The cost-effectiveness threshold: what it is, what its not and how to estimate it?

MRC NIHR methods programme:

Questions of fact and questions of value?

- When costs displace health (Δc_h)

$$\Delta h \qquad -\frac{\Delta c_h}{k} \qquad \geq 0 \qquad v.\Delta h - \frac{v}{k}\Delta c_h \geq 0, \quad or \quad \frac{\Delta c_h}{\Delta h} \leq k$$

Health gained   Health forgone

- When costs displace consumption (Δc_c)

$$\Delta h \qquad -\frac{\Delta c_c}{v} \geq 0 \qquad v.\Delta h - \Delta c_c \geq 0, \quad or \quad \frac{\Delta c_c}{\Delta h} \leq v$$

Consumption forgone

- Costs fall on both

$$\Delta h \qquad -\frac{\Delta c_h}{k} \qquad -\frac{\Delta c_c}{v} \geq 0 \qquad v.\Delta h -\frac{\Delta c_h - \frac{k}{v}\Delta c_c}{k} \gtreqless 0, \quad or$$
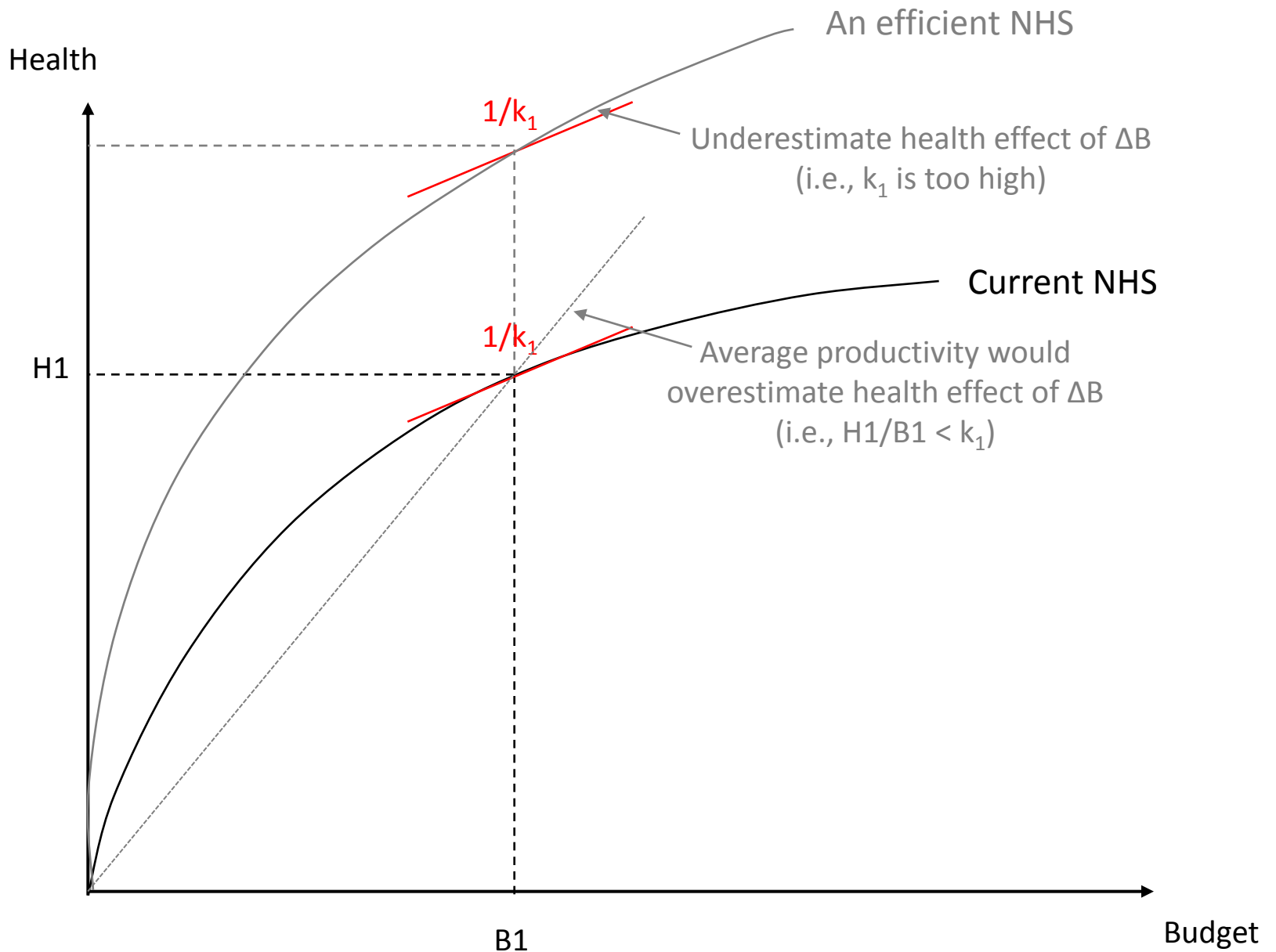
Fact : k = how much health displaced by increased HCS costs?

