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Economic Evaluation in Health Care III

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Introduction

- Economic Evaluation
  - » Outcomes
  - » Costs
  - » Decision Making

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Outline

- Modelling and decision analysis
- Exercise & Examples

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Modelling and Decision Analysis

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Decision Analysis

- Allows a formal representation of the whole chain of consequences arising from decisions about alternative interventions
- Takes into account the inherent uncertainty about different states of the world
- Reduces the complexity of the analysis by
  - assigning probabilities to events
  - assessing utilities of consequences

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Decision Analysis Steps

1. Formulate the problem
2. Structure the alternative courses of action
3. Assign probabilities to events
4. Assess the utility of outcomes and the costs
5. Evaluate strategies
6. Perform a sensitivity analysis

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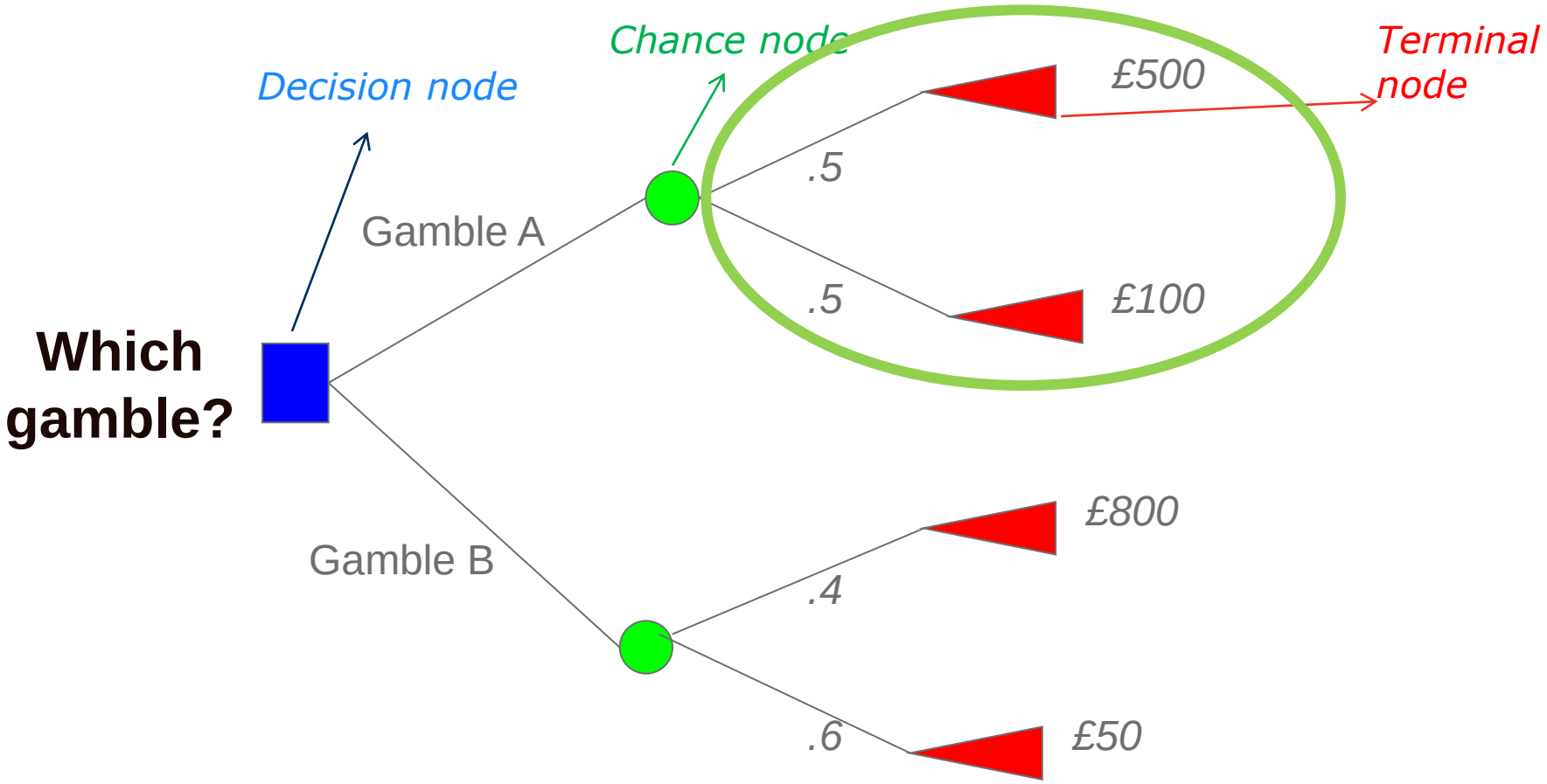
A simple decision tree



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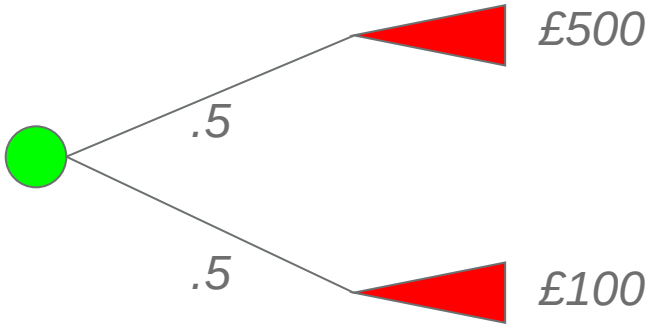
Expected value

Next calculate the expected value for each alternative at each node:

- Outcome
- Probability

Generally: $EV = \sum_i P(X_i) \times U(X_i)$



EV = 0.5*£500 + 0.5*£100 = £300

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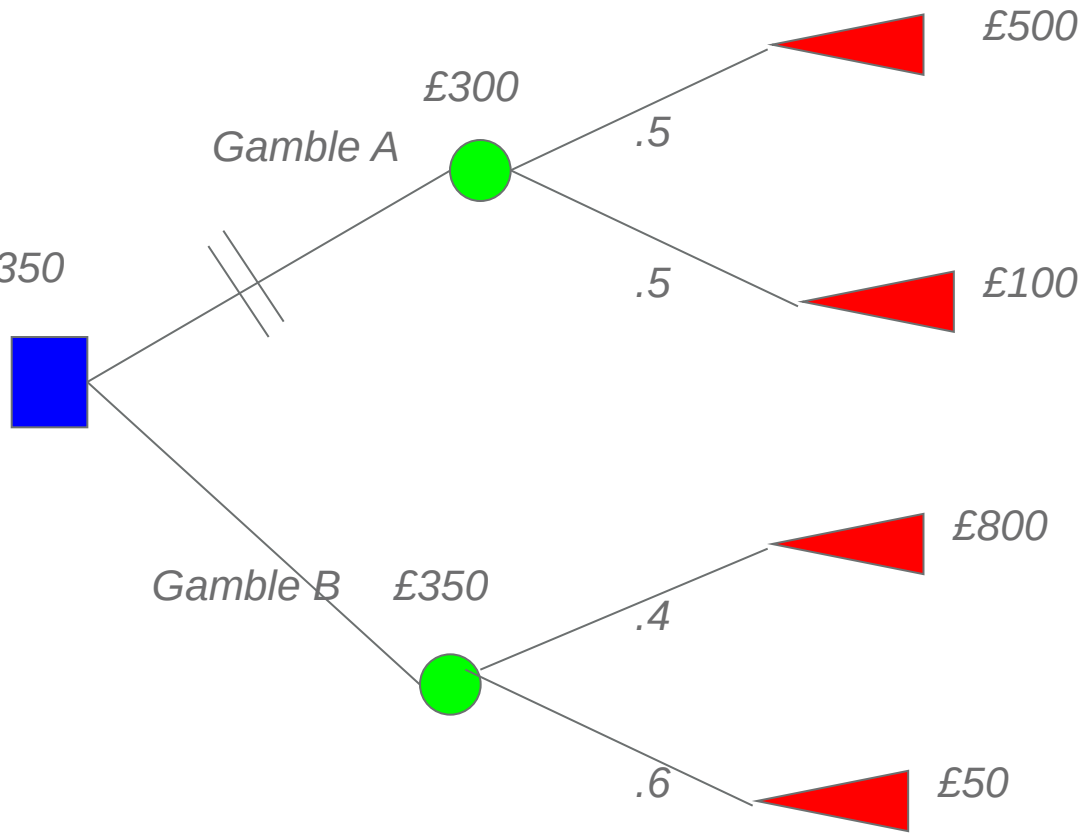
What to do? Folding back the tree



*Value of chance node = (p * outcome1)+[(1-p) * outcome2]*
Value of decision node = higher value of subsequent nodes

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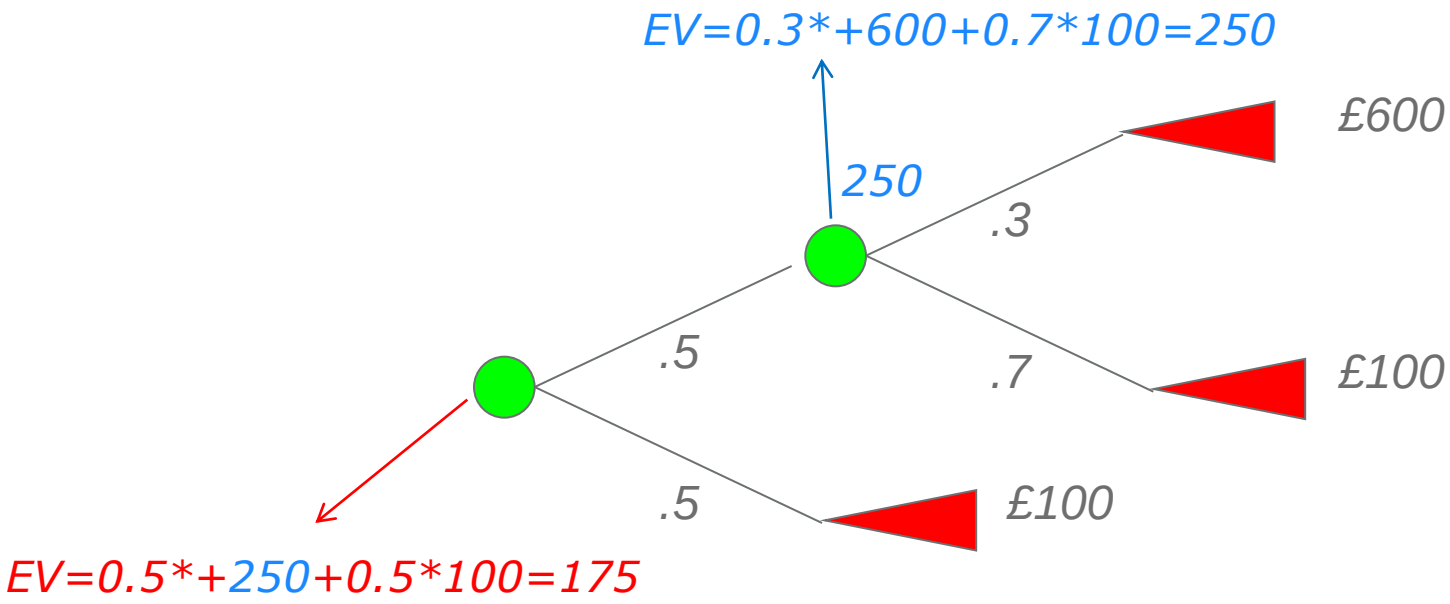
Expected Value



