A tasting of Heath Economics from Theory to Practice: linking Research, Reimbursement and Regulation

Simon Eckermann

Flinders University

FLINDERS UNIVERSITY
ADELAIDE AUSTRALIA

Flinders Centre for
CLINICAL CHANGE &
HEALTH CARE RESEARCH

Overview

- Comparing strategies in HTA: the expected net loss frontier – linking reimbursement & research

- Practice consistent with maximising net benefit: the net benefit correspondence theorem

- Joint optimal trial design and decision making: to delay and trial, adopt now or adopt and trial?

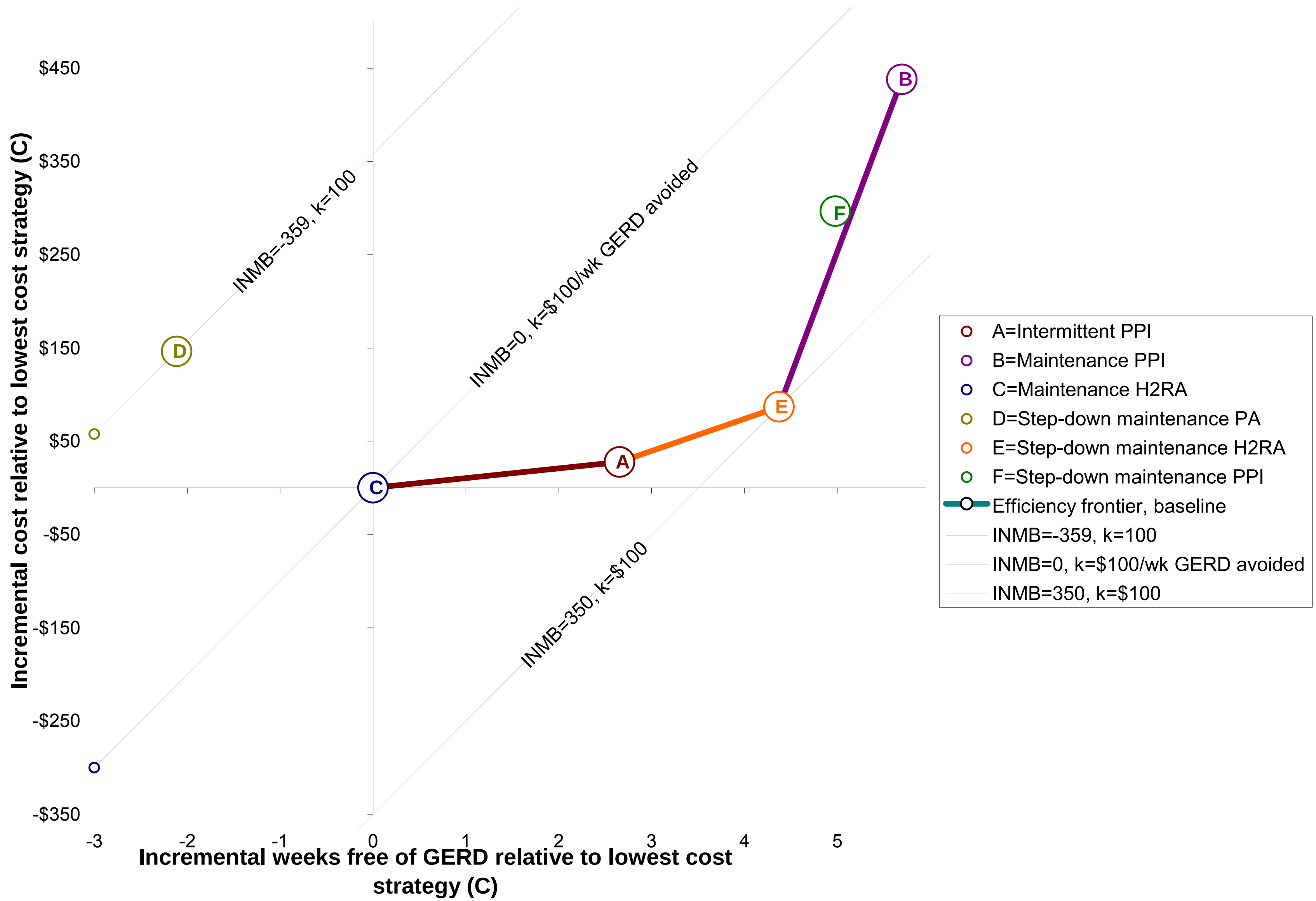
Comparing multiple strategies in HTA

- Economic analysis undertaken in HTA attempts to inform decision makers of the relative effects and costs (resource use) of alternative strategies in treating defined patient populations

- Comparison may be between a strategy and a single comparator (bilateral) or between multiple strategies (multi-lateral)

E.g. comparing six alternative strategies for Gastro Oesophogeal Reflux Disease (GORD) Briggs, Goeree, Blackhouse & O'Brien (2002)

Strategy	A	B	C	D	E	F
Cost per patient	688	1088	660	807	747	957
Expected weeks with GORD (up to 1 year)	7.90	4.86	10.55	12.67	6.18	5.58



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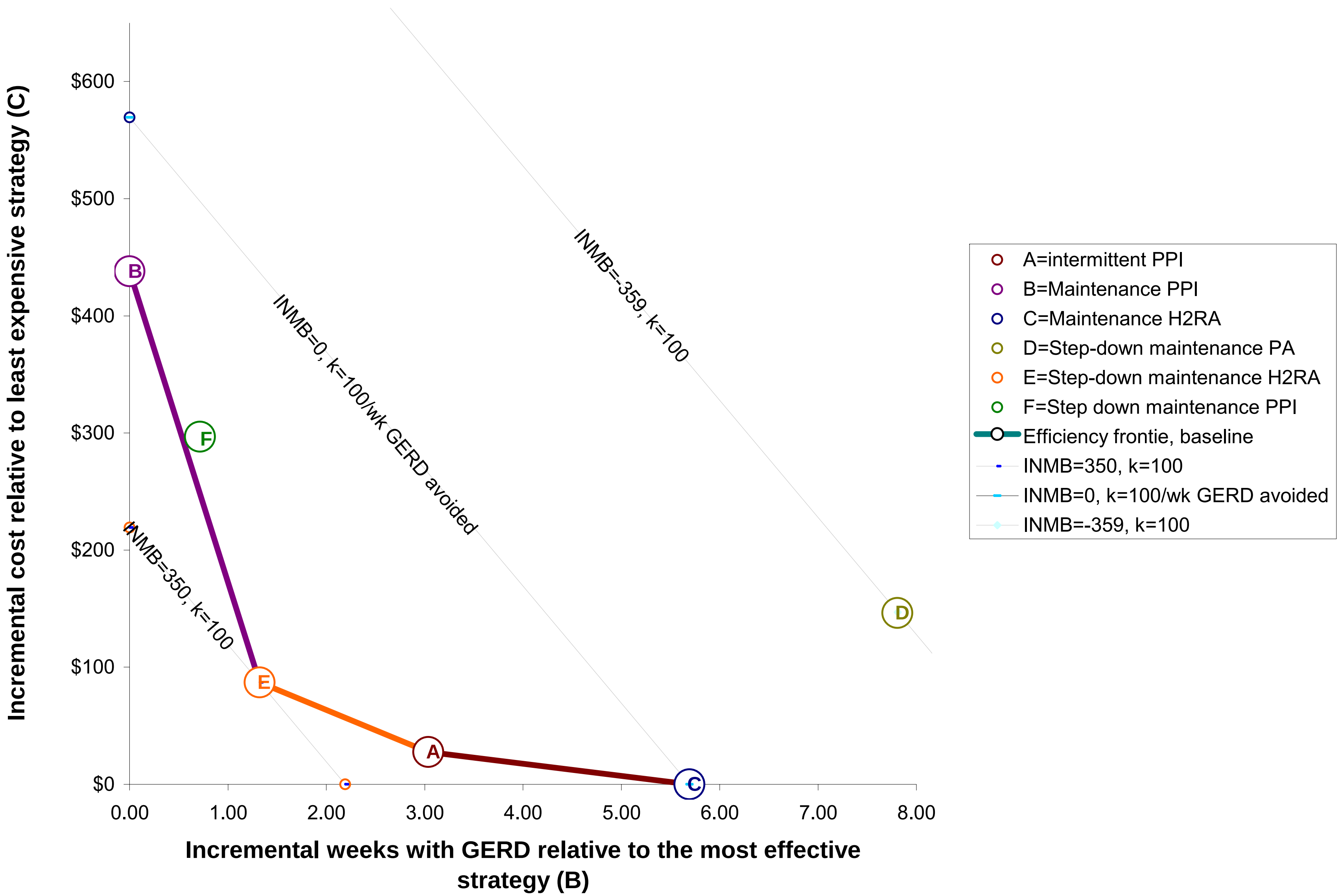