Value: v = how much consumption should we give up for health?

Why does *k* matter?
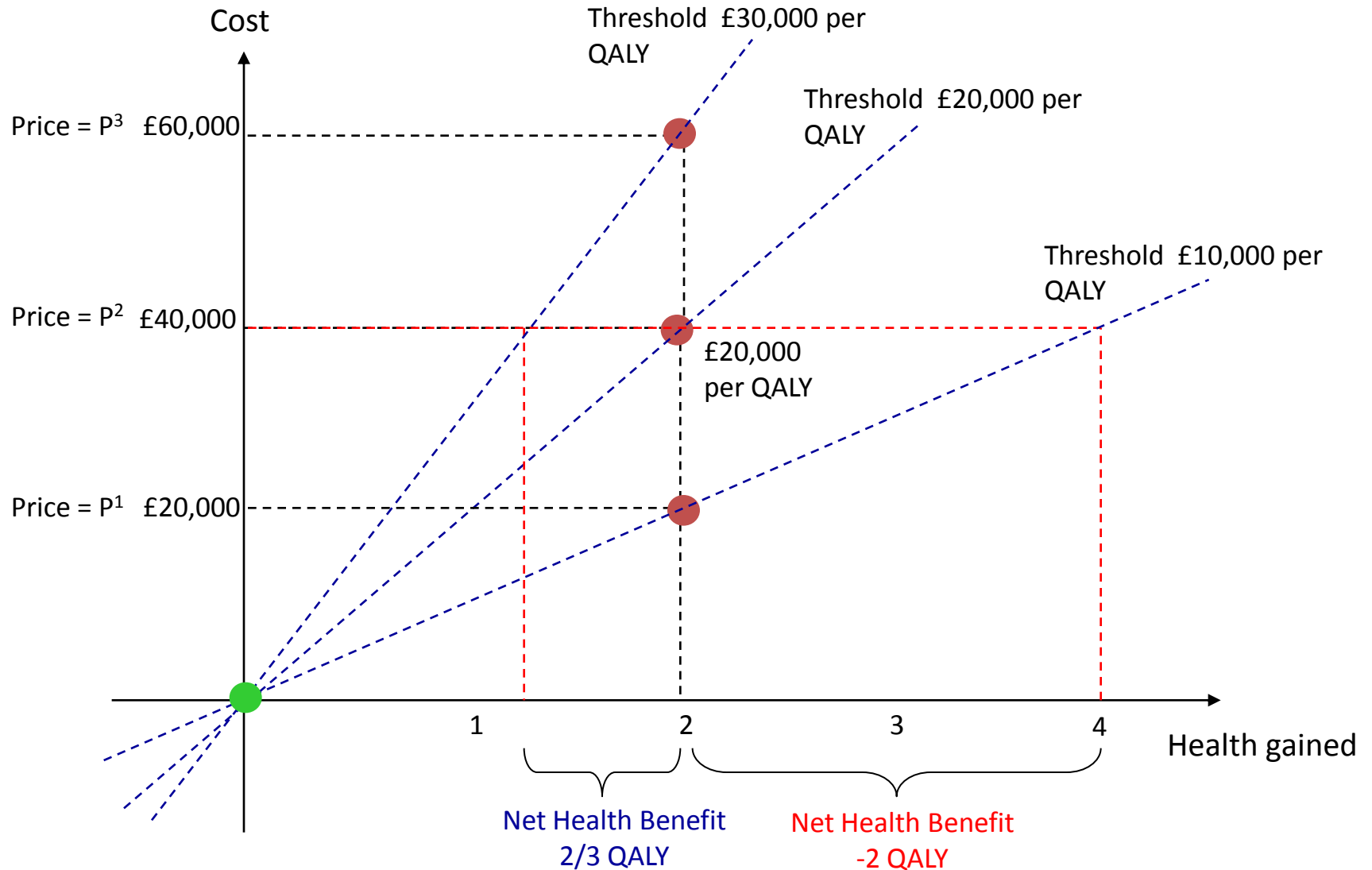
What it is and what its not