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Example

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1. *Formulate the problem*
2. *Structure the alternative courses of action*

General information

Prevention of Mother-to-Child transmission of HIV during birth

- Choice:
  - intervening in the prevention of HIV transmission (by offering a range of preventive measures)
  - Comparator: no intervention.
- If preventive measures are offered, there is some possibility that they will not be accepted by patients.
- Regardless of whether or not preventive measures are offered, there is a possibility that Mother-to-Child transmission (MTCT) of HIV will occur.
- If there is vertical transmission, the average child has a shortened life expectancy, experiencing 5 QALYs in total.
- On the other hand, with no vertical transmission, the average child experiences 40 QALYs

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1. *Formulate the problem*
2. *Structure the alternative courses of action*

Data on costs and effectiveness

No intervention

- the probability of vertical transmission is 0.26.
- Since no intervention is given the intervention cost is zero, but where transmission occurs, the treatment cost is £1500.

Intervention

- Intervention is accepted by women (p=0.95):
  - The cost of the interventions is £800.
  - Where transmission occurs, the treatment cost are £1500.
  - Because the intervention is effective, the probability of transmission falls to 0.07.
- Intervention is not accepted (p=0.05):
  - probability of vertical transmission is 0.26 (same as if no intervention)
  - no intervention costs.

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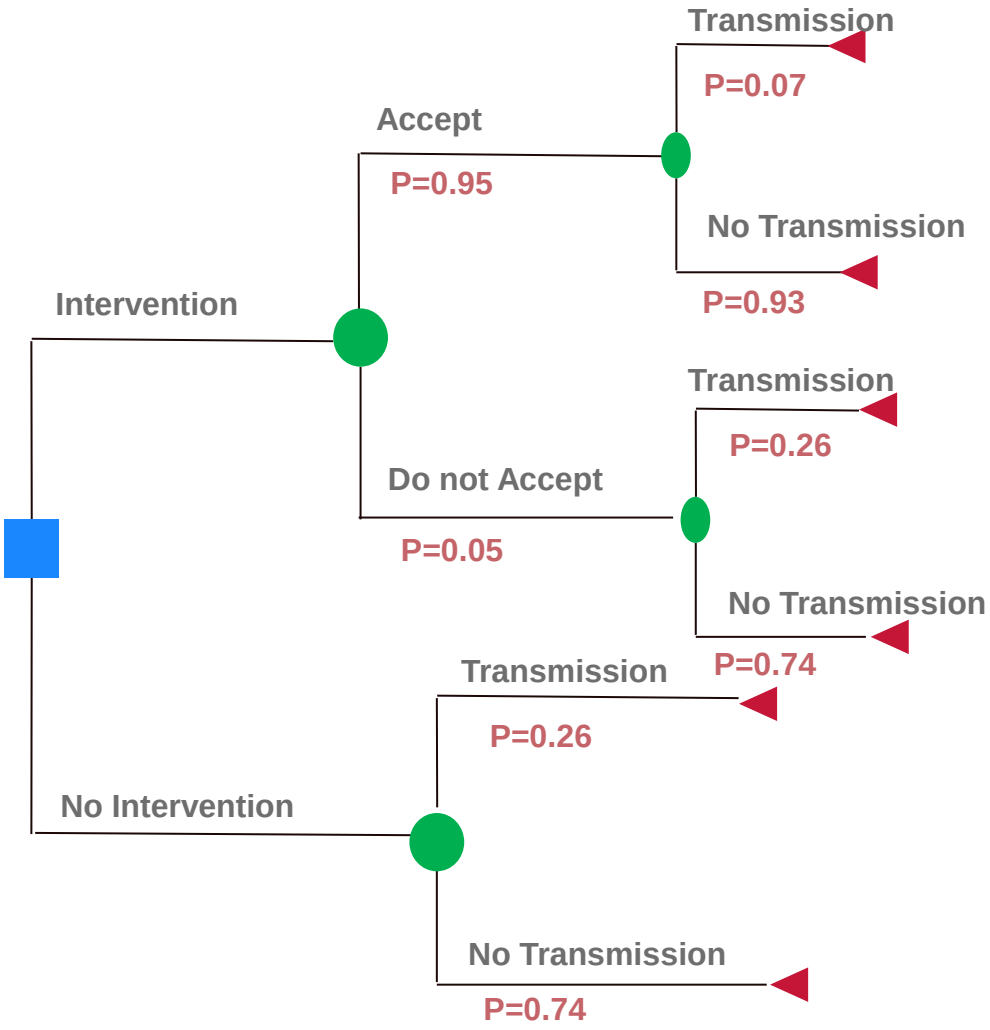
1. *Formulate the problem*
2. *Structure the alternative courses of action*
3. *Assign probabilities to events*

Decision tree



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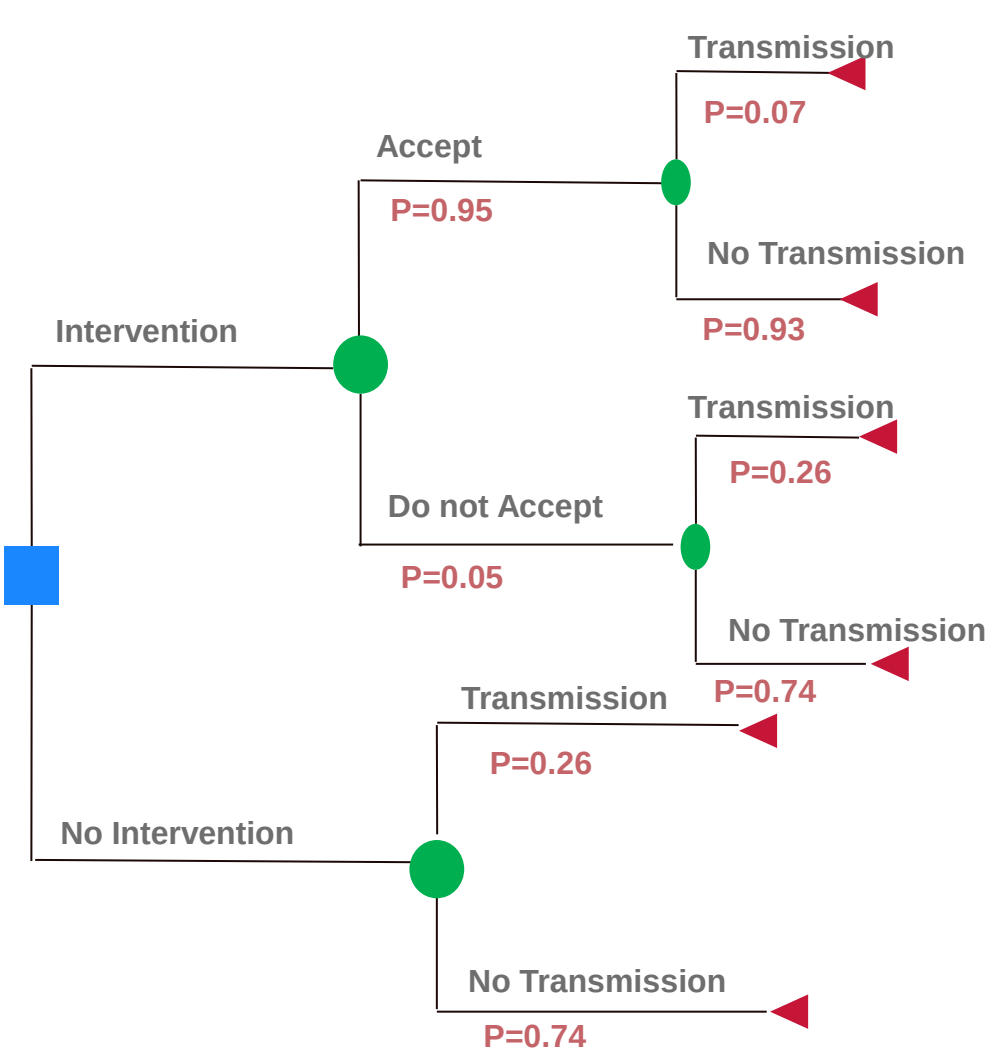
4.Assess the utility of outcomes and the costs

Decision tree



	Treatment cost	Intervention cost
Transmission	1500	800
No Transmission	0	800
Transmission	1500	0
No Transmission	0	0
Transmission	1500	0
No Transmission	0	0

