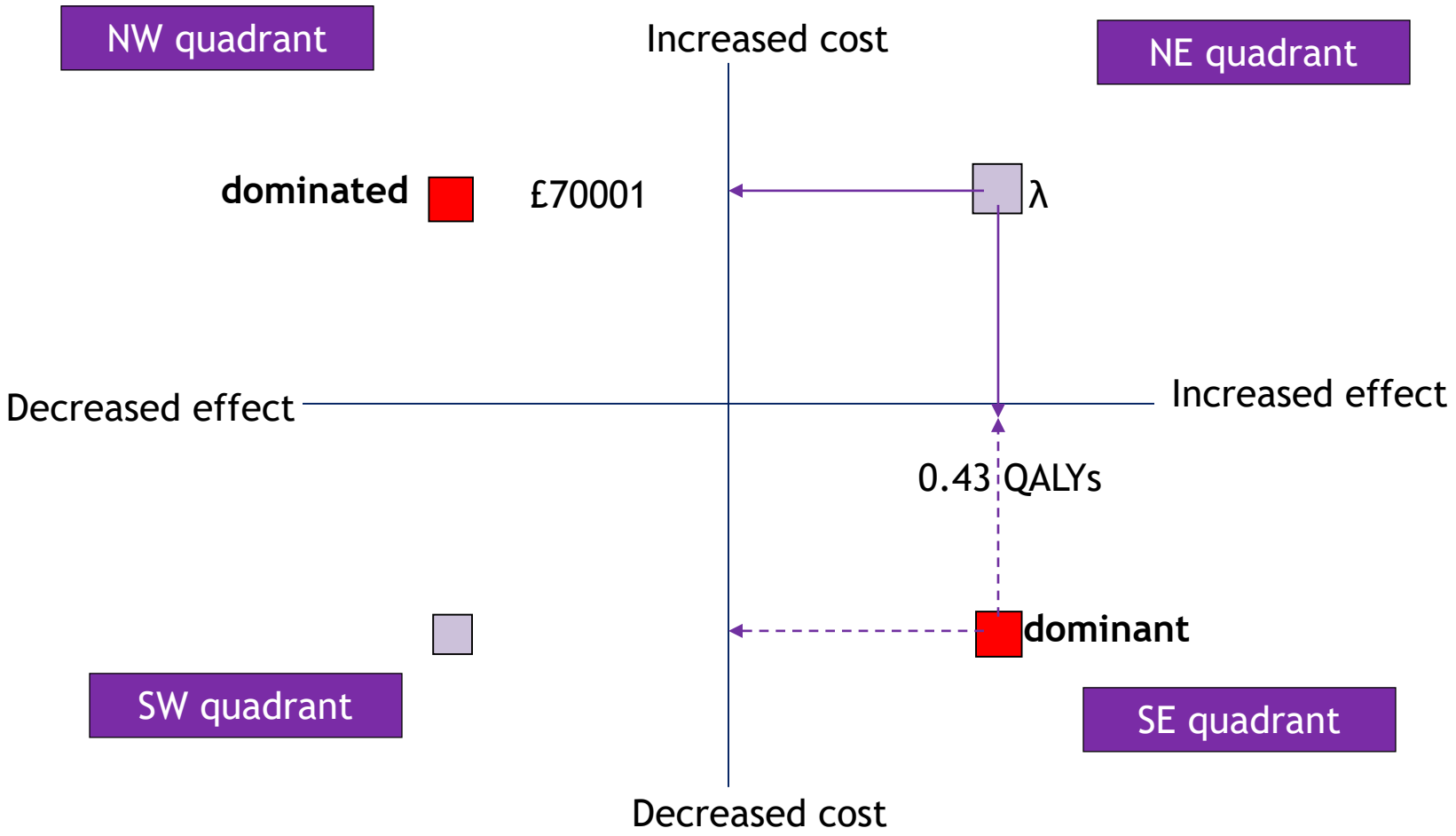
	New intervention	Current care
Total lifetime QALYs	1.87	1.44
Lifetime costs	114,584	44,583

Generate incremental cost effectiveness ratios for the comparators as appropriate using the following equation:

$$ICER = \frac{Costs_{Treatment\ A} - Costs_{Treament\ B}}{QALYs_{Treatment\ A} - QALYs_{Treatment\ B}}$$

Which intervention should be chosen?

Interpreting an incremental cost effectiveness ratio (ICER)



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Data needs for economic evaluation

Basic questions that need to be answered

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- What is the intervention?
- What is the comparator?
- Who is your population?
- What are you trying to achieve with this intervention in these people?

- What sort of comparative study can you do?
- What is/are your primary outcome(s)?
- What resources are consumed along the way?
- Who will be paying for the intervention/service?

P	Patient Population
I	Intervention or Issue
C	Comparison intervention (optional)
O	Outcome of interest

Defining the decision problem

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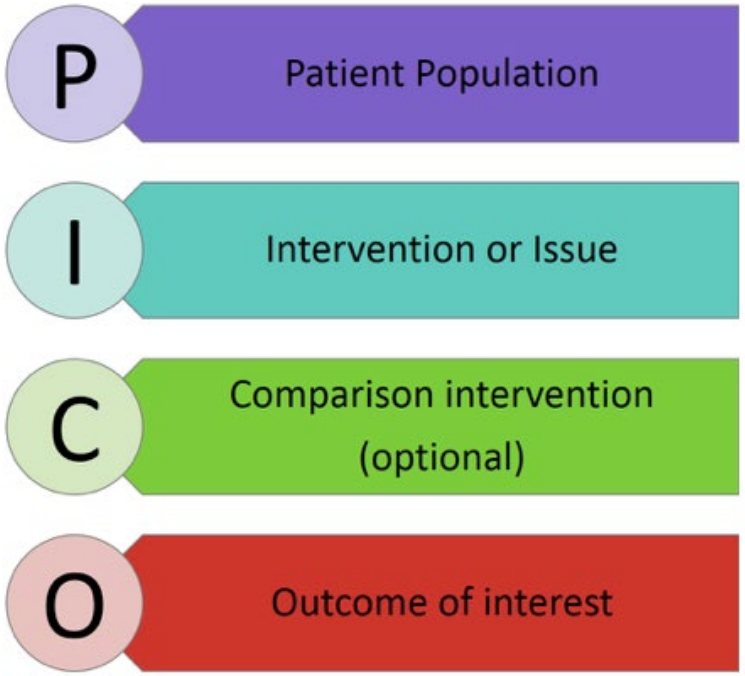
The PICO framework

- **P**opulation: who are the patients of interest (age, gender, disease severity, genotype)?
- **I**ntervention: What therapeutic, diagnostic or preventive or other healthcare interventions are you interested in
- **C**omparator: standard care, no treatment, alternative intervention?
- **O**utcome: what are you trying to achieve? Survival? Increased quality of life?