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Advantages of efficiency frontiers on the cost-disutility plane

- Frontiers in the cost disutility plane permit equivalent identification of dominance and net benefit maximisation but …
- Radial contraction properties also allow:

(i) technically simpler construction of efficiency frontiers

(ii) degree of dominance to be estimated

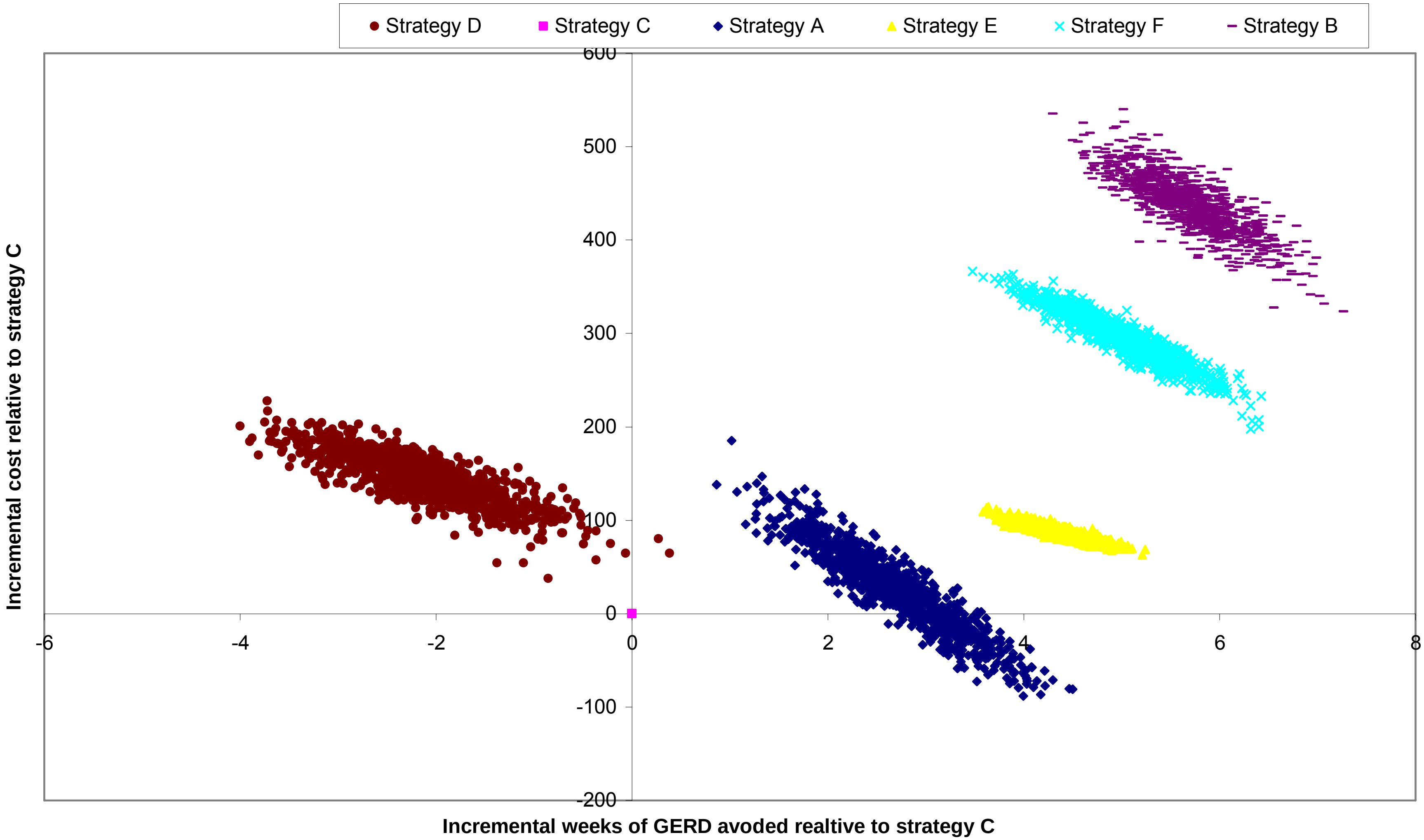
(iii) a bounded comparison of net benefit (iso-net-benefit lines)

Representing uncertainty with multiple strategies

Monte-Carlo simulation allows a joint sampling distribution of costs and effects across multiple strategies to be estimated.

How can such joint distributions best be presented and summarized to inform decision making?

Distributions for GERD strategies on the incremental CE plane



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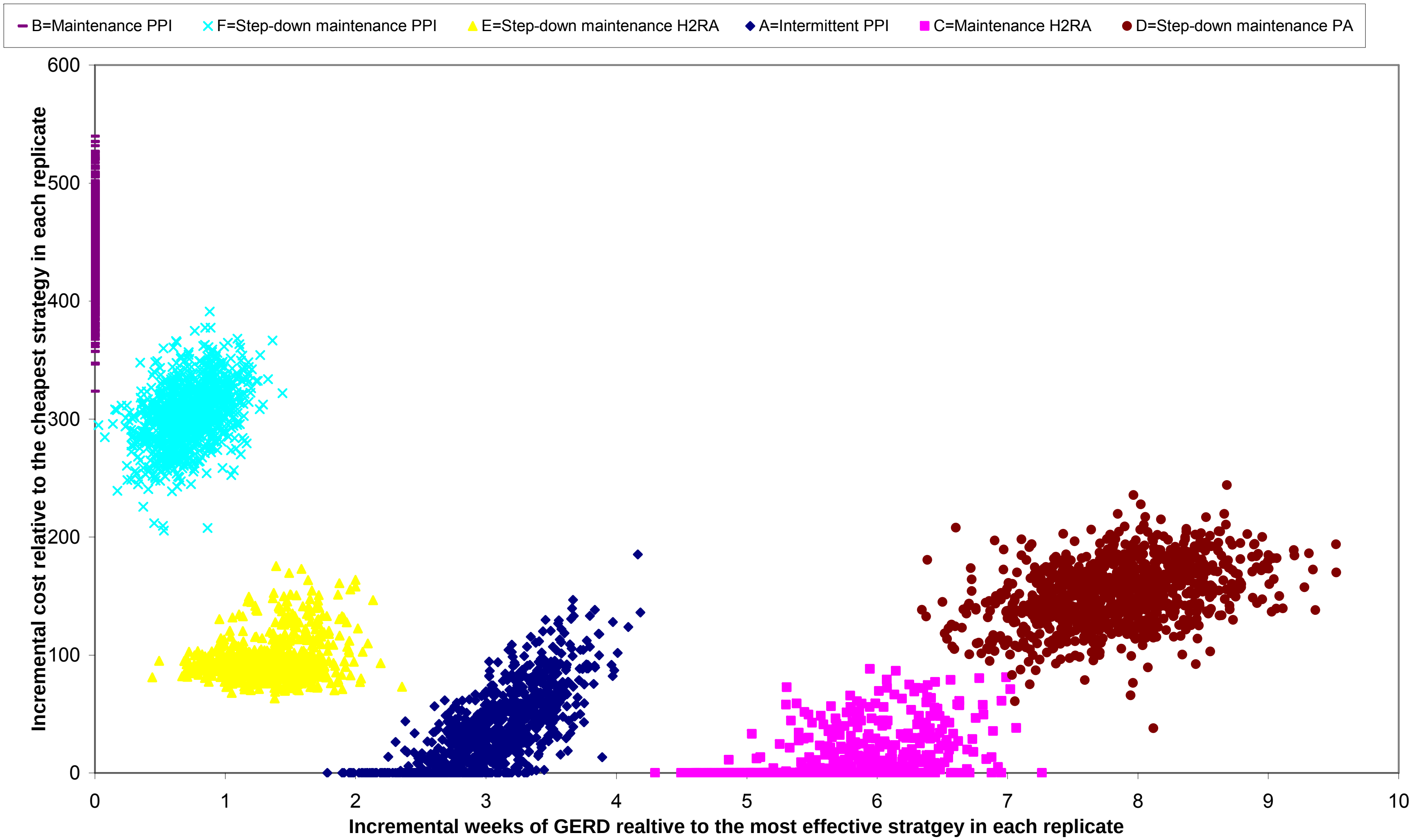
Distributions for GERD strategies on the cost-disutility plane