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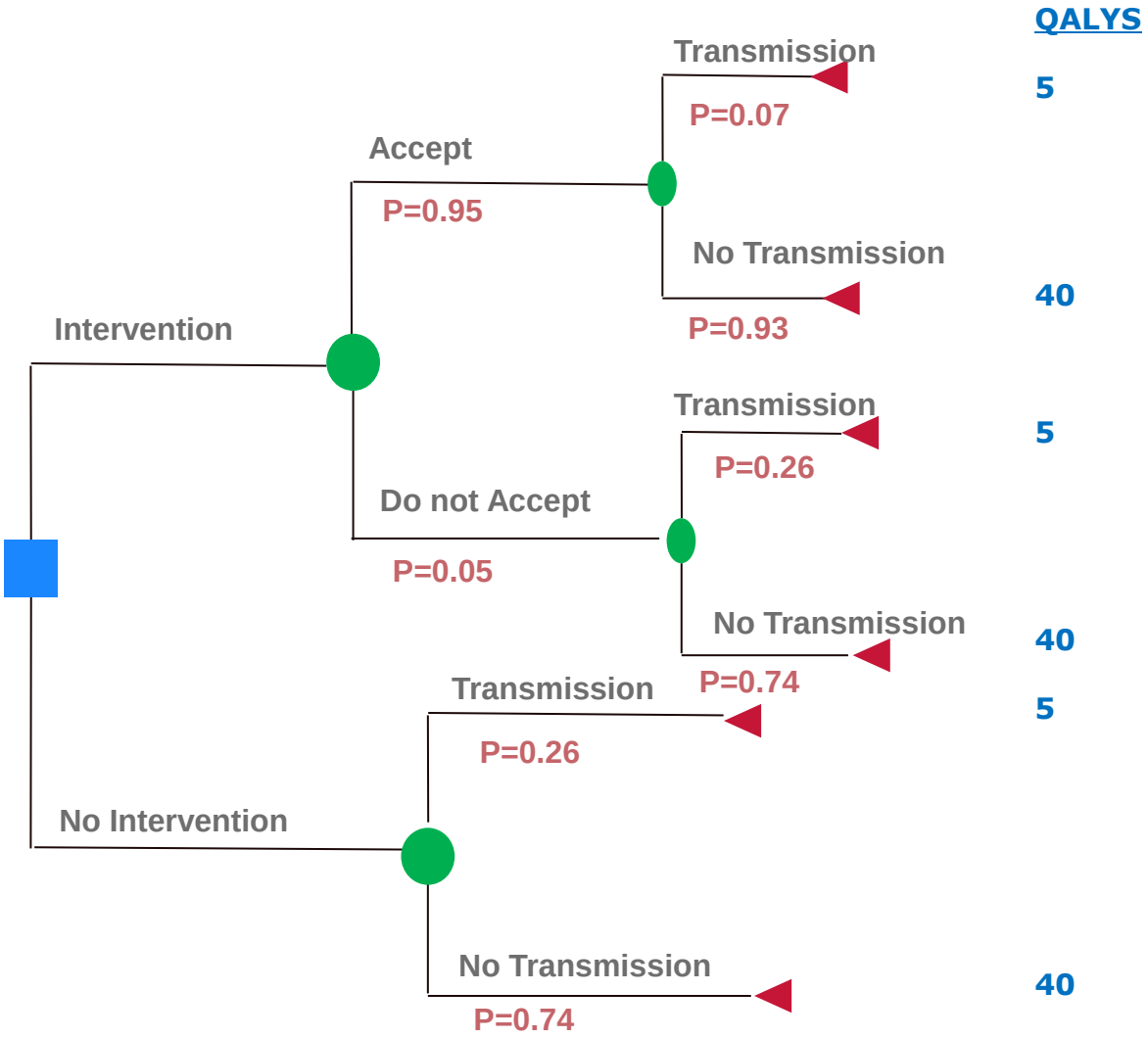
4.Assess the utility of outcomes and the costs

Decision tree



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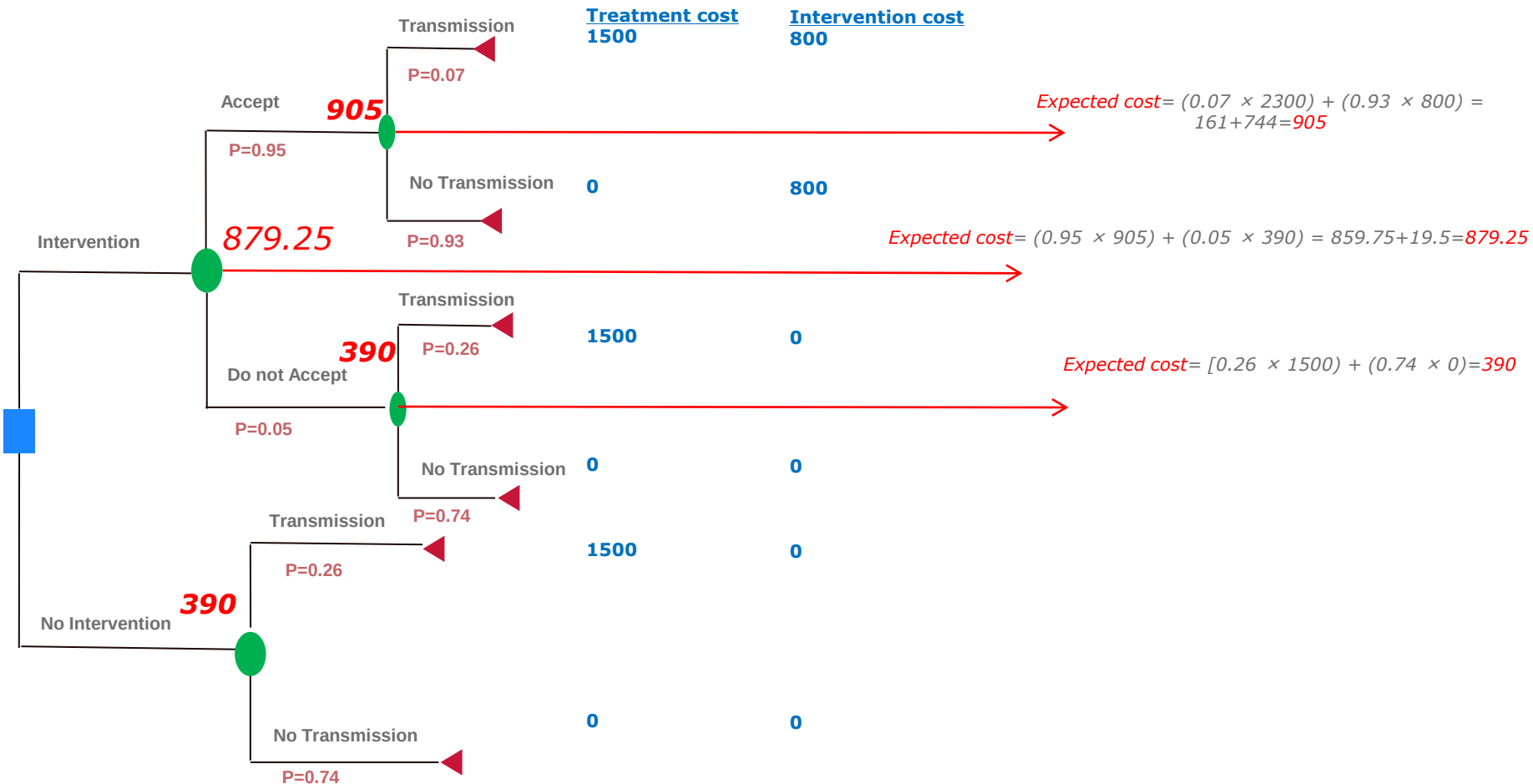

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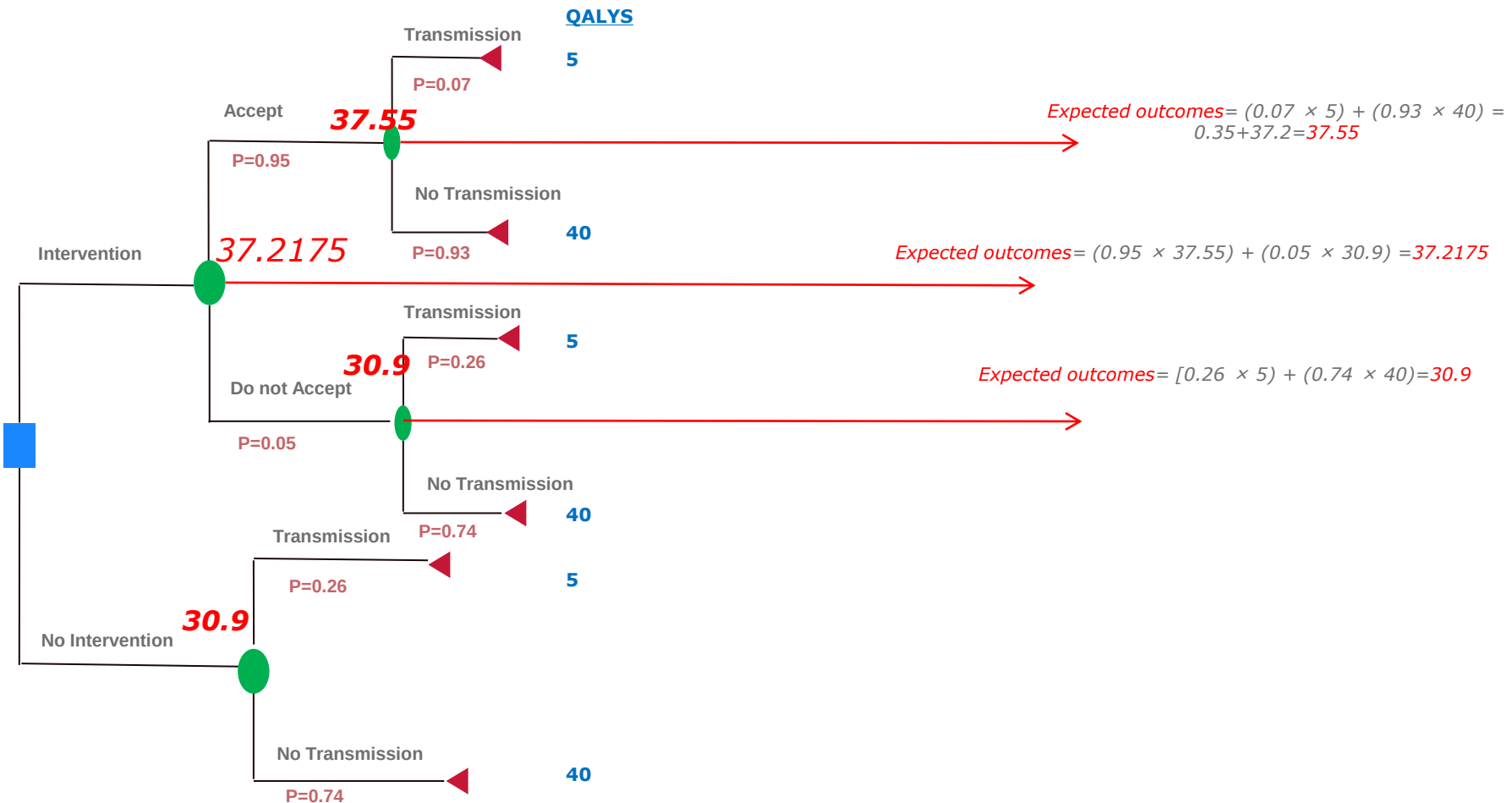