The PICO Framework: simple examples

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P: Children/adolescents with atypical haemolytic uremic syndrome

I: Eculizumab

C: Plasma therapy and dialysis

O: Quality-adjusted life-years

P: Adults with chronic sialorrhoea

I: Clostridium botulinum toxin A

C: Glycopyrronium bromide

O: Unstimulated salivary flow rate, response rates, adverse effects of treatment, quality of life

P: Women > 80 yrs of age with Br Ca

I: Surgery, RTx, CTx, hormone therapy

C: No treatment

O: Survival

P: People (aged 3-25) with relapsed/ refractory DLBCL not responding or relapsing after treatment with 2 or more courses of CTx

I: Tisagenlecleucel

C: blinatumomab or salvage CTx

O: Progression, survival

NICE Medtech Early Technical Assessment (META) Tool (https://meta.nice.org.uk)

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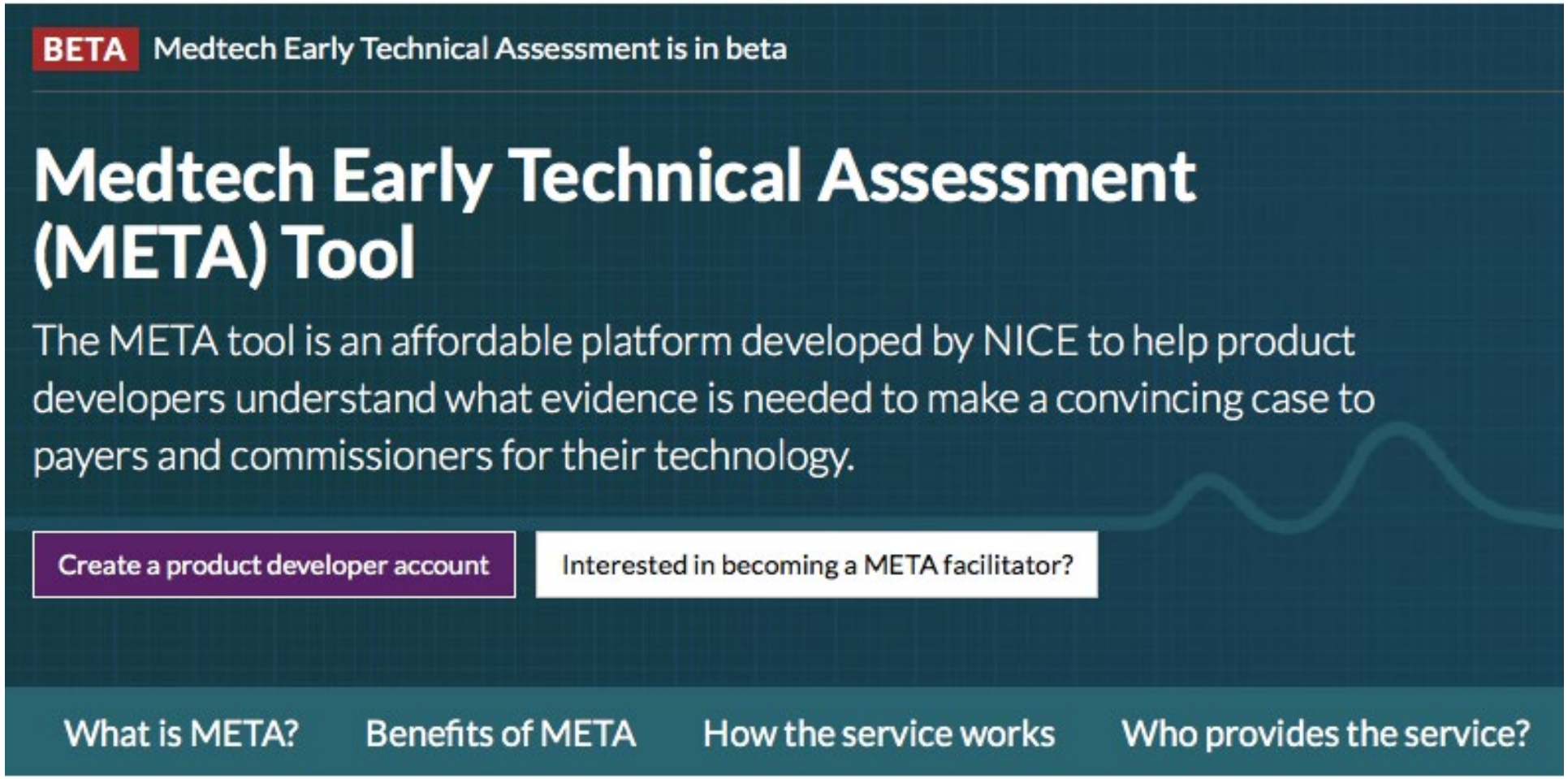
NICE META Tool



Types of economic evaluation design

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📖 Either: Primary economic evaluation eg data from a randomised controlled trial (RCT) or other comparative trial. (ie do it yourself)

📖 or Secondary economic evaluation (economic & clinical data from many sources, combined)

📖 Economic & clinical information preferably from RCTs or good observational studies

📖Modelling approaches:

- 📖Decision analytic model
- 📖Markov model
- 📖Individual patient simulation (discrete event simulation):

Davis, S., Stevenson, M., Tappenden, P., Wailoo, A.J. NICE DSU Technical Support Document 15: Cost-effectiveness modelling using patient-level simulation. 2014. Available from http://www.nicedsu.org.uk

Measuring patient outcomes

- Clinical outcomes: outcome of an intervention or service measured in natural units
  - Clinical indicators (mortality, mmHg, cholesterol, cases detected)

- Quality of life: impact on one or more domains of quality of life
  - Disease specific (AIMS)
  - Generic (HAQ)

- Utility: value attached by an individual for a specific level of health status or a specific health outcome
  - EQ-5D-3L, EQ-5D-5L

- Willingness-to-pay

What are Quality-Adjusted Life-Years (QALYs)?

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- 1 QALY= 1 year in perfect health: generic preference-based utility measure

EQ-5D-3L (Health status)