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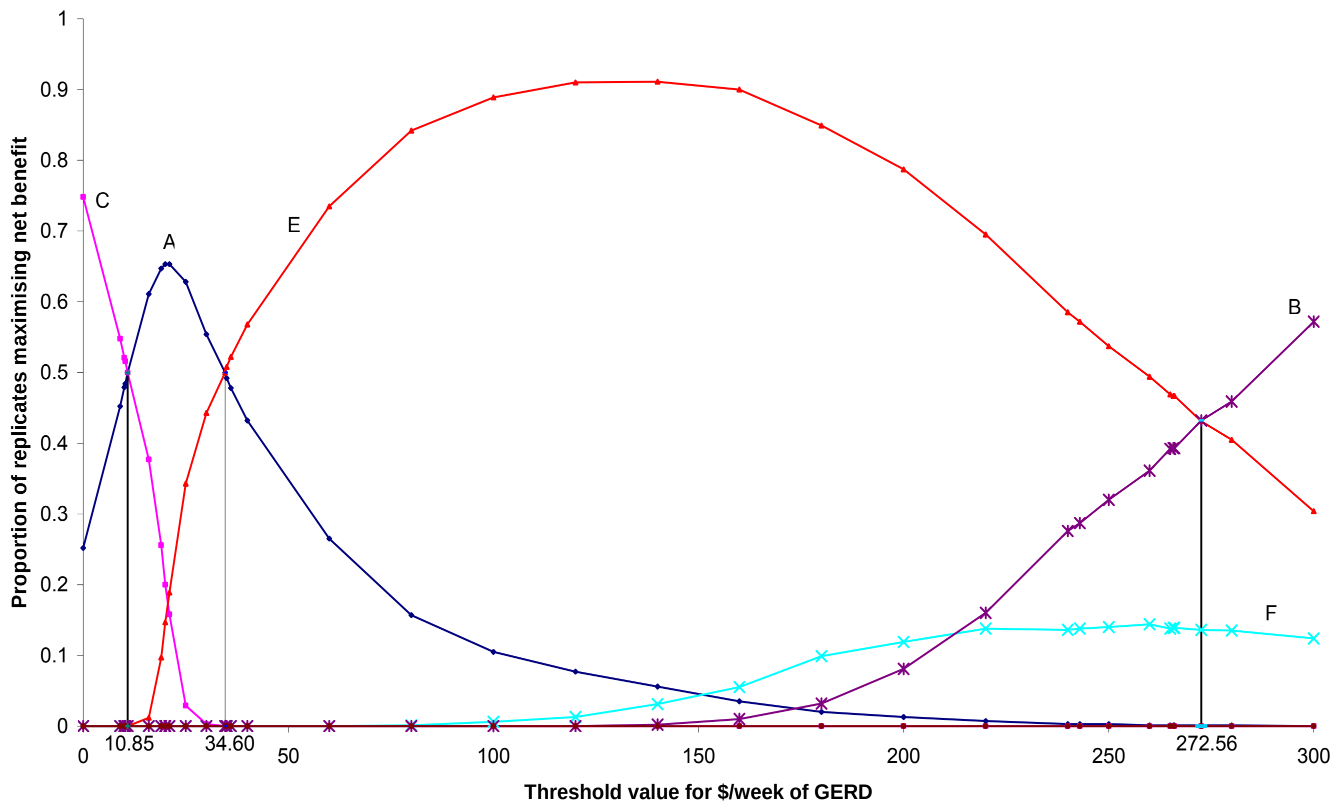
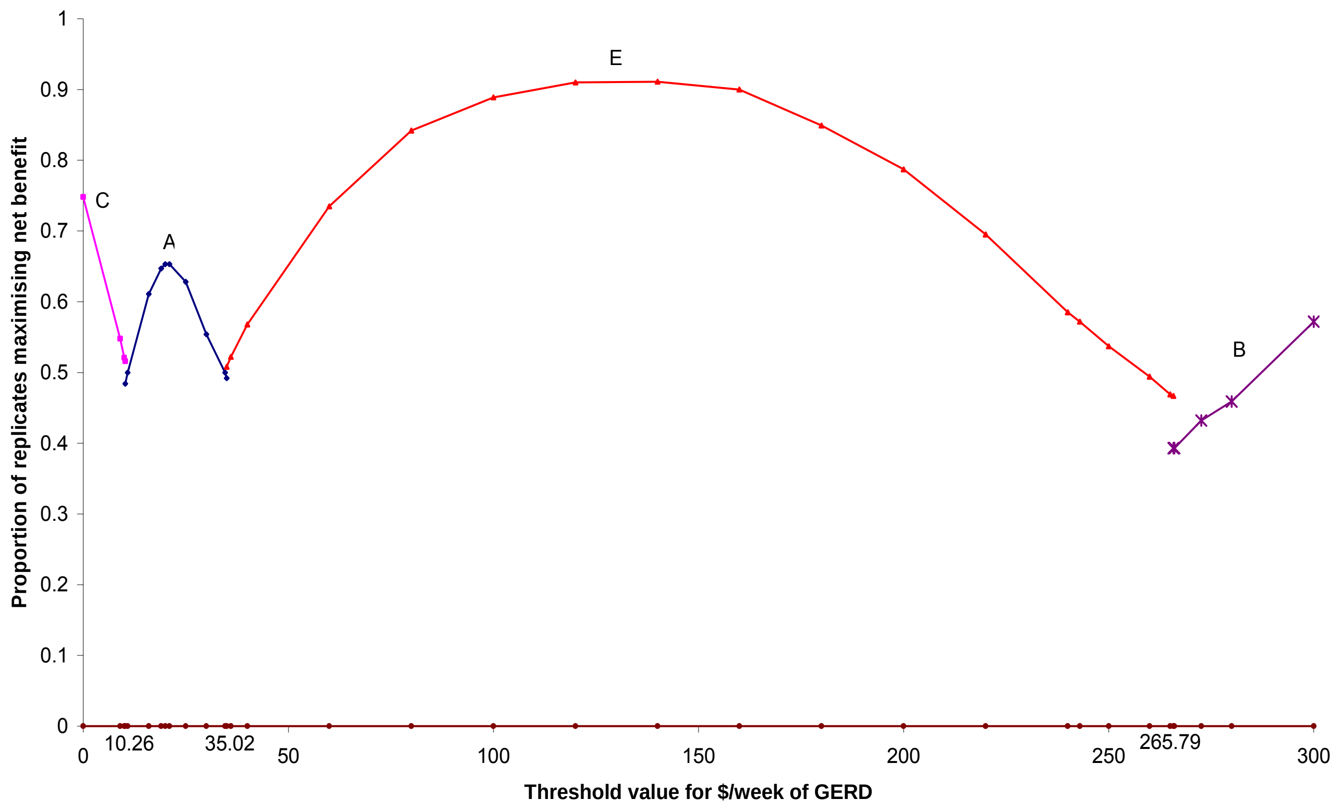
Cost effectiveness acceptability curves for GERD strategies