Expected costs and expected outcomes

Intervention

Expected cost $=0.95[(0.07 \times 2300)+(0.93 \times 800)]+0.05\ [(0.26 \times 1500)+(0.74 \times 0)] = £879.25$

Expected QALYs $=0.95[(0.07 \times 5)+(0.93 \times 40)]+0.05[(0.26 \times 5)+(0.74 \times 40)] = 37.2$ QALYs

Non-intervention

Expected cost $= (£1500 \times 0.26) + (0 \times 0.74)\ (3.2) = £390.00$

Expected QALYs $= [(0.26 \times 5) + (0.74 \times 40)] = 30.9$ QALYs.

$$\text{ICER} = \frac{£(879.25 - 390)}{37.2 - 30.9} = \frac{489.25}{6.3} = £77.66 \text{ per QALY}$$

“It costs £77.66 to generate one QALY with this intervention”

Uncertainty about acceptance probability

- Previous model: we assumed that 95% of women accept treatment
- What if only 50% of women accepted treatment?
- Sensitivity analysis on unknown parameter ‘acceptance’
- Probability of acceptance ranges between 0.50-0.95

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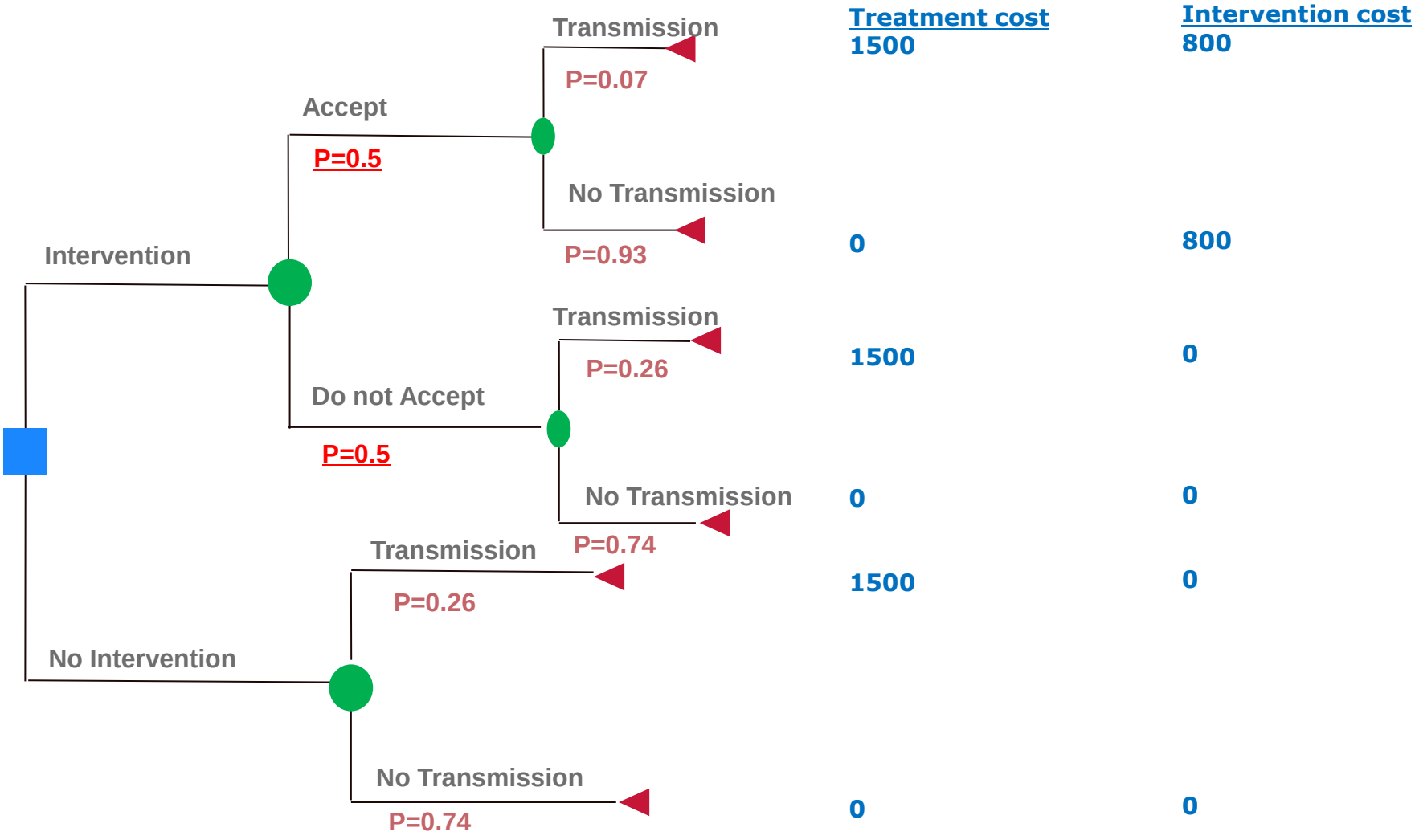
1. *Formulate the problem*
2. *Structure the alternative courses of action*
3. *Assess the utility of outcomes and the costs*

Decision tree



Expected costs and expected outcomes

Intervention

Expected cost = $0.5[(0.07 \times 2300)+(0.93 \times 800)]+0.5[(0.26 \times 1500)+(0.74 \times 0)]$ = £647.5

Expected QALYs = $0.5[(0.07 \times 5)+(0.93 \times 40)]+0.5[(0.26 \times 5)+(0.74 \times 40)]$ = 34.225 QALYs

Non-intervention

Expected cost = $(£1500 \times 0.26)+(0 \times 0.74)$ (3.2)= £390.00

Expected QALYs = $[(0.26 \times 5)+(0.74 \times 40)]$ = 30.9 QALYs.

ICER= $\frac{£(647.5 - 390)}{34.225 - 30.9} = \frac{257.5}{3.325}$ = £ 77.44 per QALY

The cost per QALY are nearly the same

Higher non-acceptance does hardly impact on cost-effectiveness estimates

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Exercise

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Instructions

- Work in groups of around 5 persons
- Read instructions
- One computer per group with Excel
- Otherwise: Grab pen and paper
- Presentation of results 5 min
- Assessment by another group

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Decision Analysis Steps

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1. Formulate the problem

- A 63 year old woman presents with severe aortic stenosis. She has no angina and no special risk factor for Coronary Artery Disease (CAD).
- Aortic valve replacement is recommended. Should she undergo preoperative coronary angiography?
- Coexisting CAD increases operative mortality of Aortic Valve Replacement (AVR) for aortic stenosis
- Prevalence of CAD in patients with aortic stenosis: 40-80%; prevalence in general population of 60 to 70 year olds: 10-15% in men and 5-10% in women
- Patient medical history, physical examination and ECG do not reliably differentiate patients with aortic stenosis and CAD from patients with stenosis alone.

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1. Formulate the problem

- Decision: angiography (catheterization)/ no angiography (no catheterization)
- With no angiography the patient undergoes the aortic valve replacement but the probability of survival depends on whether the patient has coronary artery disease
- The utility of survival is assigned a value of 1, while the value of death is assigned a value of 0.
- If angiography then there is a chance of death from angiography or alternatively if survive angiography and will go on to have surgery
- The angiography will show whether the patient has coronary artery disease
- If the patient has coronary artery disease then patients undergo aortic valve replacement and a coronary artery bypass graft (CABG).
- If the patient does not have coronary artery disease then the patient undergoes aortic valve replacement only
- With either alternative there is a probability of surviving or dying