Health

An efficient NHS

$1/k_1$

Underestimate health effect of ΔB
(i.e., k_1 is too high)

Current NHS

$1/k_1$

H1

Average productivity would
overestimate health effect of ΔB
(i.e., $H1/B1 < k_1$)

B1

Budget

How does it change?

- Need *k* what ever view of social value
- What its not
  - Consumption value of health (*v*)
  - Marginal productivity of ideal NHS
- No simple relationship to changes in budget and prices
  - Discretionary expenditure
  - Changes in productivity
    - Stop doing things the NHS shouldn't do (increase *k*)
    - Improve those things it should do (reduce *k*)
- Heath production outside NHS
  - Complement, e.g., longer life expectancy (reduce *k*)
  - Substitute, e.g., reduced base line risk (increase *k*)

How can we estimate it?

- Informal judgement about the cost-effectiveness of things the NHS does and doesn't do

- Infer a threshold from past decisions

NICE threshold range

- Find out what gets displaced and estimate its value

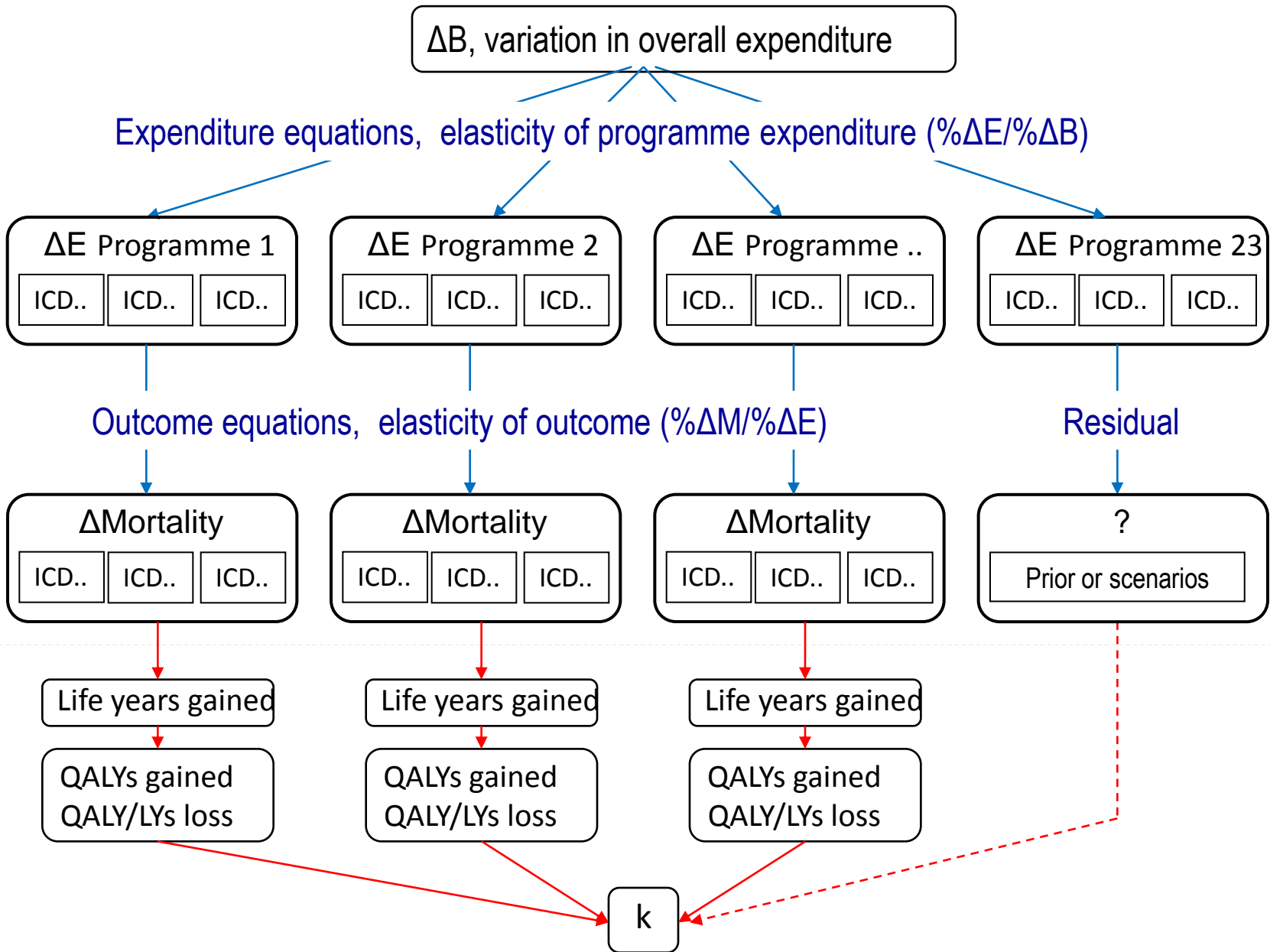- Estimate the relationship between changes in expenditure and outcomes