Cost effectiveness acceptability frontier for GERD strategies



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Does the CEA frontier inform risk neutral or somewhat risk averse DM

- Risk neutral - interested in max. ENB

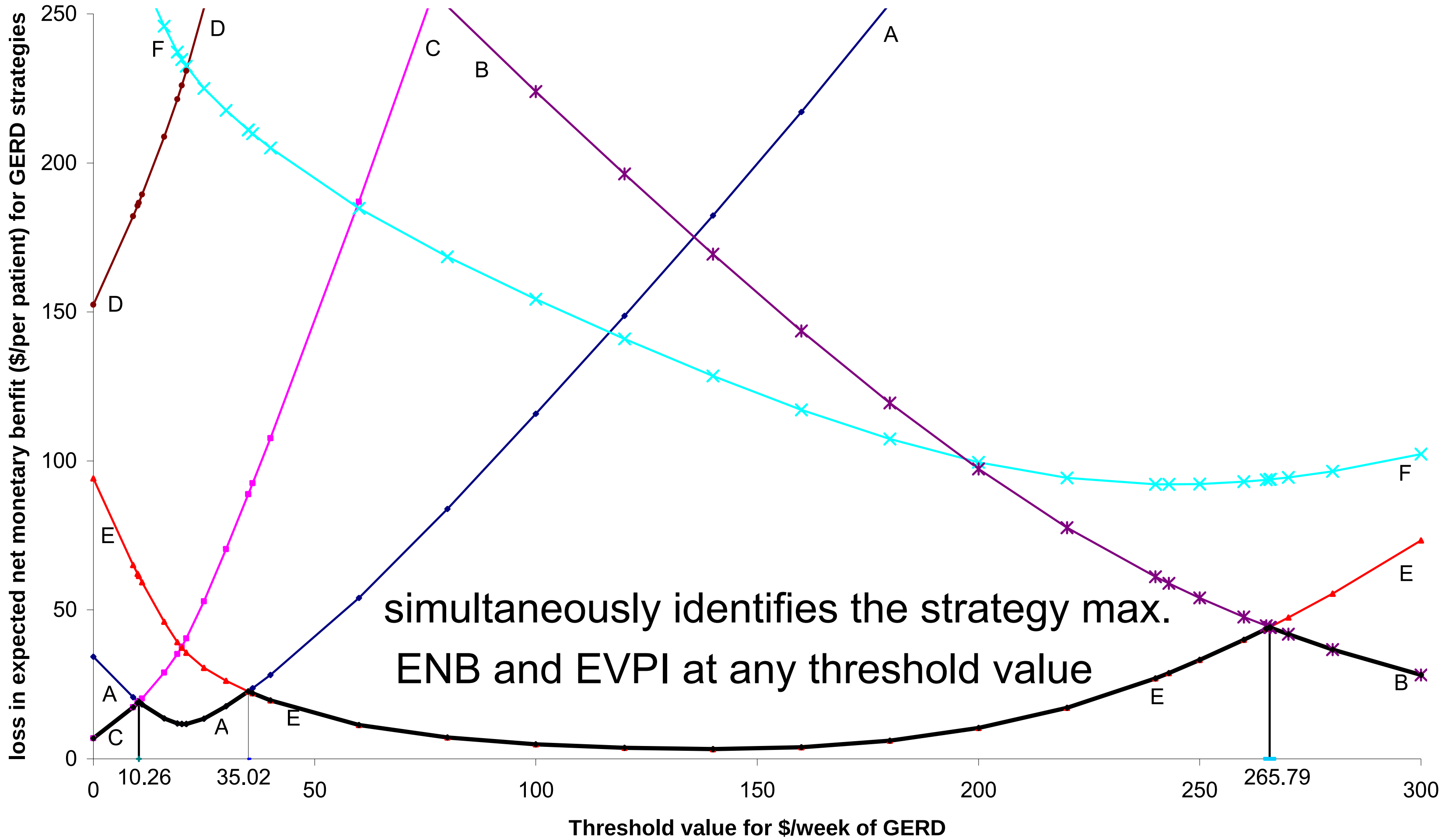
  CEA frontier while indicating strategy max ENB doesn't explain why – lacks transparency

- Risk averse – trade off ENB and P(max NB)
  CEA frontier doesn't present ENB

In either case representing difference in ENB across strategies is suggested

The expected net loss frontier

Eckermann, Briggs and Willan (2008)



Conclusions - multiple strategies

1. The cost disutility plane unlike CE plane allows:
   - bivariate distributions for all strategies and;
   - Inference P(max E), P(min C)
2. NL curves and frontier directly inform risk neutral DM, unlike CEA curves and frontier

Risk averse DM can be supplemented by tradeoffs in regions where they occur between ENB and P(max NB) from bilateral CEA curves

- prevents confounding by irrelevant strategies from CEA curves for multiple strategies

Efficiency measures in practice

- Conventional measures of economic efficiency in service industries such as health care reflect cost per service

  e.g. cost / admission in hospitals

- Such measures include the costs of quality but implicitly value the effects of quality at 0

- Hence perverse incentives are created for cost minimising quality of services

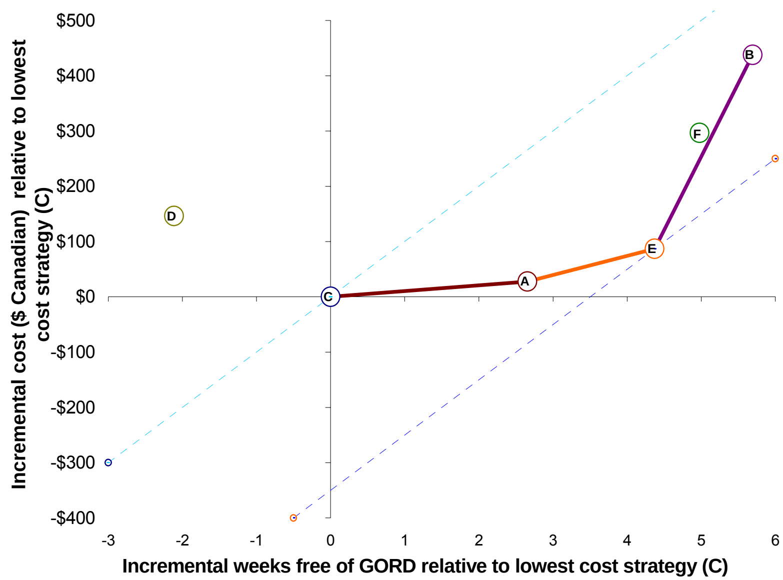
The challenge

- It is generally agreed that to create appropriate incentives economic efficiency measures need to include the value of the effects of quality, as well as the costs of quality
- How can we specify effects of quality in economic efficiency measures to be consistent with an appropriate underlying objective?

Efficiency measurement consistent with maximising net benefit?