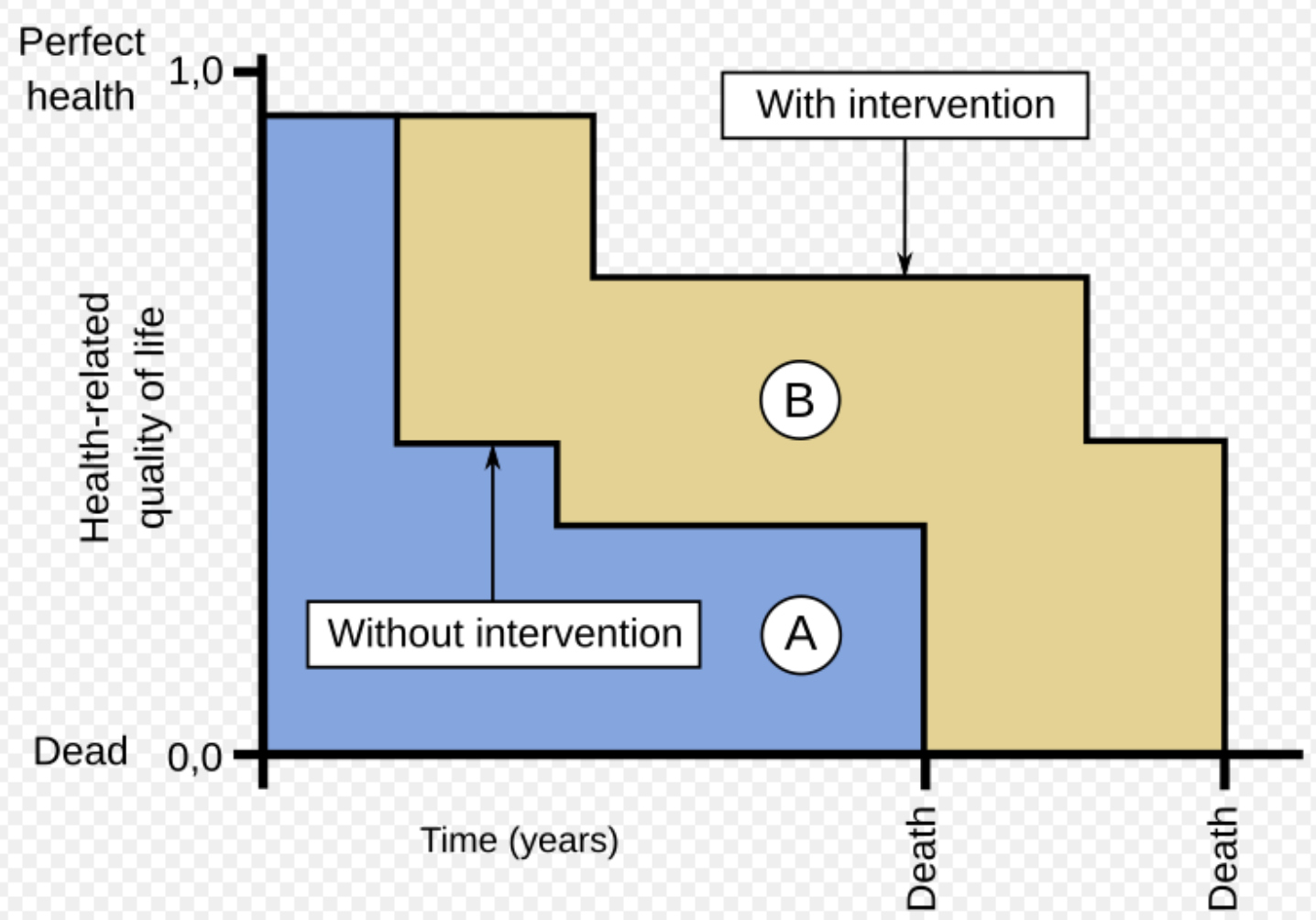
Scoring:	
Baseline	**1**
+	
Mobility 2	**-0.069**
+	
Self-care 2	**-0.104**
+	
Activities 3	**-0.094**
+	
Pain 1	**0**
+	
Anxiety 2	**-0.071**
Total	**0.662**

By placing a tick in one box in each group below, please indicate which statements best describe your own health state today.

	Level		Tariff
Mobility			
I have no problems in walking about	1	☐	0
I have some problems in walking about	2	☐	-0.069
I am confined to bed	3	☐	-0.314
Self-Care			
I have no problems with self-care	1	☐	0
I have some problems washing or dressing myself	2	☐	-0.104
I am unable to wash or dress myself	3	☐	-0.214
Usual Activities (*e.g. work, study, housework, family or leisure activities*)			
I have no problems with performing my usual activities	1	☐	0
I have some problems with performing usual activities	2	☐	-0.036
I am unable to perform my usual activities	3	☐	-0.094
Pain/Discomfort			
I have no pain or discomfort	1	☐	0
I have moderate pain or discomfort	2	☐	-0.123
I have extreme pain or discomfort	3	☐	-0.386
Anxiety/Depression			
I am anxious or depressed	1	☐	0
I am moderately anxious or depressed	2	☐	-0.071
I am extremely anxious or depressed	3	☐	-0.236

What are Quality-Adjusted Life-Years (QALYs)?

- 1 QALY= 1 year in perfect health: generic preference-based utility measure



Using QALYs to differentiate level of benefit

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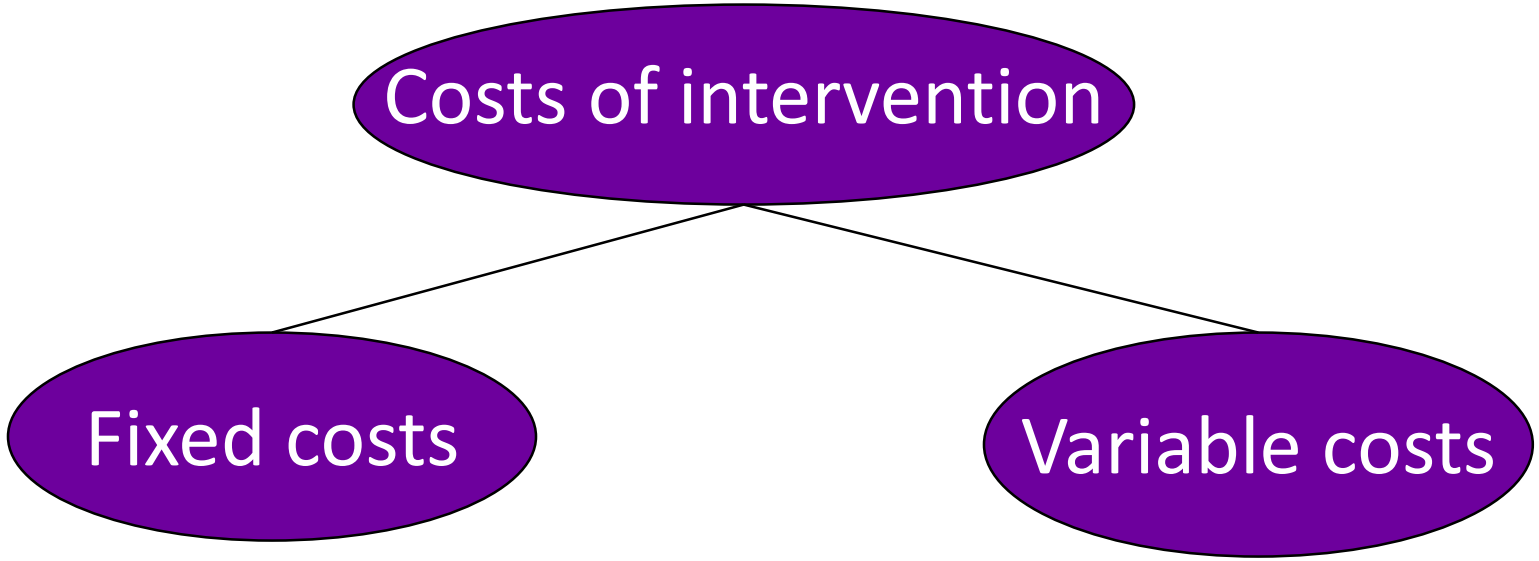
- Which of the treatments below generates most benefit?

Treatment	Life years gained vs placebo	Health state utility in each year of life	QALYs
A	0.3	0.8	?
B	0.4	0.7	?
C	0.5	0.5	?