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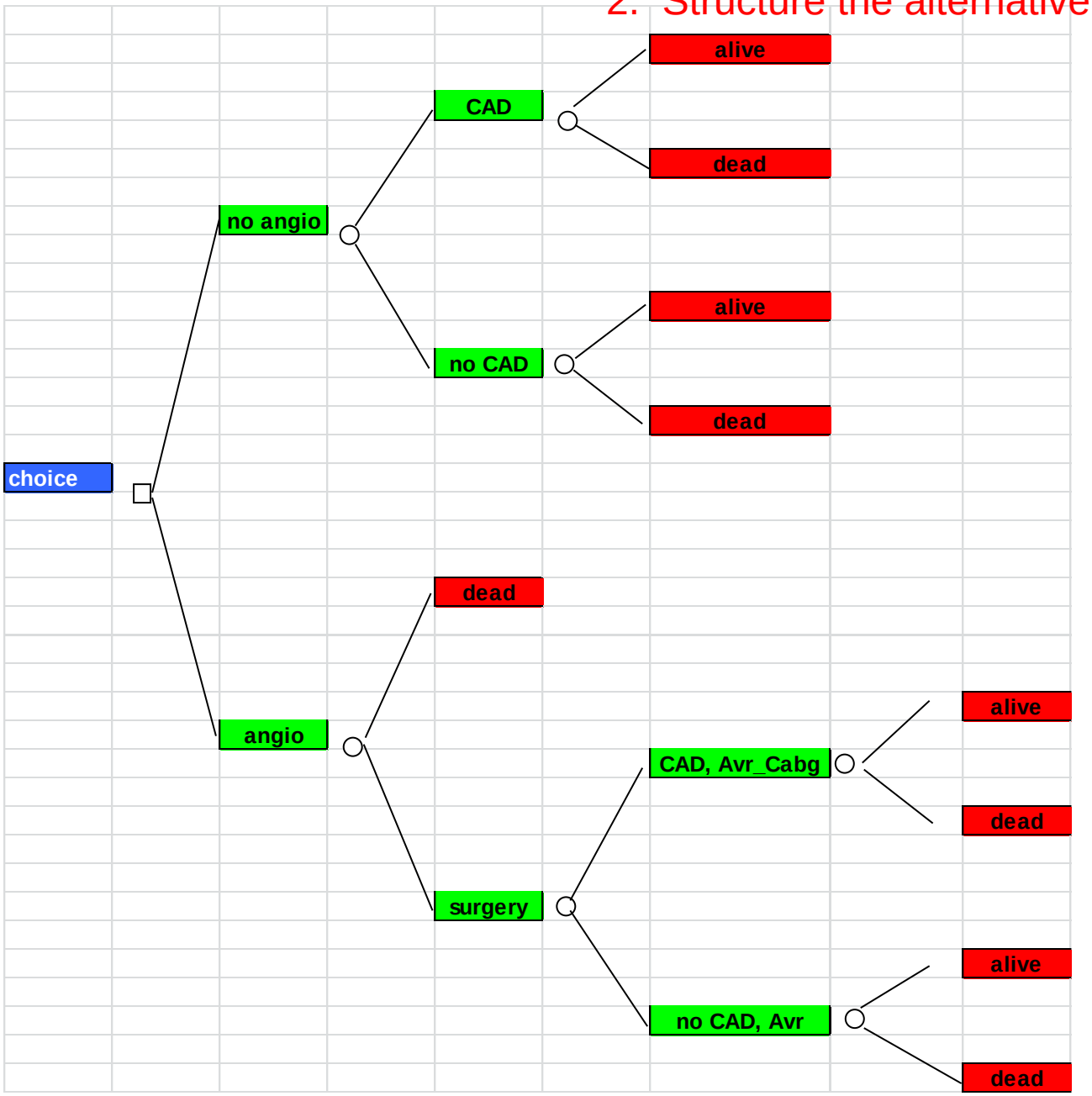
1. Formulate the problem

Summarize the data in a table (can be done in excel)

Variable	Label	Value at root
Probability of dying at angiography	pDieangio	0.002
Probability of CAD	pCAD	0.067
Probability of dying at AVR alone, non CAD	pDieAVR_noCAD	0.028
Probability of dying at AVR with CAD, but without CABG	pDieAVR_CAD	0.122
Probability of dying at AVR with CAD and CABG	pDieAVR_CABG	0.061
Utility survival	uSURV	1
Utility dead	uDIE	0
Cost of Angio	cAngio	$1,000
Cost of AVR	cAVR	$10,000
Cost of AVR and CABG	CAVRCABG	$11,000
Life expectancy if Aortic Stenosis with AVR and CABG	uSURV_AVR_CABG	8.8
Life expectancy if Aortic Stenosis with AVR and CAD	uSURV_AVR_CAD	6.2
Life expectancy if Aortic Stenosis with AVR and no CAD	uSURV_AVR_noCAD	13.3
Life expectancy if death	uDIE	0

2. Structure the alternative course of action



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3. Assign probabilities to events

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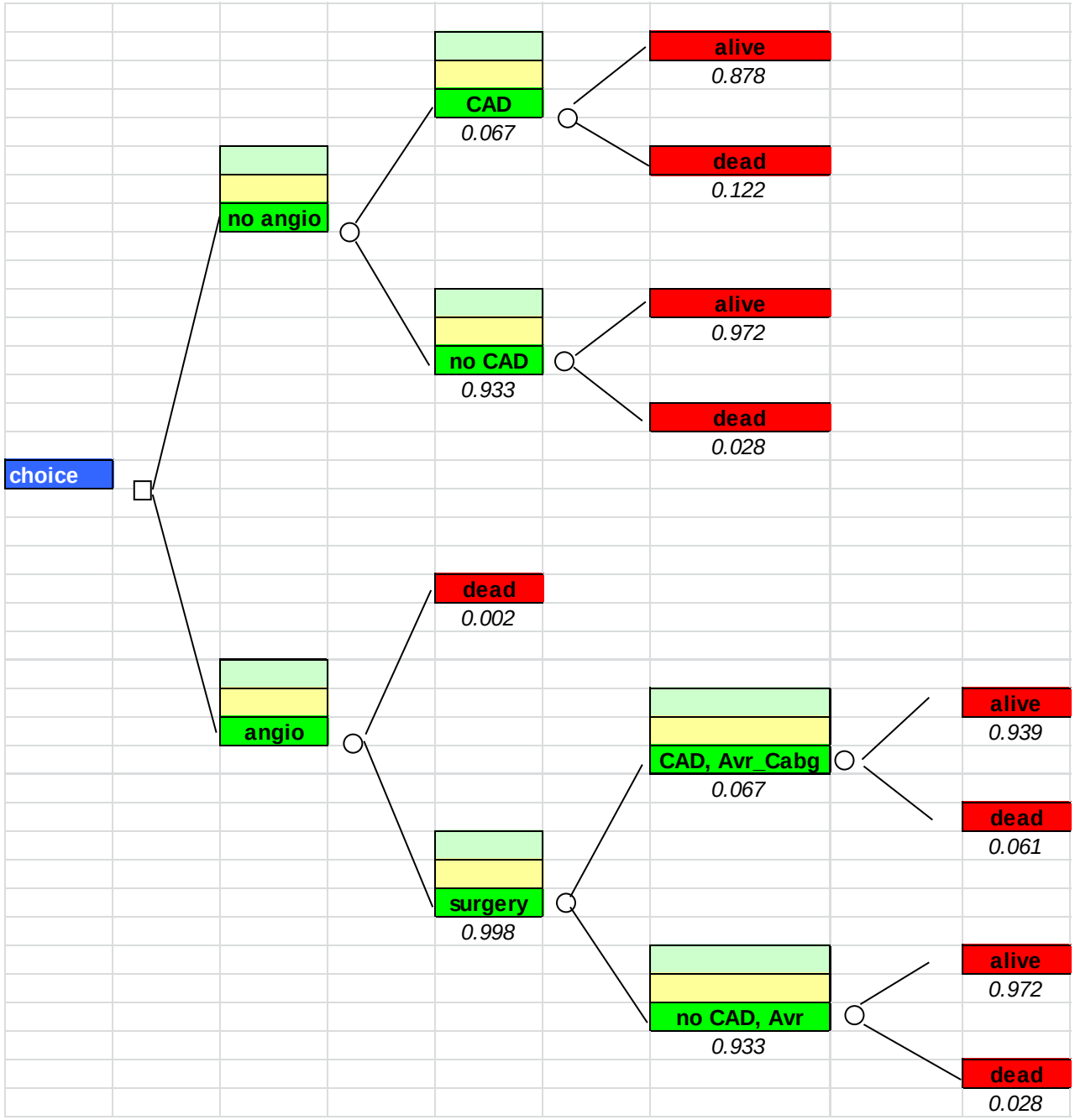
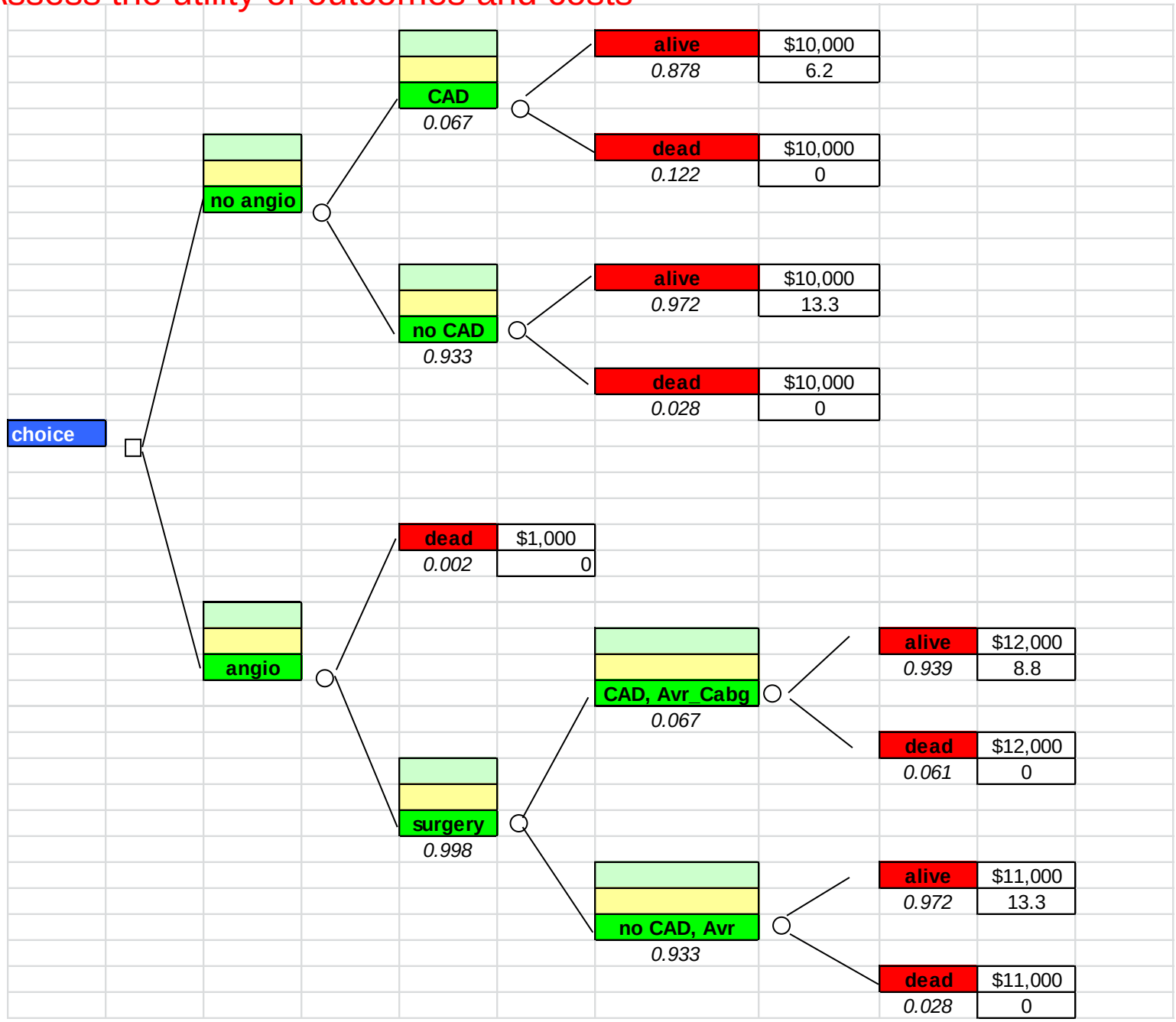
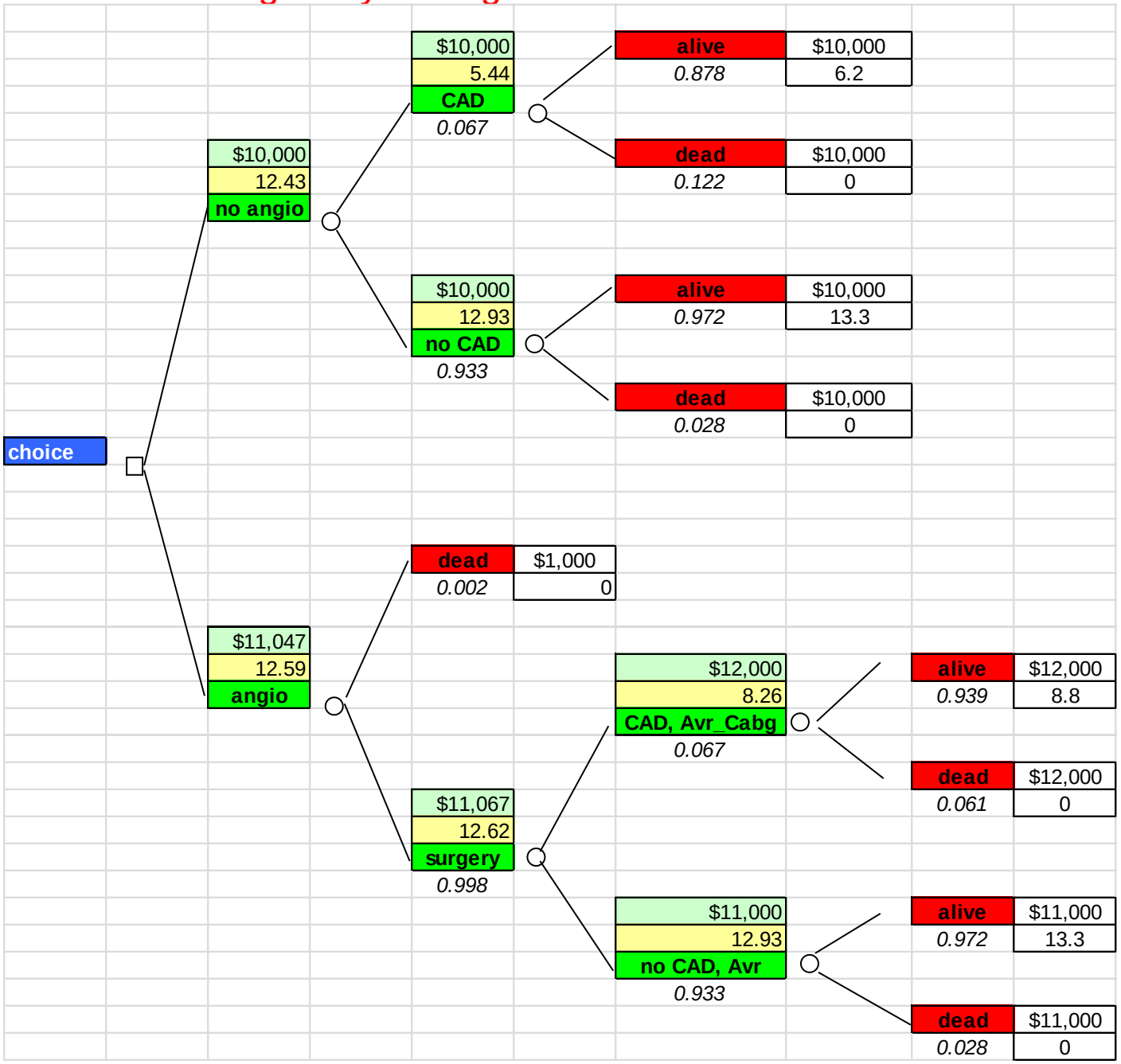