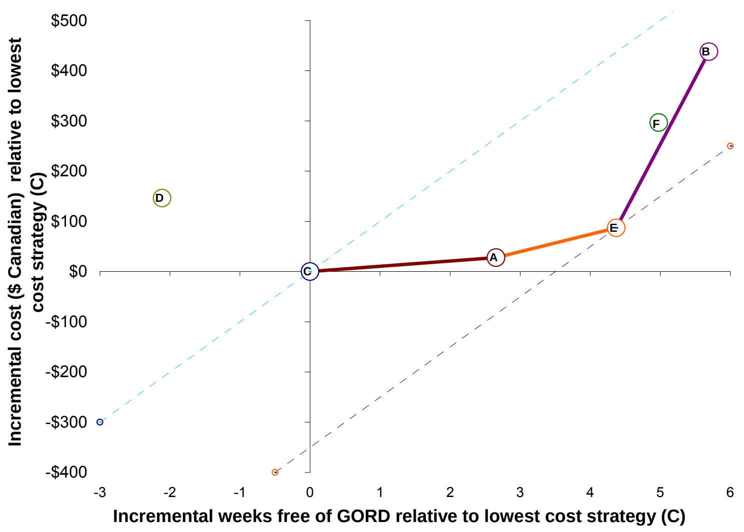
Efficiency measures require radial (ratio) properties.

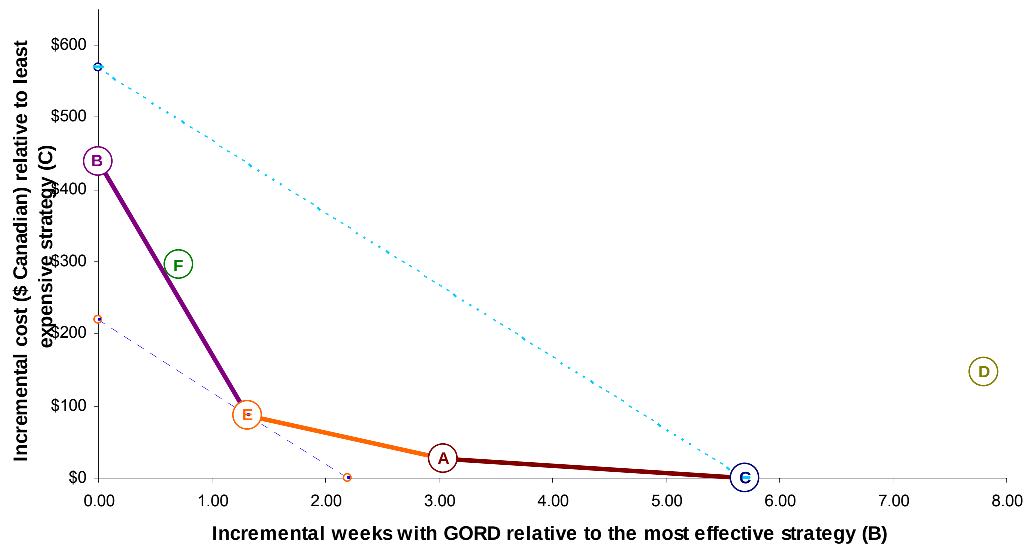
The NB formulation $NB=k\times\Delta E-\Delta C$ doesn't have radial properties



However.. a linear transformation of net benefit may allow radial (ratio) properties while retaining a correspondence with maximising net benefit…

Radial properties on the cost-disutility plane





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Net benefit correspondence theorem

There is a one-to-one correspondence between:

Maximising $NB=k\times E-C$ and Minimising $C+k\times DU$

Where two conditions are satisfied:

1. differences in expected costs and DU are adjusted for - **common comparator condition**

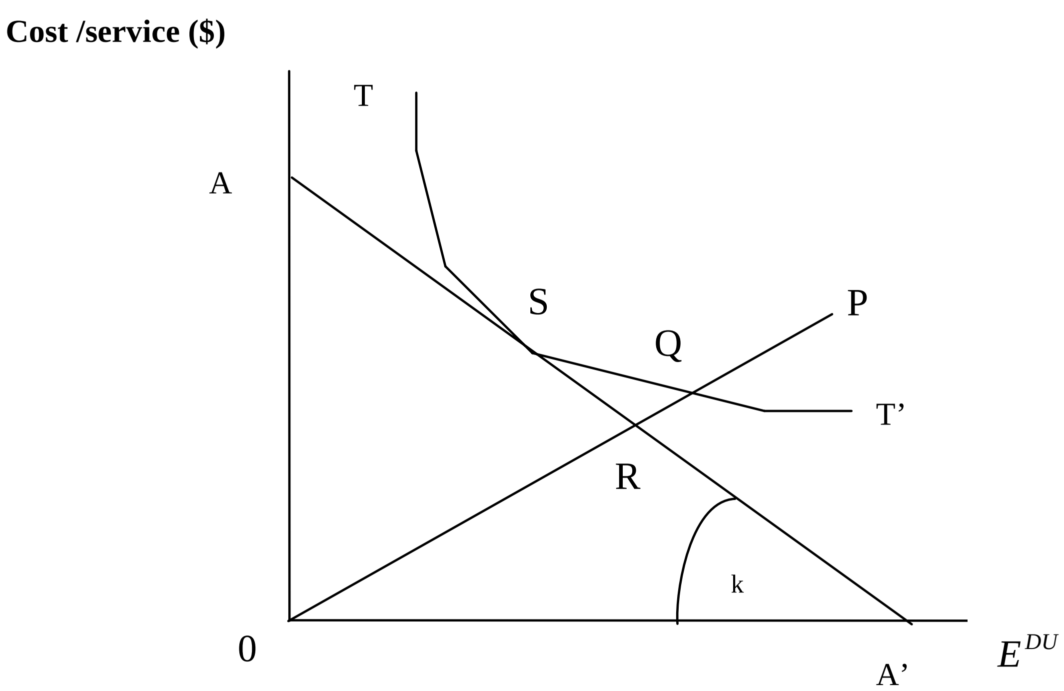
2. effects framed from a disutility perspective (DU) cover effects of care in NB - **coverage condition**

Eckermann (2004), Eckermann Briggs and Willan (2008)

Comparing provider efficiency on the cost-disutility plane

	Minimum **C+k×DU**				Minimum
	k=$0	k=$10,000	k=$25,000	k=$50,000	C/E
Hospital					
1	0.74	0.54	0.41	0.28	0.53
2	0.39	0.41	0.4	0.32	0.35
3	0.45	0.54	0.61	0.58	0.49
4	0.29	0.37	0.43	0.43	0.32
5	0.7	0.53	0.4	0.28	0.50
6	0.44	0.54	0.62	0.61	0.48
7	0.87	0.63	0.47	0.32	0.67
8	0.6	0.65	0.64	0.53	0.61
9	0.49	0.55	0.57	0.5	0.50
10	0.54	0.68	0.8	0.8	0.61
11	0.48	0.6	0.71	0.72	0.54
12	0.43	0.42	0.38	0.29	0.35
13	0.59	0.48	0.39	0.27	0.43
14	0.27	0.36	0.44	0.47	0.31
15	0.54	0.63	0.66	0.59	0.58
16	0.58	0.55	0.49	0.37	0.52
17	**0.93**	**1.00**	**0.99**	**0.81**	**1.00**
18	0.48	0.49	0.45	0.36	0.44
19	0.79	0.84	0.81	0.66	0.83
20	0.59	0.56	0.5	0.38	0.53
21	0.48	0.54	0.56	0.49	0.49
22	0.74	0.64	0.54	0.39	0.65
23	0.61	0.6	0.56	0.43	0.57
24	0.68	0.58	0.48	0.34	0.56
25	0.79	0.72	0.62	0.46	0.74
26	**1.00**	**0.91**	**0.78**	**0.58**	**0.98**
27	0.59	0.71	0.8	0.76	0.65
28	0.46	0.5	0.5	0.43	0.45
29	0.68	0.75	0.75	0.64	0.71
30	0.61	0.53	0.44	0.32	0.49
31	0.65	0.66	0.62	0.49	0.64
32	0.53	0.5	0.45	0.34	0.46
33	**0.68**	**0.85**	**1.00**	**1.00**	**0.78**
34	0.51	0.6	0.65	0.58	0.55
35	0.48	0.49	0.46	0.36	0.44
36	0.69	0.62	0.53	0.39	0.62
37	0.62	0.54	0.46	0.34	0.51
38	0.52	0.52	0.48	0.38	0.47
39	0.56	0.5	0.43	0.32	0.46
40	0.61	0.6	0.55	0.43	0.57
41	0.64	0.57	0.48	0.35	0.54
42	0.51	0.52	0.49	0.39	0.47
43	0.67	0.55	0.45	0.31	0.53
44	0.47	0.46	0.42	0.33	0.41
45	0.53	0.5	0.44	0.33	0.45

