Health Economics from Theory to Practice: creating incentives for net benefit maximisation within a budget

Simon Eckermann
Professor in Health Economics
Flinders University

Flinders University Adelaide Australia
Flinders Centre for CLINICAL CHANGE & HEALTH CARE RESEARCH

Overview

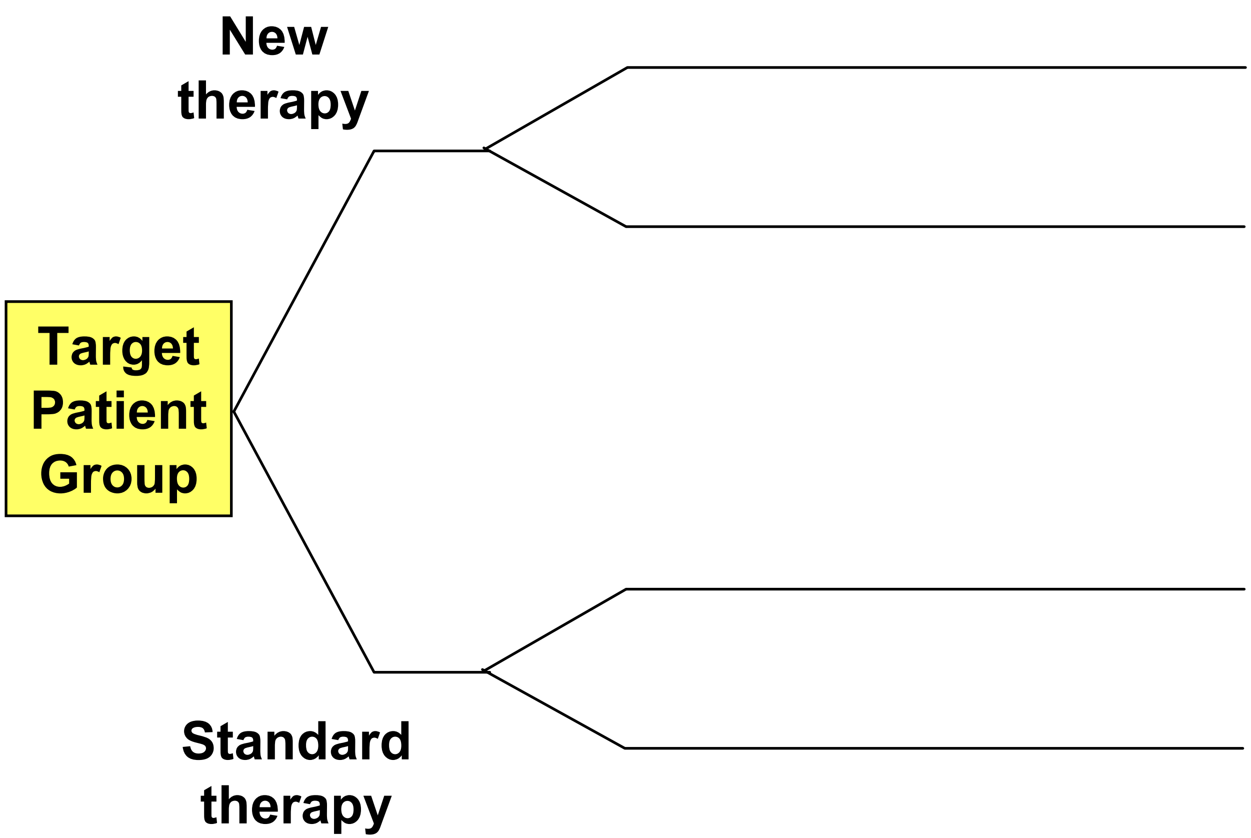
- Inconsistency between comparing performance in HTA and practice
- Measuring efficiency consistent with EBM while preventing cream skimming and cost shifting incentives
- Funding to maximise quality within budget constraints
- Linking optimal research, reimbursement & practice

Economic evaluation in HTA

- Public health systems face scarcity of resources in attempting to satisfy health needs of defined populations over time

- Health technology assessment (HTA) attempts to best inform choices between alternative strategies by comparing relative costs and effects in treating defined patient populations for a public health system (jurisdiction) of interest

Capturing incremental outcomes and cost (resource use×price) of alternatives



Treatment pathways for therapies and associated outcomes:

<u>Health Outcomes</u>

- survival, events & health related utility over time
-QALYS

<u>Resource use and Cost</u>

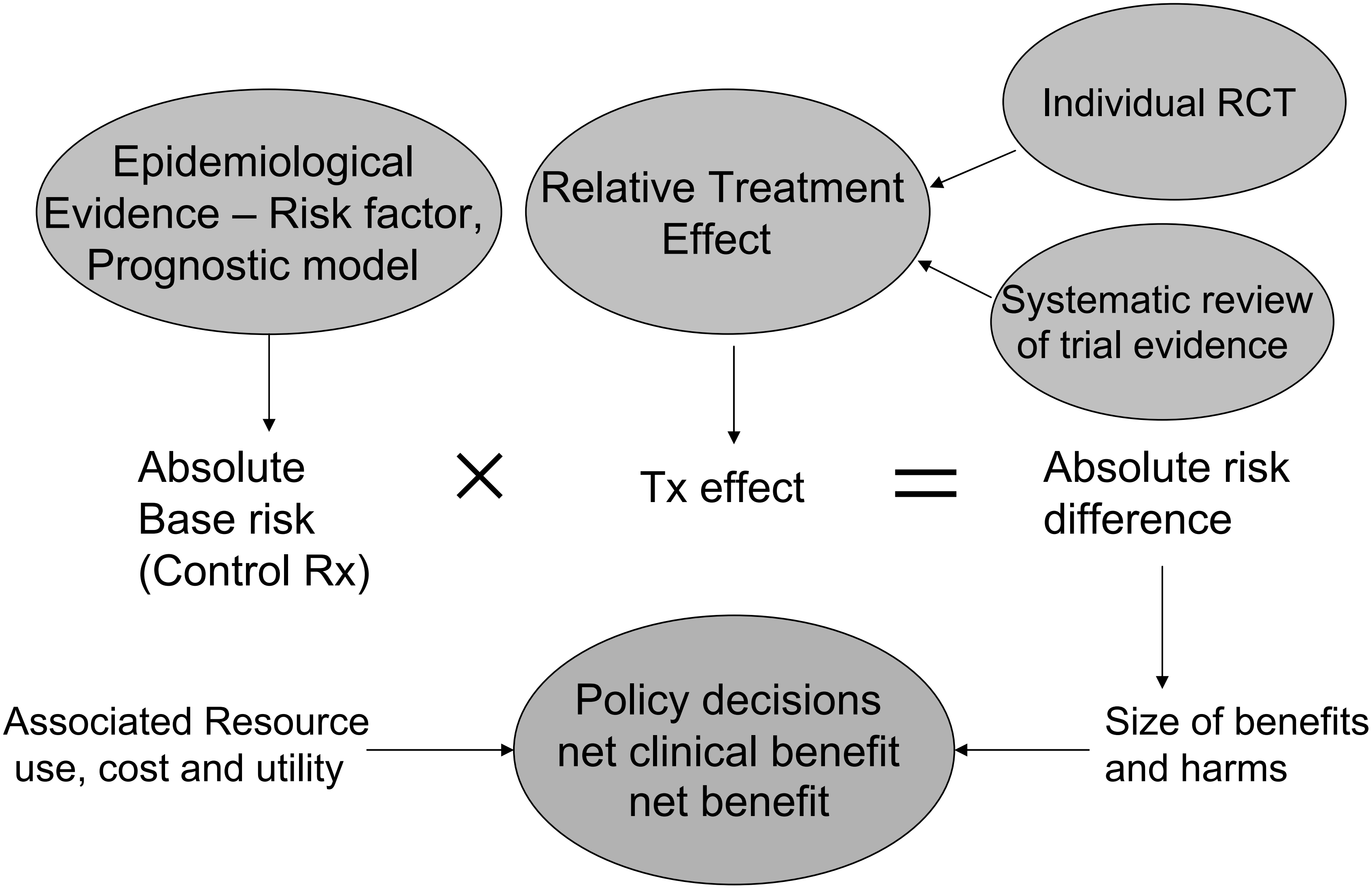
Direct cost
Follow up costs
Hospital, GP, specialist
medications
Nursing home etc.

Decision analytic principles

Robust decision and cost effectiveness analysis in HTA requires:

- Unbiased estimation of treatment effect on health effects/ resource use relative to an appropriate comparator (Comparability)
- Sufficient length of follow up and scope of resource use and health outcomes to capture incremental costs and effects (Coverage)