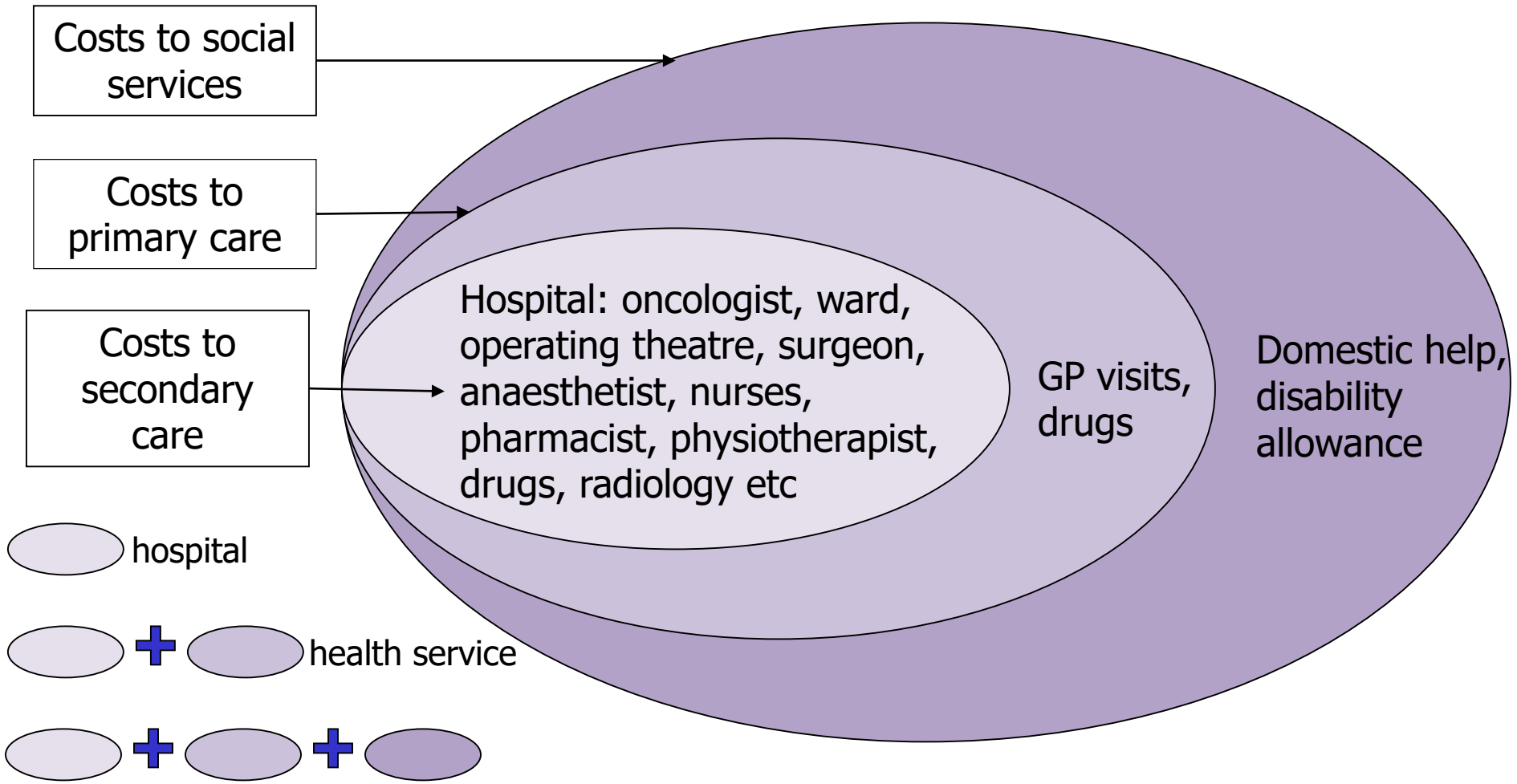
Costs involved in providing healthcare



Overheads: (running the intervention)
Capital: (setting up intervention)

Resources used treating patients: eg: drugs, disposables

Costs of providing health care: the value of perspective



A taxonomy of costs

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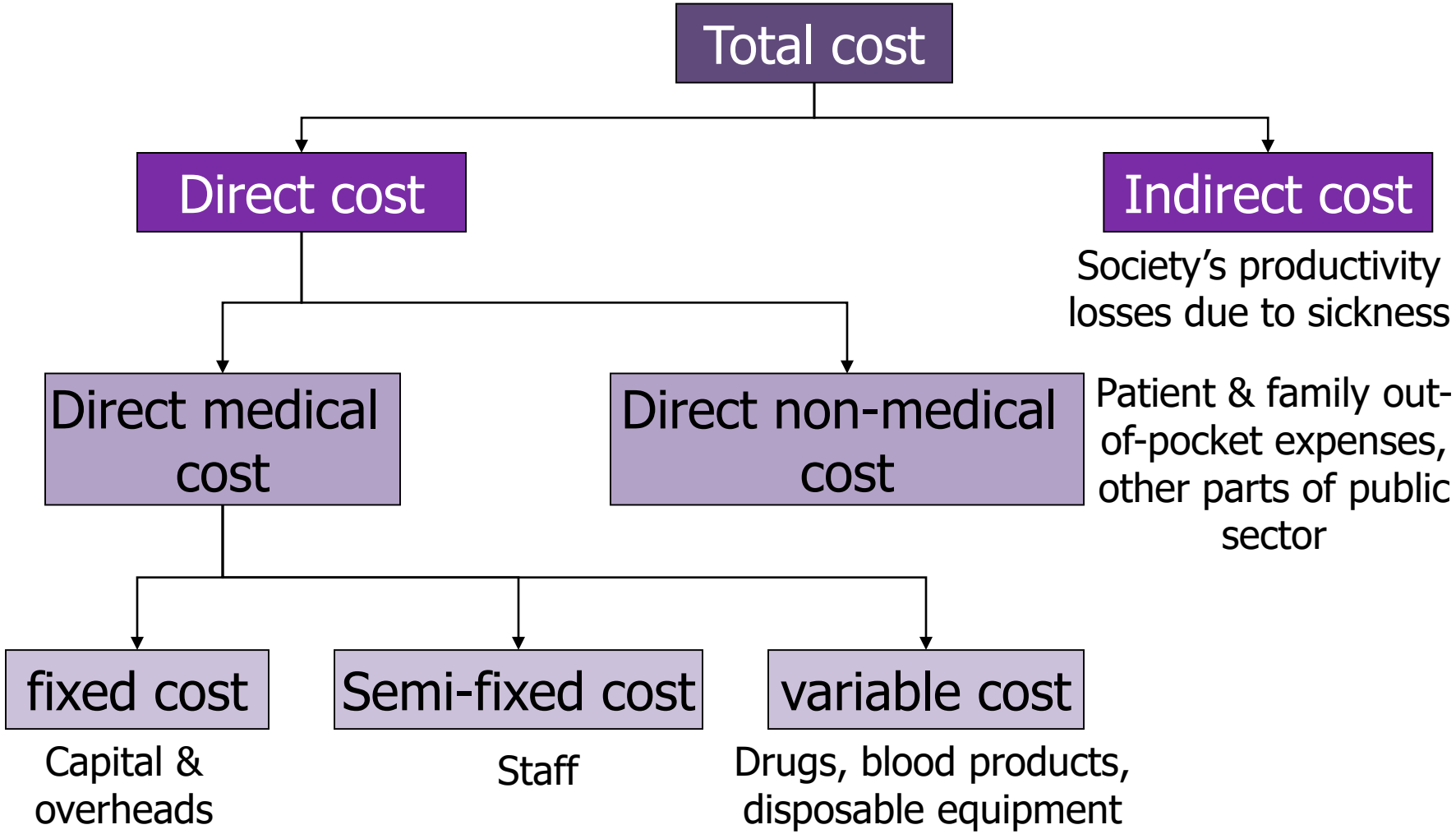