Decomposing net benefit efficiency into technical efficiency of net benefit (minimising cost per service | E^{DU}) and allocative efficiency



technical efficiency of provider at P=OQ/OP
with value of effects k:
economic efficiency for provider at P=OR/OP
allocative efficiency for provider at P=OR/OQ

Technical efficiency under constant and variable returns to scale

Hospital	Technical efficiency (constant returns to scale)	Technical efficiency (variable returns to scale)	Scale efficiency
1	0.74	1.00	0.74
2	0.41	0.74	0.56
3	0.61	1.00	0.61
4	0.47	1.00	0.47
5	0.70	0.84	0.83
6	0.62	1.00	0.62
7	0.87	0.98	0.88
8	0.65	0.82	0.79
9	0.58	0.68	0.86
10	0.80	1.00	0.80

Back-solving to identify where technically efficient providers max NB

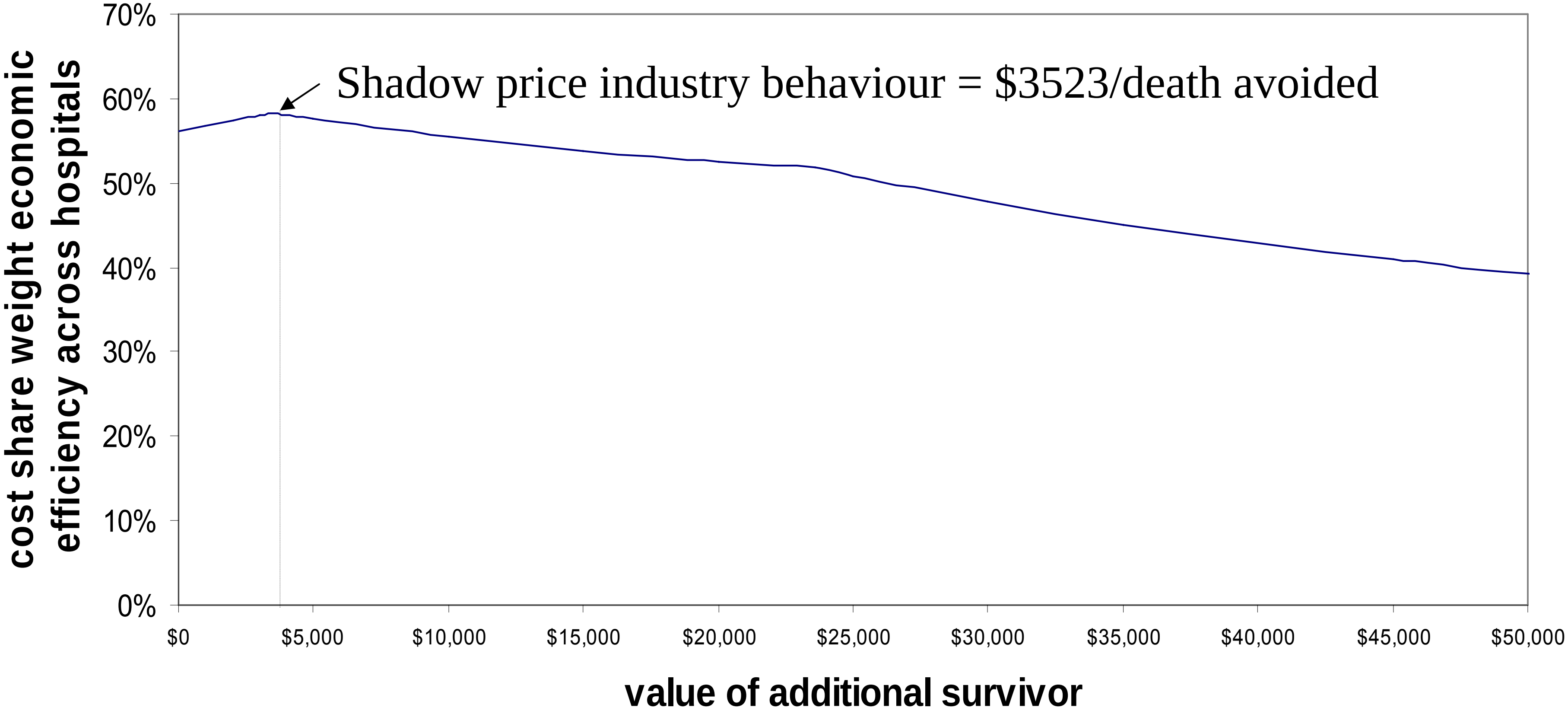
Comparing adjacent technically efficient hospitals on the frontier:

$$C_i + DU_i \times k = C_j + DU_j \times k$$

$$\Leftrightarrow k = (C_j - C_i)/(DU_i - DU_j)$$

- Hospital 27 benchmark $0 to $3523 per death avoided;
- Hospital 18 from $3524 to $24,356 per death avoided;
- Hospital 34 beyond $24356 per death avoided

Shadow price for health effects where industry economic efficiency - weighted by provider cost share is maximised



Satisfying comparability & coverage

To satisfy comparability condition

- requires risk factors adjustment
- necessary and sufficient to prevent cream-skimming

To satisfy coverage condition

- systematically identify and measure effects including those beyond service (data linkage)
- necessary and sufficient to prevent cost-shifting

Qualification required where conditions not satisfied

Conclusions – measuring efficiency

Applying the net benefit correspondence theorem allows:

- An intuitive story of economic, technical, allocative and scale efficiency consistent with maximising net benefit
- Identification of efficient peers and thresholds where they maximise NB
- the shadow price for effects (quality of service) across provider behaviour

Comparability and coverage conditions also:

- provide a robust framework to prevent cream-skimming and cost-shifting incentives - supports data linkage, risk factor adjustment