4.Assess the utility of outcomes and costs



5. Evaluate strategies by folding back the tree



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5. Evaluate strategies by calculating ICER

	Cost	Survival (years)/ QALY	Incremental cost	Incremental survival	Incremental C/E ratio
No angio	$10,000	12.4	-	-	-
Angio	$11,047	12.6	$1,047	0.2	$6395.7

Based on Georgeson et al., 1990

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Why is economic evaluation used?

- Maximise the benefits possible from health care spending- efficiency
- Contain costs and manage demand- efficiency
- Provide bargaining power with suppliers of health care products in order to keep prices down- efficiency
- Overcome regional variations in access, for example, ‘postcode prescribing’- promote equity

Postcode lottery for cancer wonder drug

By DAVID WILKES, Daily Mail

Last updated at 09:03 10 April 2006

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Breast cancer patients from England must pay £47,000 to get the wonder drug Herceptin - at the same hospital where Welsh women get it for free.

The postcode lottery has arisen at the Royal Shrewsbury Hospital which treats people from Shropshire and parts of Wales.

The Primary Care Trust in Shropshire has refused to pay for Herceptin for early stage breast cancer sufferers until the drug is licensed.

Margaret Bradford has been denied treatment despite living just two miles from the Welsh border

Click here for your guide to the cancer wonder drug

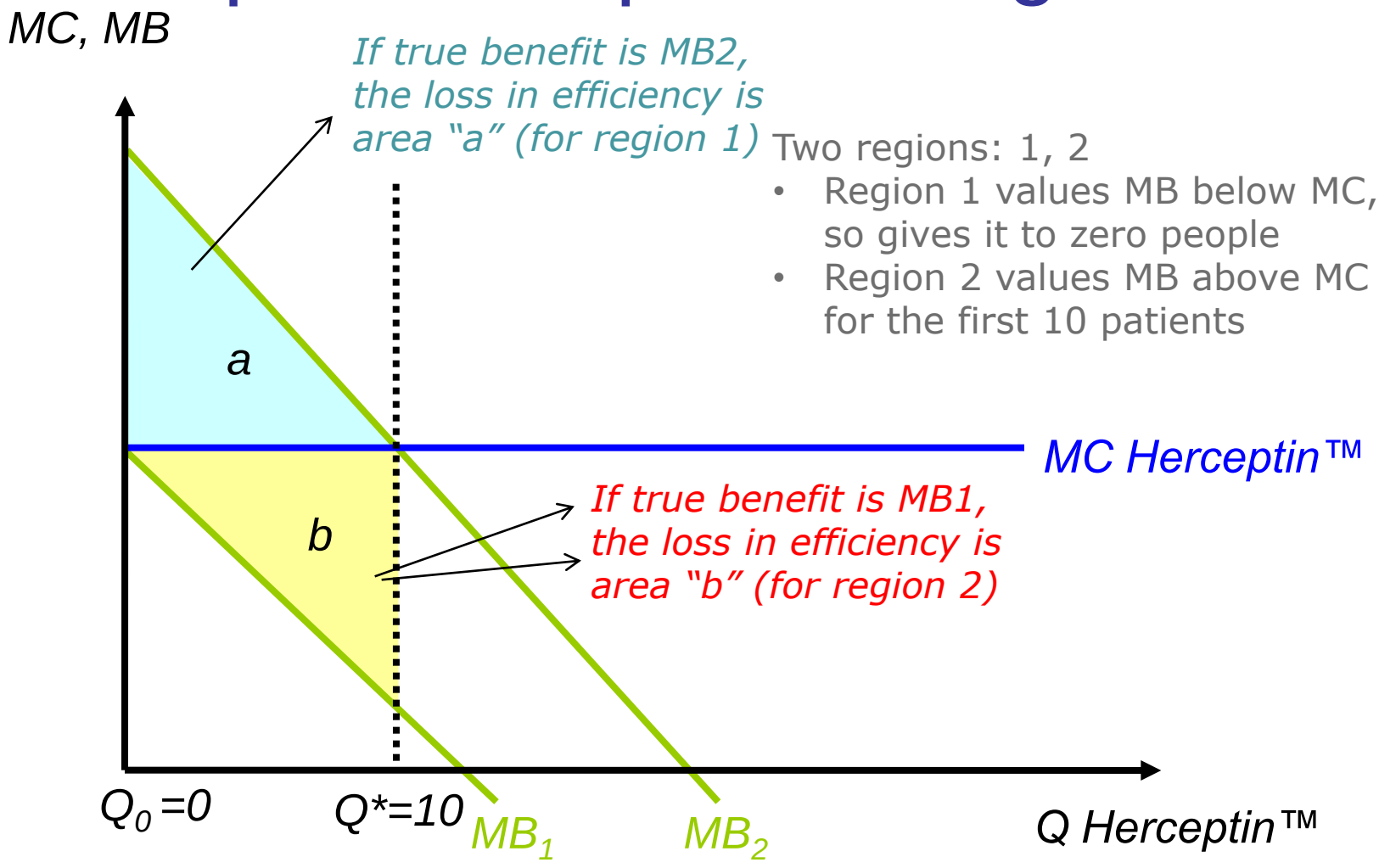
But in a cruel twist, patients can receive the drug for free if they live over the Welsh border.

Since February, all Welsh Local Health Boards have agreed to pay for the drug for women living in Wales who need it, even if they are treated in England.

It is thought four women from Mid Wales will be treated at the 544-bed Shrewsbury hospital.