Measuring resource use

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- **Trial-based economic evaluations**
- Clinical trials or prospective studies important for capturing data on healthcare resource use
- Methods typically rely on:
  - Patient (or carer) recall (e.g. questionnaires, diaries or interviews)
  - Prospective forms completed by trial researchers or healthcare professional
  - Routinely available data (e.g. hospital and GP records, hospital episode statistics)
  - Expert panels

- **Model-based economic evaluations**
  - Published data
  - Expert panels

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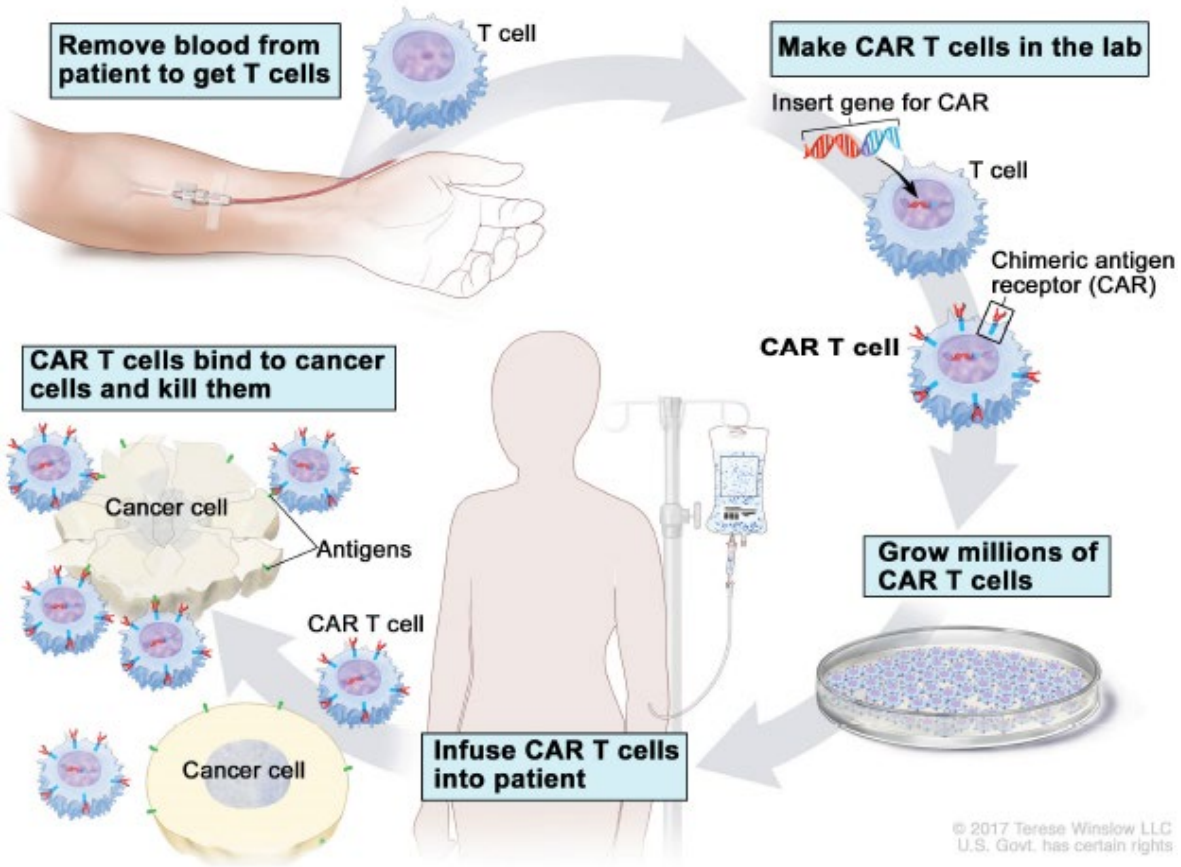
Worked example

Tisagenlecleucel or blinatumomab in people with relapsed/refractory DLBCL not responding or relapsing after treatment with 2 or more courses of CTx



Tisagenlecleucel or blinatumomab in people with relapsed/refractory DLBCL: questions we need to answer

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- Who are we treating? People with relapsed/refractory DLBCL
- What are we trying to achieve? Delay of disease progression
- What are the options? Tisagenlecleucel or blinatumomab

- How effective is each comparator at preventing disease progression and extending life expectancy?
- What is the quality of life/health status of someone in the different stages of this disease?
- How safe is each comparator?
- How much does it cost to treat someone with this disease? Drugs, monitoring, adverse events, post-progression

- What is the difference in effectiveness?
  - (which option delays progression for the longest and by how much?)
- What is the difference in safety?
- What is the difference in costs? Drugs, monitoring, adverse events, post-progression

Markov model for Tisagenlecleucel or blinatumomab in people with relapsed/refractory DLBCL