.. **And extends to budget constrained funding consistent with maximising NB**

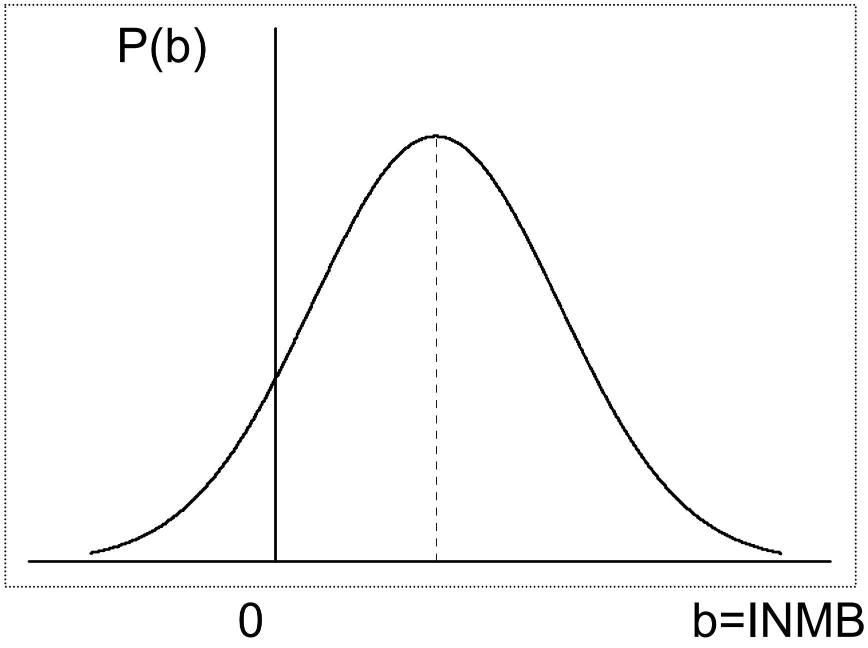
Eckermann (2004)

VoI and decision making within jurisdiction

- Decision makers with evidence of positive but uncertain net benefit of a new therapy can choose between:

1. delay & trial (DT)
2. adopt and trial (AT)
3. adopt with no trial (AN)

How can VoI methods inform this choice?

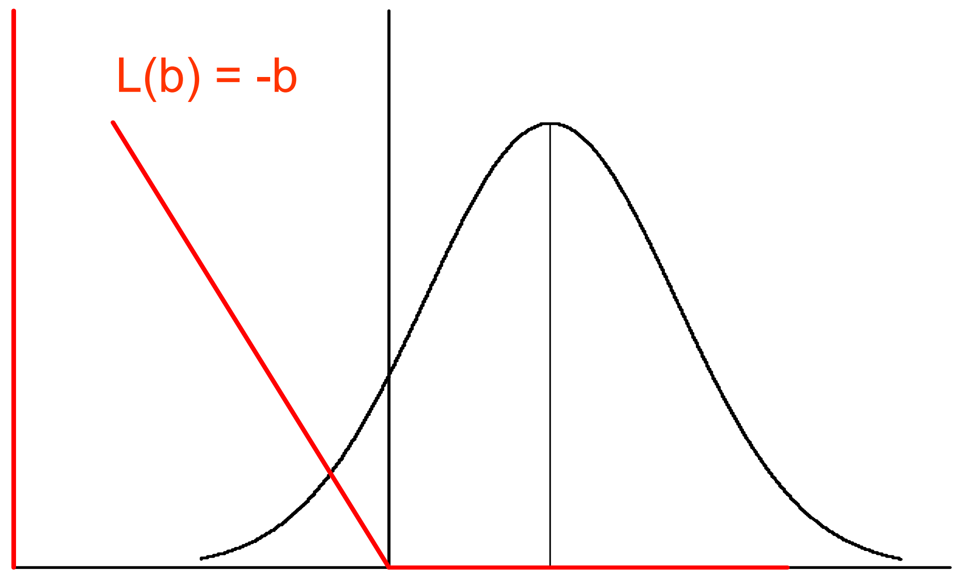


Expected value of perfect information (EVPI)

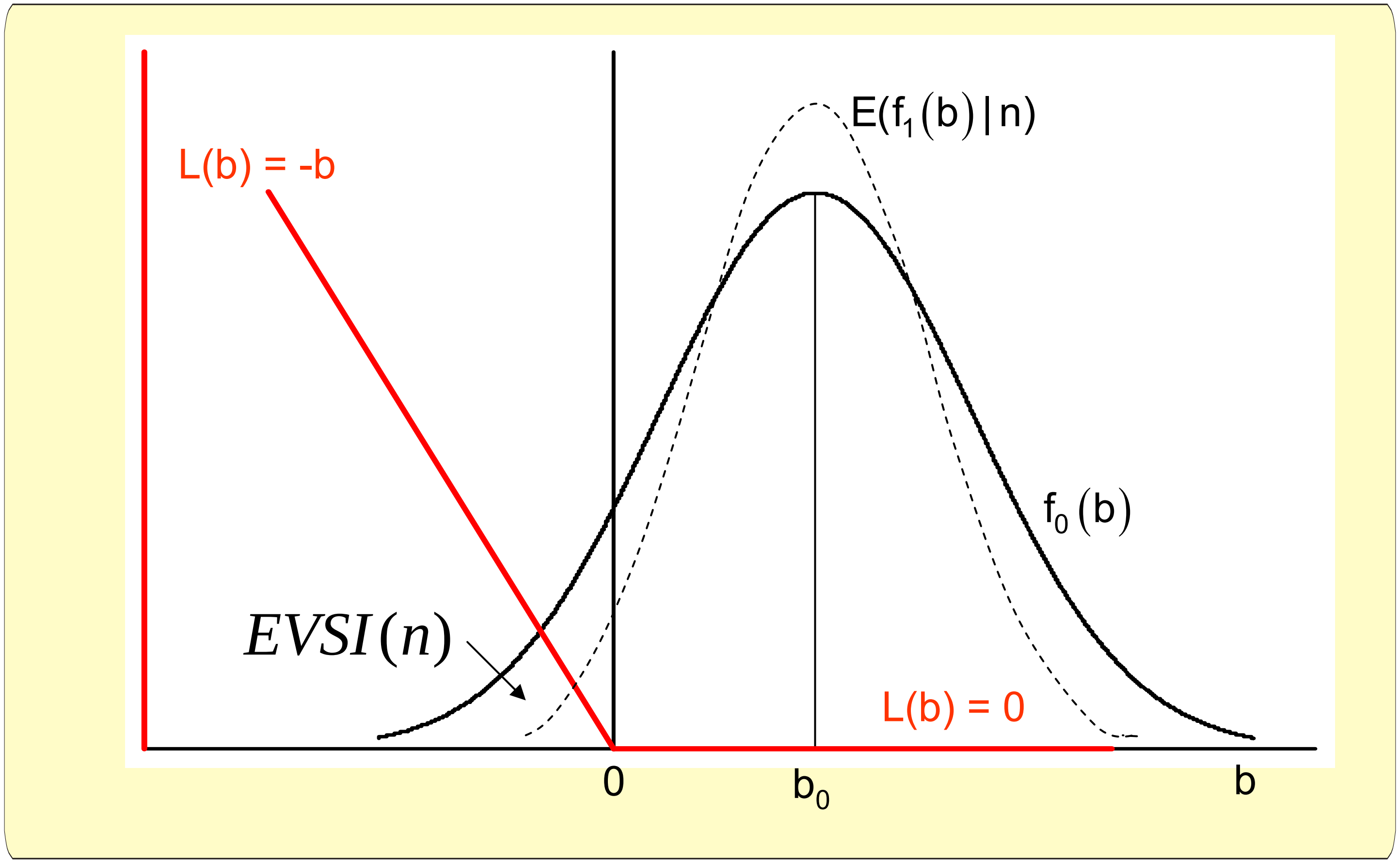
EVPI – the expected value of losses avoided with perfect information can be estimated for current evidence by integrating across the distribution of INB below 0

$$E_0\left[L(b)\right] = \int_{-\infty}^{0} -b \cdot f_0(b)\,db$$

$$= e^{-b_0^2/(2v_0)}\sqrt{v_0/(2\pi)} - b_0\Phi\left(-b_0/v_0^{\frac{1}{2}}\right)$$



EVSI per patient | prior density of INB (b) and trial size n



Additional information is ex-ante expected to reduce the likelihood, and extent of losses integrated across INB < 0

Eckermann and Willan (2007)