Relationship between expenditure and outcomes

- Martin et al (2008, 2009)
  - Variations in expenditure and outcomes within programmes
  - Reflects what actually happens in the NHS
  - Estimates the marginal productivity (on average) across the NHS

	Cancer	Circulation	Respiratory	Gastro-int
04/05 per LY	£13,137	£7,979		
05/06 per LY	£13,931	£8,426	£7,397	£18,999

- Need to estimate:
  - How changes in overall expenditure gets allocated across all the programmes
  - How changes in mortality might translate into QALYs gained
  - More (all) programmes

How can we estimate it?

ΔB, variation in overall expenditure

Expenditure equations, elasticity of programme expenditure (%ΔE/%ΔB)

ΔE Programme 1	ΔE Programme 2	ΔE Programme ..	ΔE Programme 23
ICD.. ICD.. ICD..	ICD.. ICD.. ICD..	ICD.. ICD.. ICD..	ICD.. ICD.. ICD..

Outcome equations, elasticity of outcome (%ΔM/%ΔE)   Residual

ΔMortality	ΔMortality	ΔMortality	?
ICD.. ICD.. ICD..	ICD.. ICD.. ICD..	ICD.. ICD.. ICD..	Prior or scenarios

Life years gained	Life years gained	Life years gained

QALYs gained QALY/LYs loss	QALYs gained QALY/LYs loss	QALYs gained QALY/LYs loss

k

Illustrative results

2006 expenditure and mortality data for 2006-08 (2MFFs)

	Share of change in total expenditure	Cost per life year gained	Cost per QALY gained (proportion of patients in ICD)	Cost per QALY gained (contribution to variance in PBC expenditure
Big 4 PBCs	14.93%	£12,824	£8,773	£9,613
11 PBCs (with mortality)	29.12%	£23,924	£13,621	£14,904
All 23 PBCs *	100%	£27,039	£15,395	£16,844

*Assumes same health effects per £ as the 11 PBCs with outcome data for the remaining 11 PBCs.
'Other' (GMS) is assumed to have no health effects.
Any health effects of GMS expenditure is through other PBCs

What we need to do?

- How do changes in mortality translate into QALYs gained?
  - DALY ratio overestimates QALYs gained
- What about PBCs with no mortality?
  - Which PBCs and ICDs matter most (effect on overall threshold)
  - Estimates of CE greater or less than overall estimate?
  - How might we use future routine data
- How uncertain is any overall estimate?
  - Estimated parameters, model identification and correlation
  - Certainty equivalent for the threshold
- How it changes with scale of expenditure change?
- How it changes over time
  - 7 years of expenditure and outcome data
  - Panel with more complex lag structure

What about the 'going rate'?