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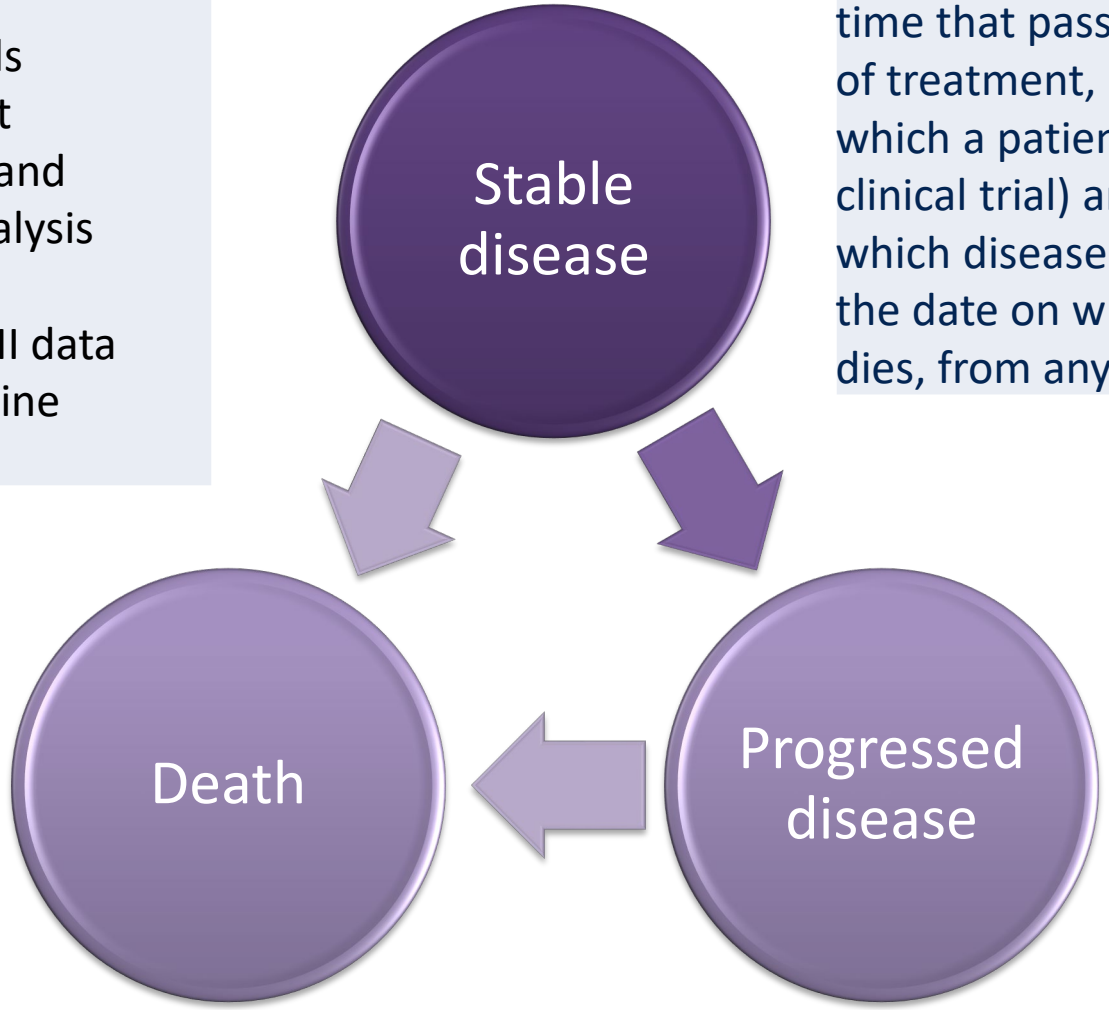
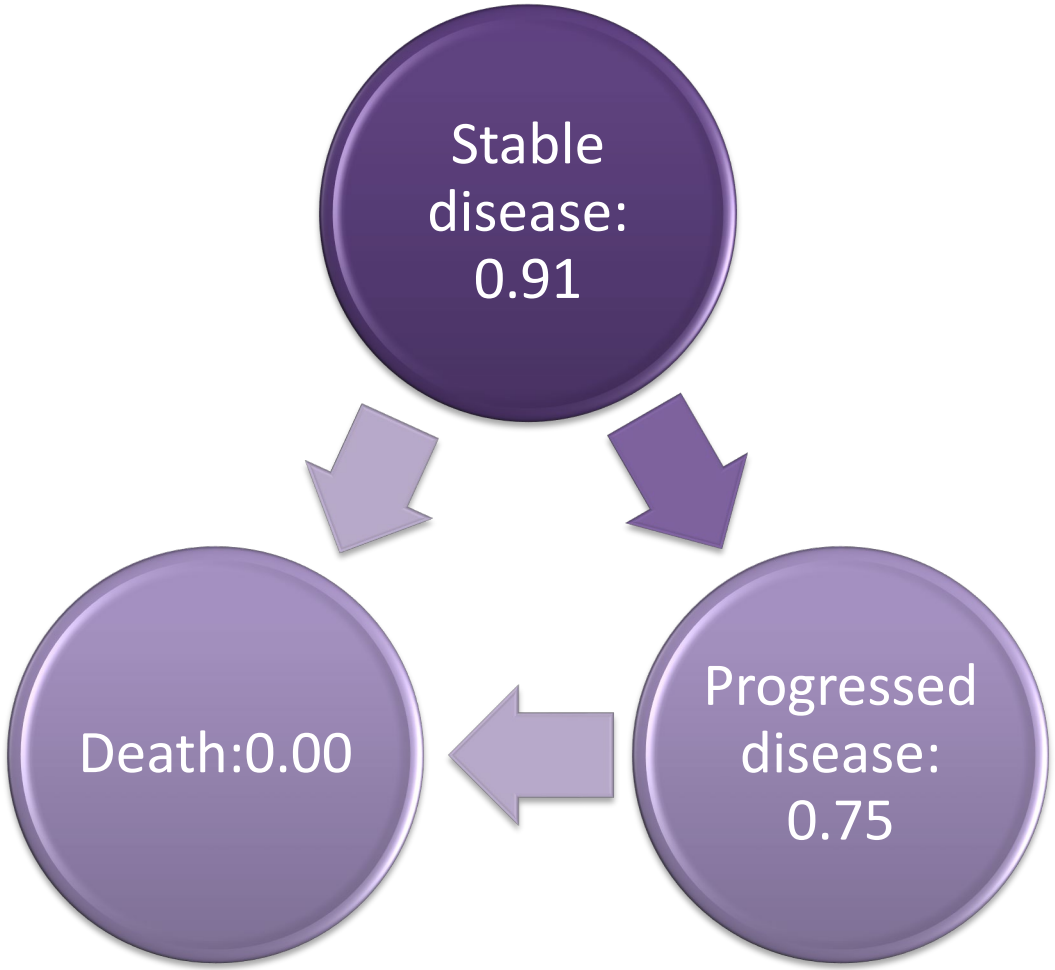
Effectiveness (and safety) data from:

- Head to head trials
- Indirect treatment comparison (ITC) and network meta-analysis (NMA)
- Single arm Phase II data adjusted for baseline confounding



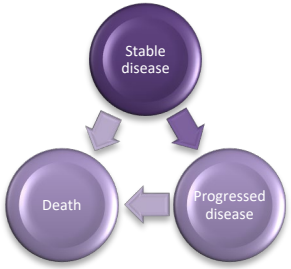
Progression-free survival (PFS): time that passes from first day of treatment, (or the day in which a patient is enrolled in a clinical trial) and the date on which disease "progresses" or the date on which the patient dies, from any cause.

Utilities in Markov model for people with relapsed/refractory DLBCL



Costs for economic model

Parameter		Cost (£)
Treatment costs	Blinatumomab	2017 per 38.5 microgram vial
	Tisagenlecleucel	282000 per infusion
Other costs of care	Leukopheresis	1000
	Bridging CTx	1100
	Lymphodepleting Ctx	7200
	Hospitalisation for CAR-T administration	20000
Adverse events	Cytokine release syndrome	18000
	B-cell aplasia	11200
	Stem cell transplant	116000



Generation of incremental cost-effectiveness ratios (ICERs)

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Results – ERG's base case

	Total		Incremental			
Technologies	Costs (£)	QALYs	Costs (£)	QALYs	ICER (£/QALY)	Δ ICER from CBC
Deterministic (with tis-T patient access scheme price)						
Tis-T	[redacted]	[redacted]				
Salvage chemotherapy	[redacted]	[redacted]	[redacted]	[redacted]	£45,397	£19,992
Blinatumomab	[redacted]	[redacted]	[redacted]	[redacted]	£27,732	£9,339
Probabilistic (with tis-T patient access scheme price)						
Tis-T	[redacted]	[redacted]				
Salvage chemotherapy	[redacted]	[redacted]	[redacted]	[redacted]	£48,265	£22,861
Blinatumomab	[redacted]	[redacted]	[redacted]	[redacted]	£29,501	£11,109

CBC, company base case; ICER, incremental cost effectiveness ratio; LYG, life years gained; Tis-T, tisagenlecleucel-T; QALY, quality-adjusted life year.

Generation of incremental cost-effectiveness ratios (ICERs)

- Cost per extra QALY generated by tisagenlecleucel compared with blinatumomab:
  - Company ICER: £20,046
  - Evidence Review Group ICER: £29,501

Why are these ICERs different?

Which intervention should be chosen?