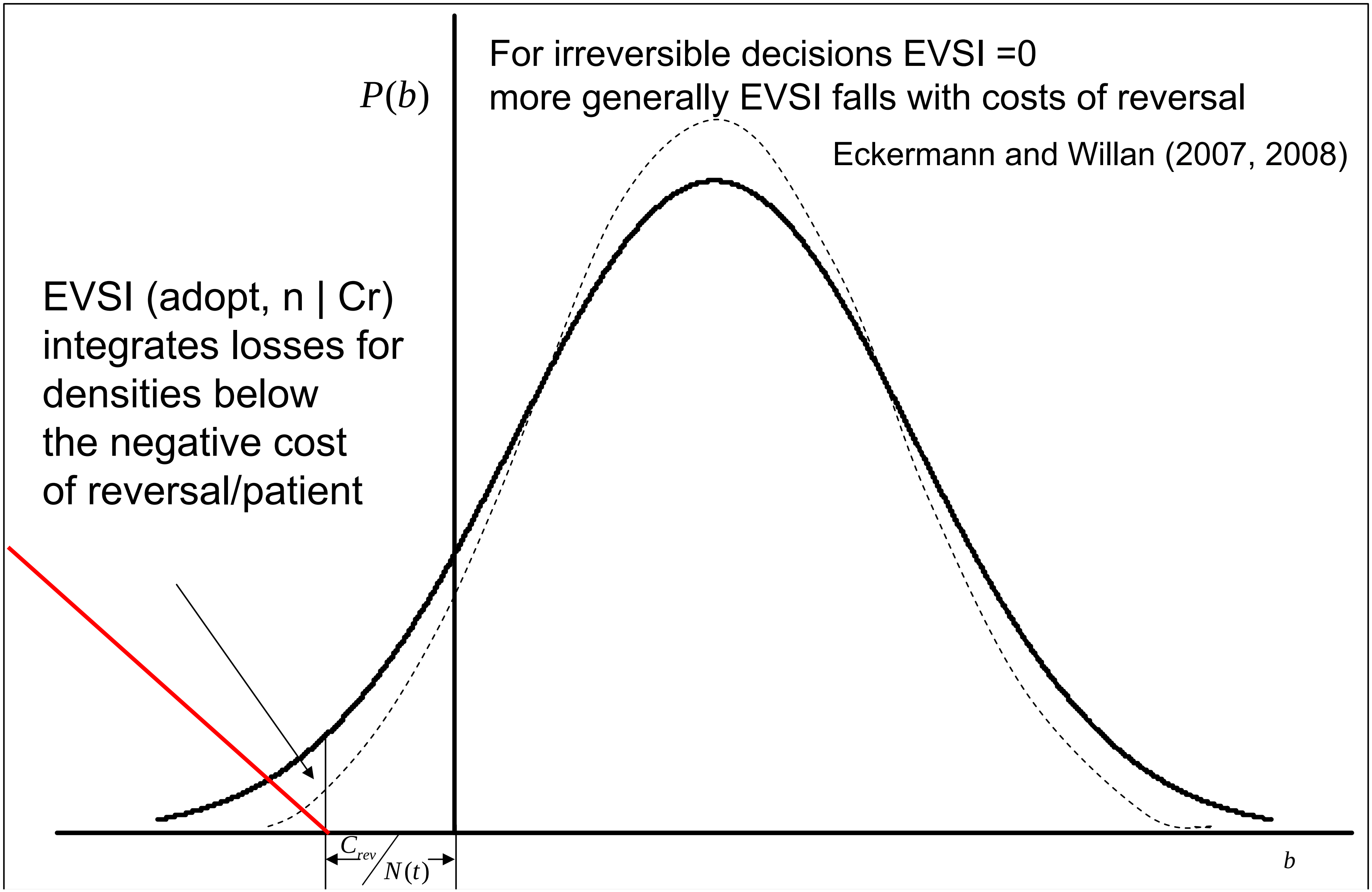
An implicit assumption with adoption

- EVPI and EVSI implicitly assume that the avoiding of losses with perfect information is costless
- However.. expected costs of reversal (Cr) are faced if the new therapy is adopted at the same time a trial is undertaken (AT)
- Cr include:

  costs of reversing public health messages +

  unamortised costs of technology and training

EVSI with Adoption | costs of reversal



Comparing AT, DT and AN

- **Adopt and trial (AT)** - EVSI reduced by costs of reversal

however

- **Delay and trial (DT)** - additional opportunity costs of delay for patients treated outside the trial setting

Hence a trade-off arises between the value and cost of trial information | decision context (adopt or delay)

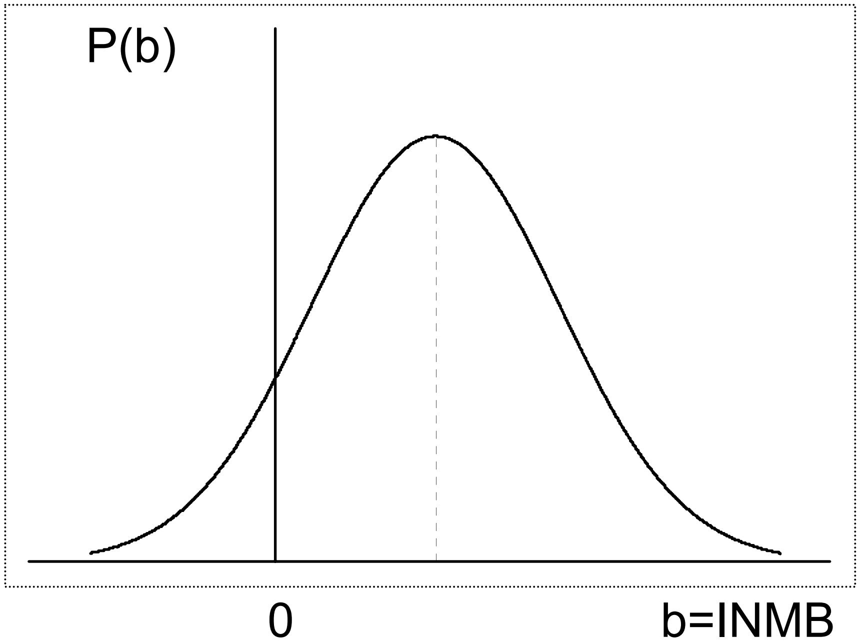
and

- **Adopt and no trial (AN)** - preferred if expected net gain (value less cost) is not positive for any feasible trial

VOI and optimal decision making "within jurisdiction"

- Optimal DM with evidence of positive but uncertain net benefit

Maximise ENG for feasible local trial designs (n) with:
 1. DT vs AN | opp. cost delay
and
 2. AT vs AN | costs reversal



Eckermann and Willan (2007, 2008a,b)
Expected value of information and decision making in HTA
Option value of delay in HTA, Time and EVSI wait for no patient

General impact on decision making & trial design

- Establishes joint nature of optimal research and reimbursement
- Identifies optimal trial design for DT | opportunity cost of delay
- Costs of reversal reduce EVSI and ENG of AT – and hence:
  1. AT less likely optimal and
  2. Optimal trial smaller when AT is optimal

Within jurisdiction - AT infeasible / unethical when have positive net clinical benefit – informed patients prefer treatment outside trial to chance of new therapy in trial - DT vs AN relevant comparison

However AT feasible moving beyond "within jurisdiction"

Globally optimal trial design for local decision making, Eckermann & Willan (2008c)

Linking research, reimbursement & practice

- Comparing loss in net benefit (net loss) on the cost-disutility plane (Eckermann 2004) naturally leads to:

1. Performance (efficiency) measurement consistent with net benefit maximisation in practice **(Eckermann 2004)**

2. The expected net loss frontier - linking research and reimbursement in HTA

   (Eckermann Briggs and Willan, 2008)

…further supporting joint nature of optimal research and reimbursement decisions using VOI methods

(Eckermann and Willan 2007, 2008a, 2008b, 2008c)

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