Among those denied the drug is Margaret Bradford, 54, who was diagnosed with the most aggressive form of breast cancer in April last year and lives in Oswestry, Shropshire - just two miles from the Welsh border.

Welfare losses from postcode prescribing



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Who buys economic evaluations?

- Economic evaluations are commissioned by stakeholders who have an interest in the provision of a good or service
  - E.g. pharmaceutical industry, health care providers, clinicians and patients

- Type of stakeholder: affects the outcome of the economic analysis

How is economic evaluation used to make decisions?

- Cost effectiveness thresholds

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Cost-effectiveness thresholds

- Maximum amount of money decision-maker is willing to pay for an additional QALY

- The cost-effectiveness threshold may be a point estimate, with a binary decision to accept or reject an intervention

- It may also be represented by a range of values if there are criteria other than cost-effectiveness that are important
  - uncertainty surrounding the value of the ICER
  - new vs currently used therapy
  - Political considerations
  - Interest groups

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Selected drugs rejected or restricted by NICE

Drug	Indication	Company	NICE indication recommendation	Effect on access	Cost (£)/QALY (£)
Tysabri (natalizumab)	MS	Biogen-Idec/Elan	Highly active remitting relapsing MS	Restricted	32,000/44,600
Humira (adalimumab)	Psoriatic arthritis	Abbott	When no response to two standard anti-rheumatic drugs	Restricted	19,856/30,701
Rituxan/MabThera (rituximab)	RA	Genentech/Biogen-Idec	Only if improvement is seen, no more than every 6 months	Restricted	12,214/29,810
Fludara (fludarabine)	CLL	Bayer	Not recommended for initial treatment	Denied	86,770
Gemzar (gemcitabine)	Breast cancer	Lilly	Only when other therapies have failed	Restricted	17,200/23,200
Avastin (bevacizumab)	Colorectal cancer	Genentech	Not recommended for first-line use	Denied	60,430/75,831
Erbitux (cetuximab)	Colorectal cancer	ImClone Systems	Not recommended	Denied	77,210/370,044
Source: BioCentury, San Carlos, California					

Nuala Moran (2008), "Priced out of the UK market: is NICE's approach to cost-effectiveness turning the UK into a biotech-free zone?", *Nature Biotechnology* 26, 151 – 154 doi:10.1038/nbt0208-151

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Last Updated: Sunday, 20 May 2007, 23:02 GMT 00:02 UK

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Fears over pricey NHS therapies

By Nick Triggle
BBC News, health reporter

The NHS is probably using too many expensive treatments, according to health economists and managers.

NICE judges drugs on cost effectiveness

New drugs are generally used only if they cost under £30,000 for each year of good health they provide.

But some claim this is too high and forces potentially more effective care to be ditched with limited funds.

It comes as the NHS is reviewing the way it judges new treatments, with officials hinting the threshold is more likely to increase.

The National Institute for Health and Clinical Excellence (NICE) is responsible for deciding whether new treatments are used in the NHS.

It works out what it costs to provide a year of good health by looking at how long a drug extends life by, what the quality of health a person will have and any potential side-effects of the treatment under a system known as Quality Adjusted Life Year (Qaly).

> **"I would say something like £20,000 would be more appropriate if we are to get the best of out of the NHS"**
>
> Professor Alan Maynard, health economist

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5 How bad are local polls for Brown?
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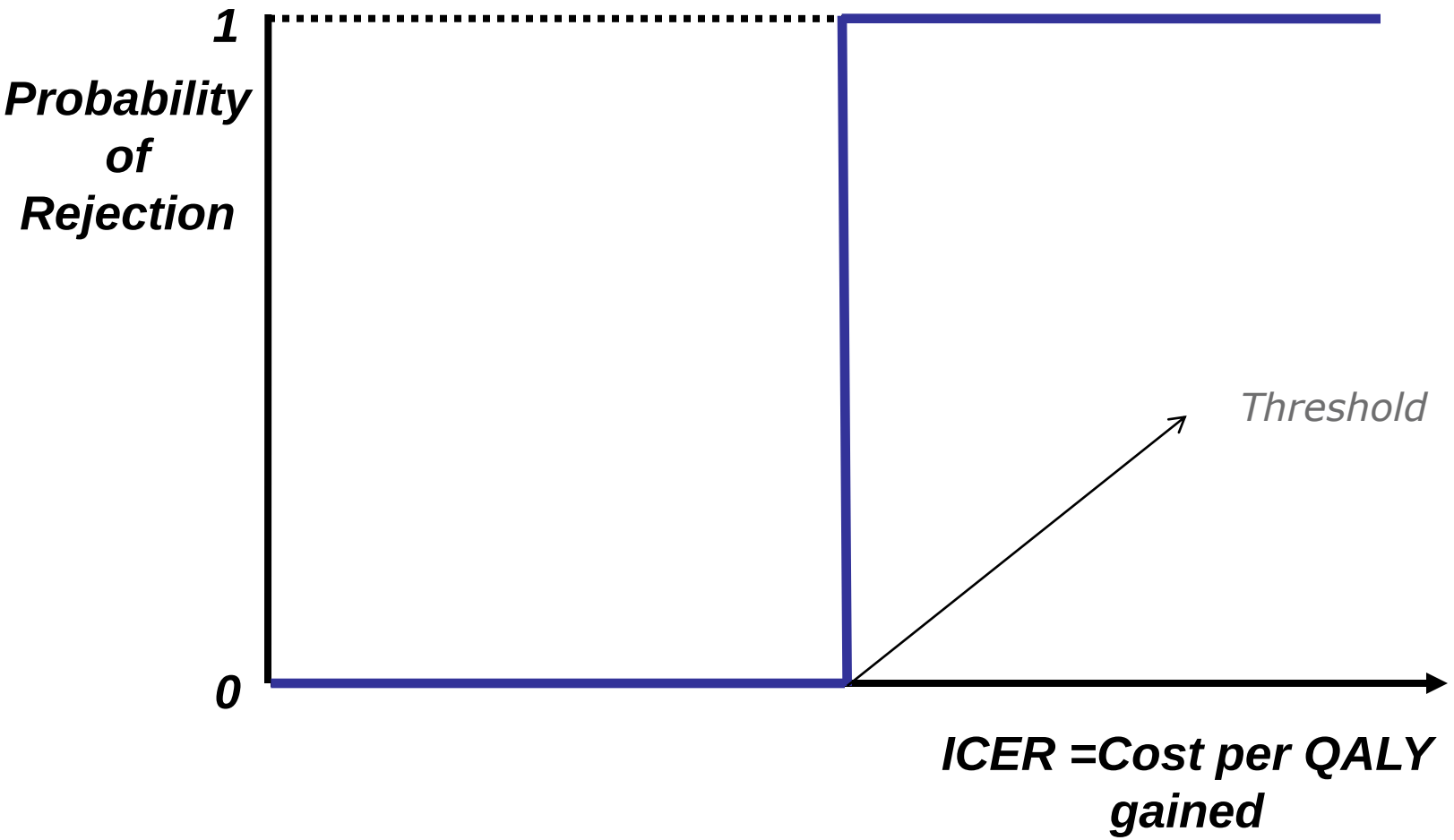
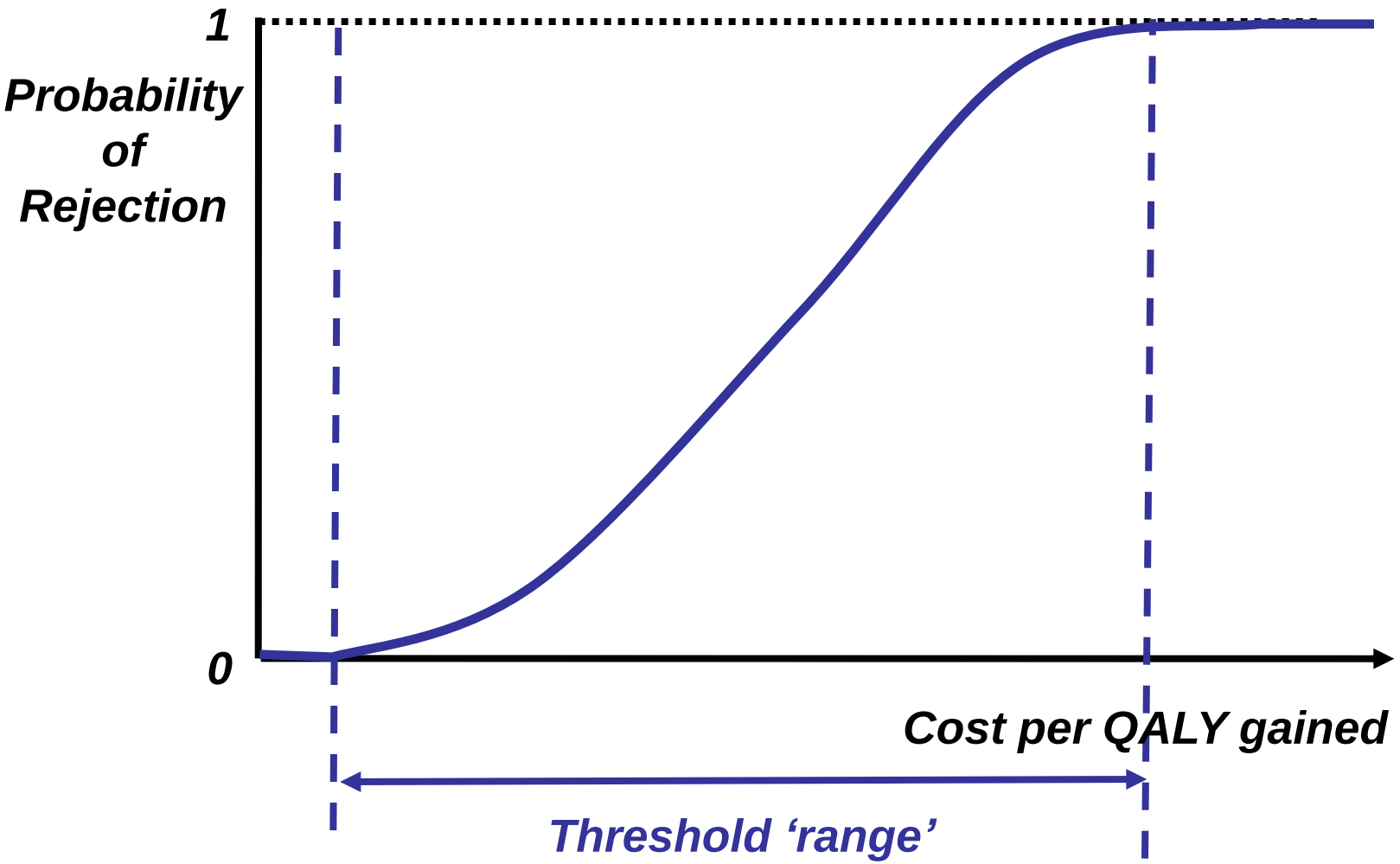
The following slides will not be examined