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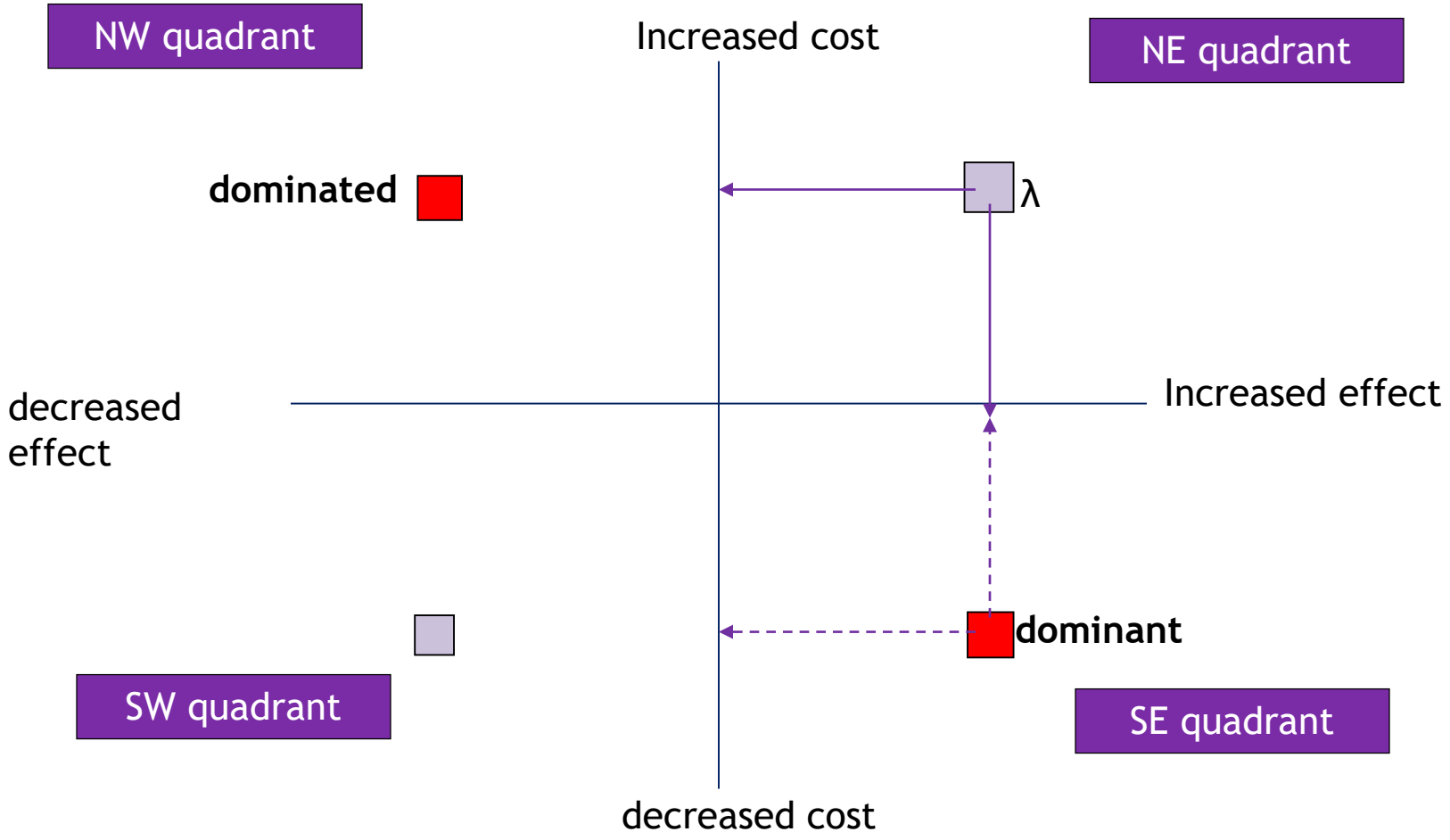
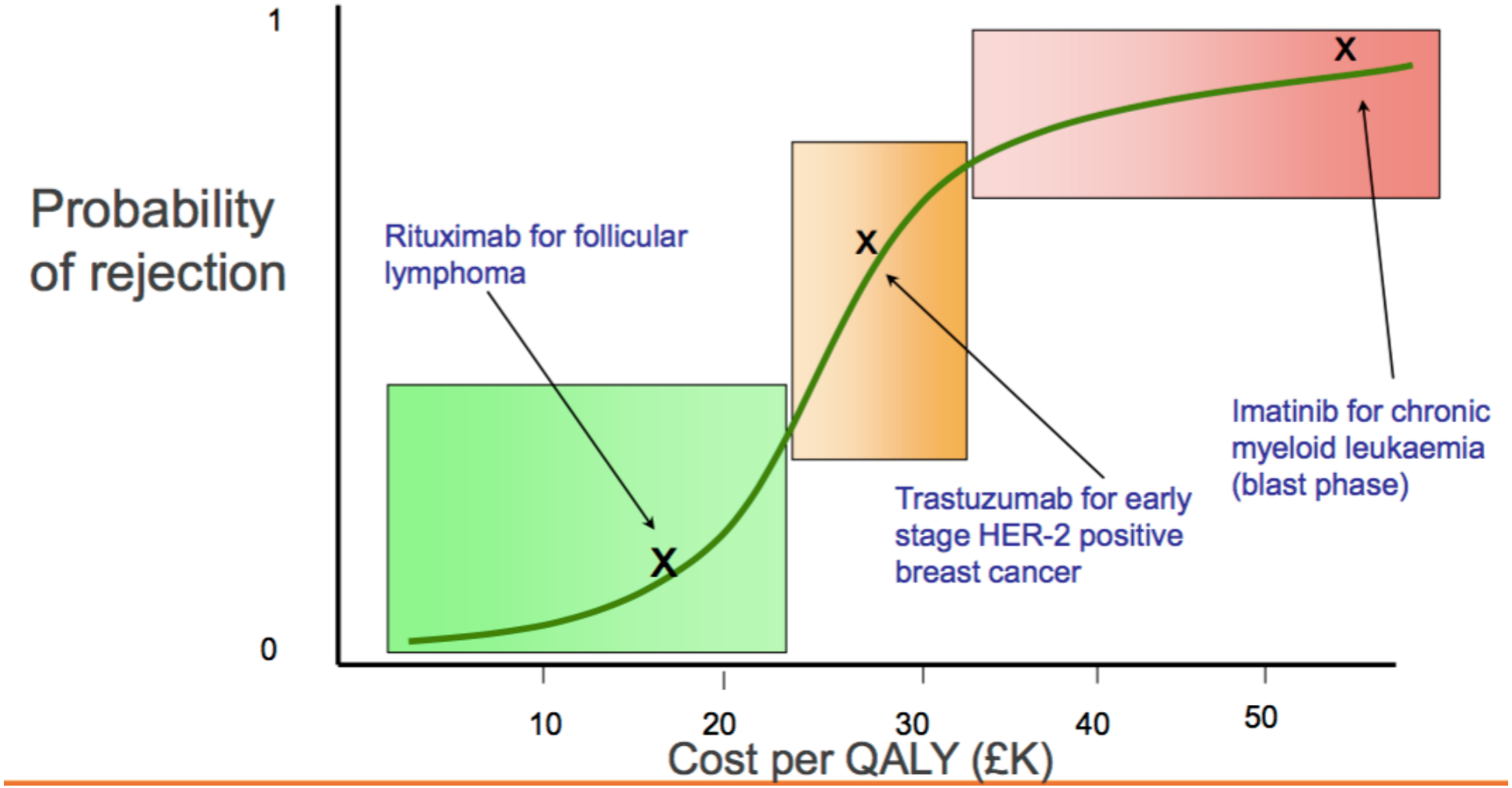
Interpreting economic evaluation for decision-making