Applying DA principles - Modelling



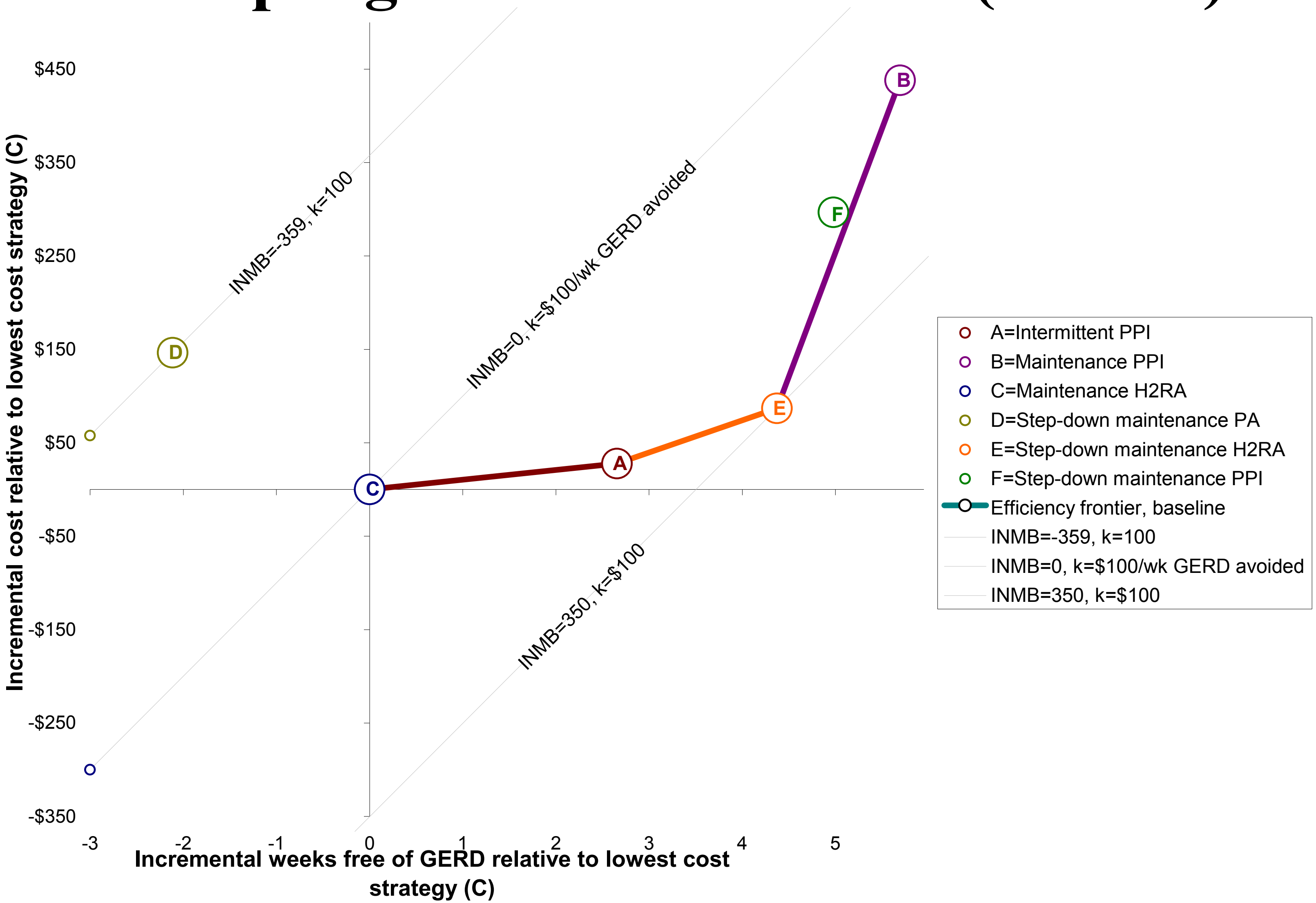
Net Clinical Benefit (NCB=ΔE)

- ΔE = change in effectiveness not efficacy
  - trades off harms and benefits
  - **Absolute not relative differences i.e.** baseline risks (epidemiological evidence in jurisdiction) modified by treatment effect (RCT evidence) in translating trial evidence to jurisdiction of interest

Net benefit (NB) extends net clinical benefit, ΔE to allow for incremental cost implications

NB= $k \times \Delta E - \Delta C$

e.g. Comparing NB of six strategies for Gastro Oesophageal Reflux Disease (GORD)



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Measuring performance in HTA

- In processes of health technology, relative performance of strategies is measured consistent with maximising net benefit per patient

$NB = k \times \Delta E - \Delta C$, where $k \times \Delta E$ is the value of incremental effects

ΔC is incremental cost

Efficiency measures of providers (e.g. hospitals) in practice

- Conventional measures of economic efficiency in health care reflect cost per service:

  e.g. cost / admission in hospitals

- In contrast to HTA, such measures while including the per admission cost of quality ignore the effects of quality