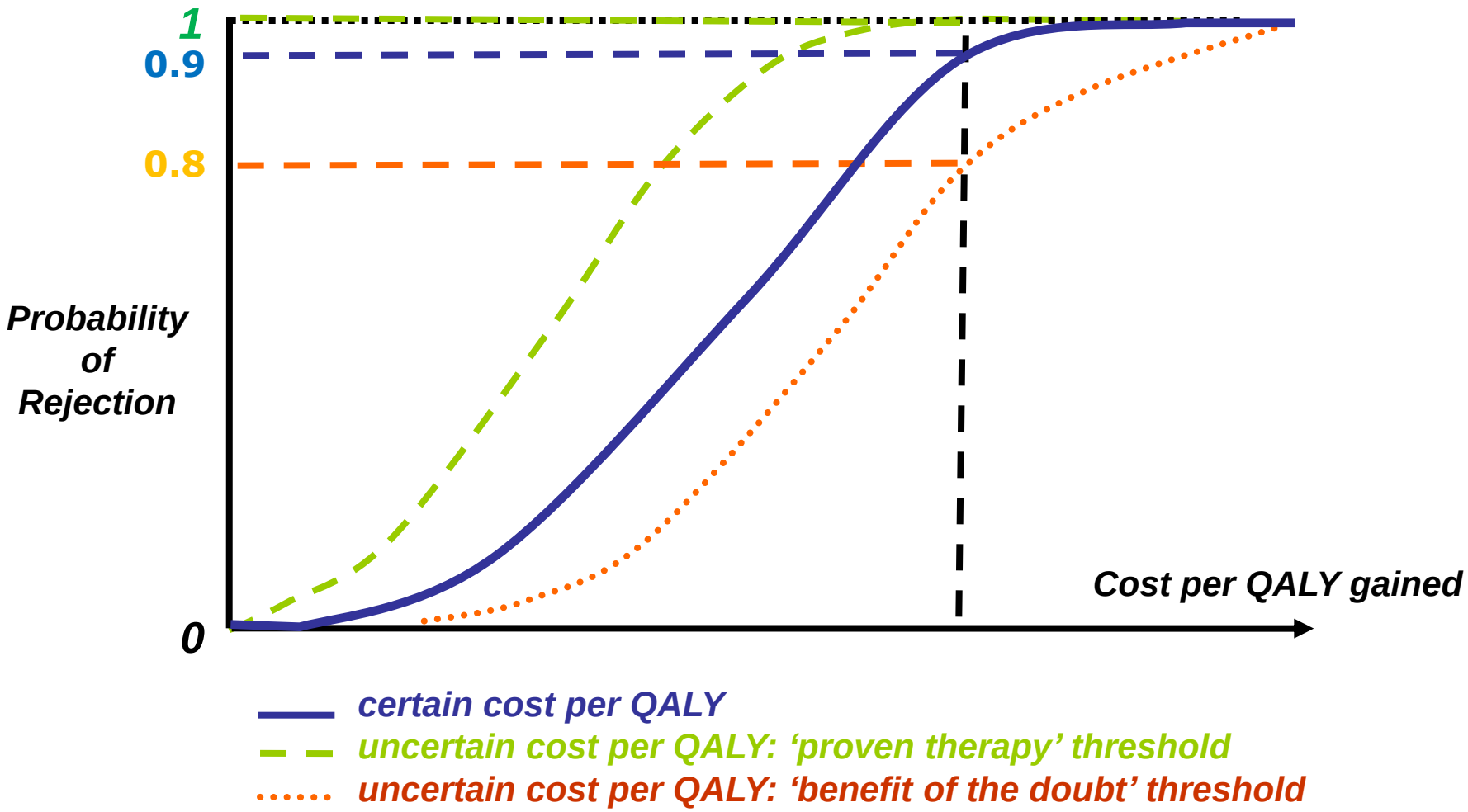
The cost effectiveness threshold as a point



The cost effectiveness threshold as a range



The cost effectiveness threshold under uncertainty



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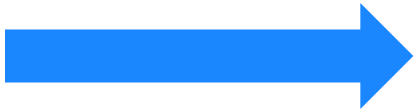
Objections to their use

Differences in methodology

- Choice of comparator
- Choice of discount rate
- Method of estimating utility values
- Range of costs included

What ‘threshold’ should be used?



Imperfect!

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“Evaluating” economic evaluation

- Resource allocation decisions cannot be avoided
- There are factors other than cost-effectiveness that might legitimately or illegitimately be used in deciding whether or not to provide a particular health care programme- e.g. equity considerations
- In recent years increase in use of economic evaluation
- Still considerable scope for extending its use in decision making in health care
- Key issue: does economic evaluation leads to better decisions?

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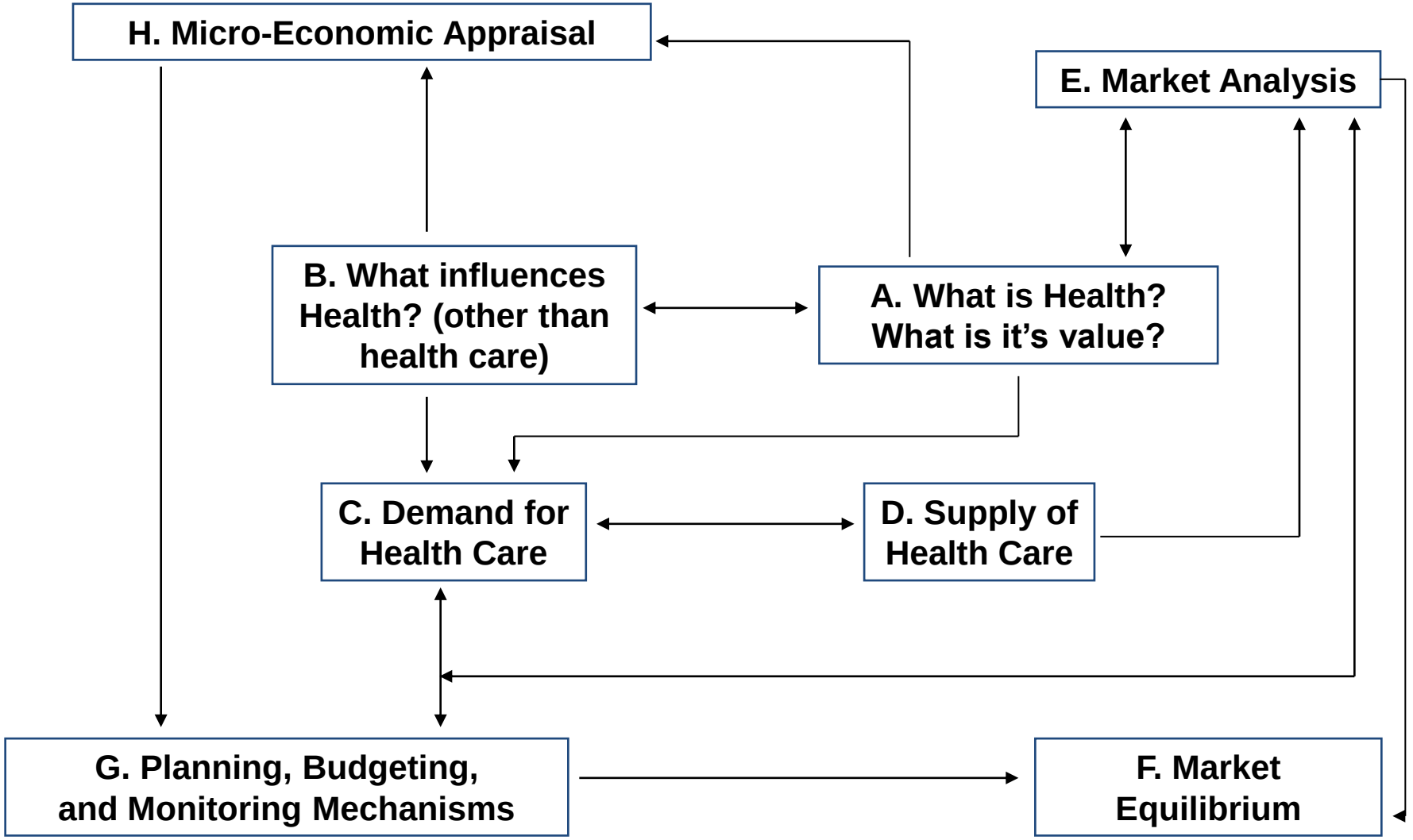
The role of health economics
Alan Williams 'plumbing diagram'



Source: A. Maynard and K. Bloor, "Health economics and policy: the challenges of proselytizing", In Glied, S. and Smith, P. (eds) (2011), The Oxford handbook of health economics, Oxford: Oxford University Press.

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Key Concepts

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Key concepts

Decision tree: a visual representation of a decision problem intended to help people make better decisions. Each node represents either a choice by the decision-maker, a probabilistic outcome, or a terminal node. A decision tree can be used to determine the probability and net value of benefits and costs depending on which treatment alternatives are chosen.

Expected value: the expected value is calculated as the sum over all possible outcomes of the probability of the outcome multiplied by the value of the outcome. Can be calculated for both the costs and the benefits of a treatment.

Sensitivity Analysis: sensitivity analysis allows for uncertainty within an economic evaluation. It shows how responsive the result is to changes in key economic parameters. Values are varied around key parameters to see if the results are sensitive to such variations.