Using an incremental cost effectiveness ratio (ICER) in decision-making



If λ <£20,000 = c/e

NICE threshold for cost-effectiveness is £20,000 per QALY



NICE End of Life (EOL) considerations

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Introduced Jan 2009, revised July 2009 & April 2013

Criteria in order to qualify as a life-extending, end-of-life (EoL) treatment:

1. The treatment is indicated for patients with a short life expectancy, normally < 24 months
2. There is sufficient evidence to indicate that the treatment offers an extension to life, normally of at least an additional 3 months, compared with current NHS treatment
3. ~~The treatment is licensed or otherwise indicated for small patient populations (≤ 7,000)~~

➔ ICER threshold ≈ £50,000

Highly specialised technologies (HST)

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- Single technology for a single indication
- Drugs for very rare conditions (<500 people in England)
- Topics identified by the NIHR Innovation Observatory
- Key, new and emerging healthcare technologies that might need to be referred to NICE against the following timeframes:
  - new drugs, in development, at 20 months to marketing authorisation
  - new indications, at 15 months to marketing authorisation

ICER threshold: Incremental QALYs gained per person

- <10 QALYs: £100,000
- 11-29 QALYs: £100,000-£300,000
- >30 QALYs: £300,000

NICE HST interim guidance. https://www.nice.org.uk/Media/Default/About/what-we-do/NICE-guidance/NICE-highly-specialised-technologies-guidance/HST-interim-methods-process-guide-may-17.pdf

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The role of iterative economic evaluation

The role of earlier economic evaluations

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- Early and iterative health economic modeling provides insight in potential cost-effectiveness of a healthcare innovation in its intended context, and the associated uncertainty
  - Structure evidence on clinical and cost effectiveness
  - Identify key stakeholders & value drivers

- Assessments can provide insights in how to proceed:
  - development and positioning of the innovation
  - further research, in order to maximize value for money

- Shift away from traditional use of health economic modeling with the aim of estimating the exact cost-effectiveness of a technology

The role of earlier economic evaluations

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- Early: begin with a “ballpark” estimation of cost-effectiveness
- Iterative: carry out more detailed CEA as development progresses
- Typical methods to identify development uncertainties and investment decisions:
  - Real Options Analysis (ROA)
  - Return on Investment (ROI)

Headroom analysis

$$\triangle QALY = (HRQoL_{NT} - HRQoL_{CT}) \times t$$

$$\max \triangle Cost_{pp} = (\triangle QALY \times £20{,}000) + \triangle C$$

NICE Medtech Early Technical Assessment (META) Tool (https://meta.nice.org.uk)

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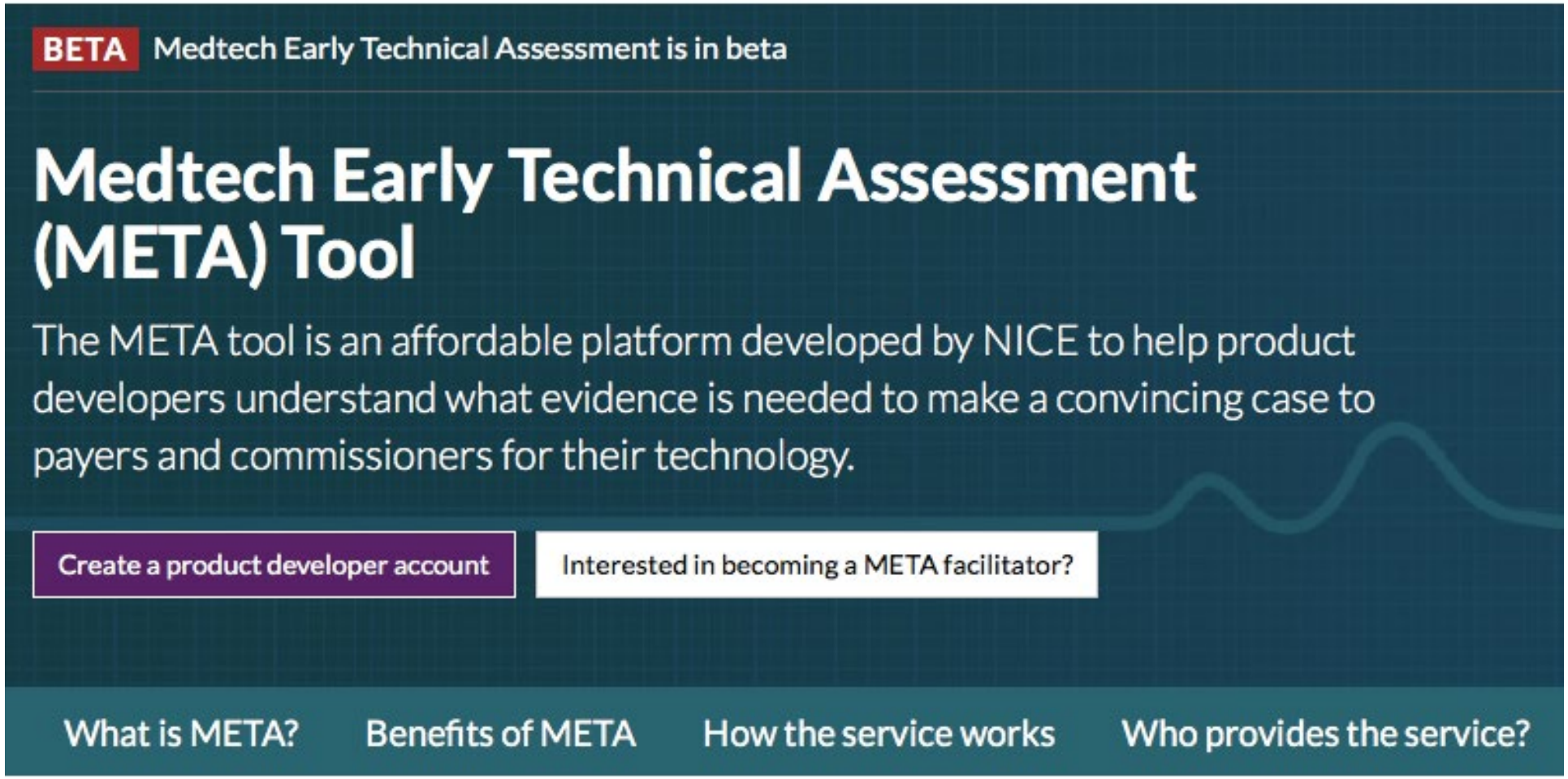
NICE META Tool



NICE Medtech Early Technical Assessment (META) Tool: what it does

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META offers insights on evidence generation for Medtech products to support future engagement with:

- NHS England: To support NHS commissioning decisions
- NICE: To inform Health Technology Assessment
- Research organisations: To support interactions with research organisations (E.g. NIHR, MRC)
- Finance providers: To influence future development funding

The META Tool is designed to help companies understand how robust are their current and future development plans

Areas covered in the “gap analysis” include:

- information about your technology
- what it is indicated for (used to treat)
- what benefits it has for patients and for the wider healthcare system
- what clinical and economic data you have collected so far, and what evidence generation plans you have for the future.

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THANK YOU

Any questions?

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