Cost and mortality rate for 45 NSW hospitals treating DRG E62a

Hospital	cost per admission	mortality rate	Hospital	cost per admission	mortality rate	Hospital	cost per admission	mortality rate
1	$4,830	40%	16	$6,199	25%	31	$5,518	17%
2	$9,224	25%	17	**$3,858**	**9%**	32	$6,779	27%
3	$8,056	8%	18	$7,411	24%	33	**$5,283**	**3%**
4	$12,409	7%	19	$4,520	12%	34	$6,977	10%
5	$5,123	40%	20	$6,134	24%	35	$7,407	24%
6	$8,249	6%	21	$7,484	14%	36	$5,189	25%
7	$4,138	35%	22	$4,878	26%	37	$5,820	30%
8	$6,000	14%	23	$5,890	21%	38	$6,887	23%
9	$7,382	13%	24	$5,296	30%	39	$6,424	31%
10	$6,649	4%	25	$4,543	21%	40	$5,921	21%
11	$7,545	4%	26	**$3,590**	**17%**	41	$5,618	29%
12	$8,301	32%	27	$6,132	6%	42	$7,057	21%
13	$6,052	38%	28	$7,744	18%	43	$5,324	34%
14	$13,128	4%	29	$5,302	11%	44	$7,605	27%
15	$6,616	10%	30	$5,920	32%	45	$6,797	28%

Industry	$6,332	22.4%

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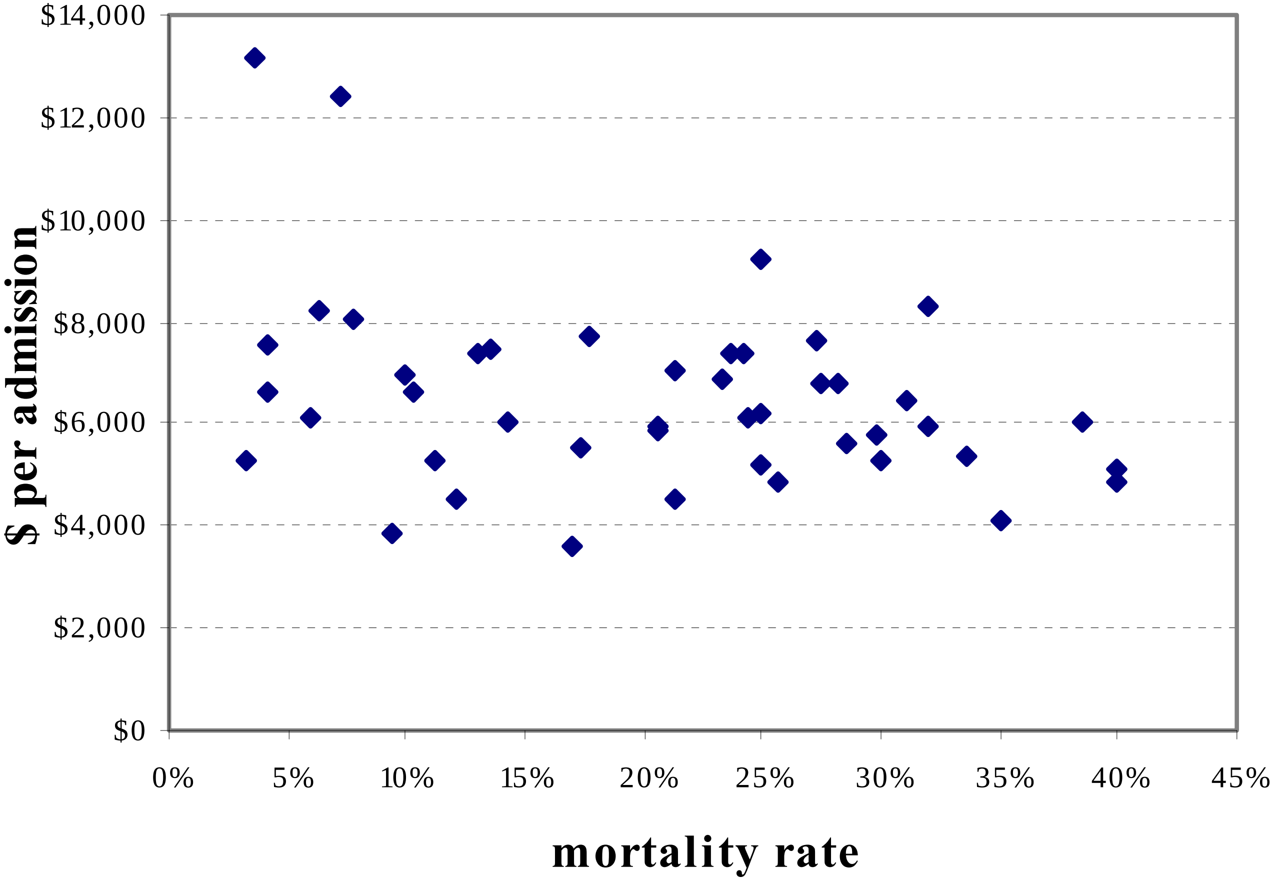
What incentives does comparing cost alone create?



Clinical neutrality of accounting for costs but not outcomes?

- Cost per admission measures make hospitals accountable for the expected average cost of their mix of clinical activities, but not patient outcomes

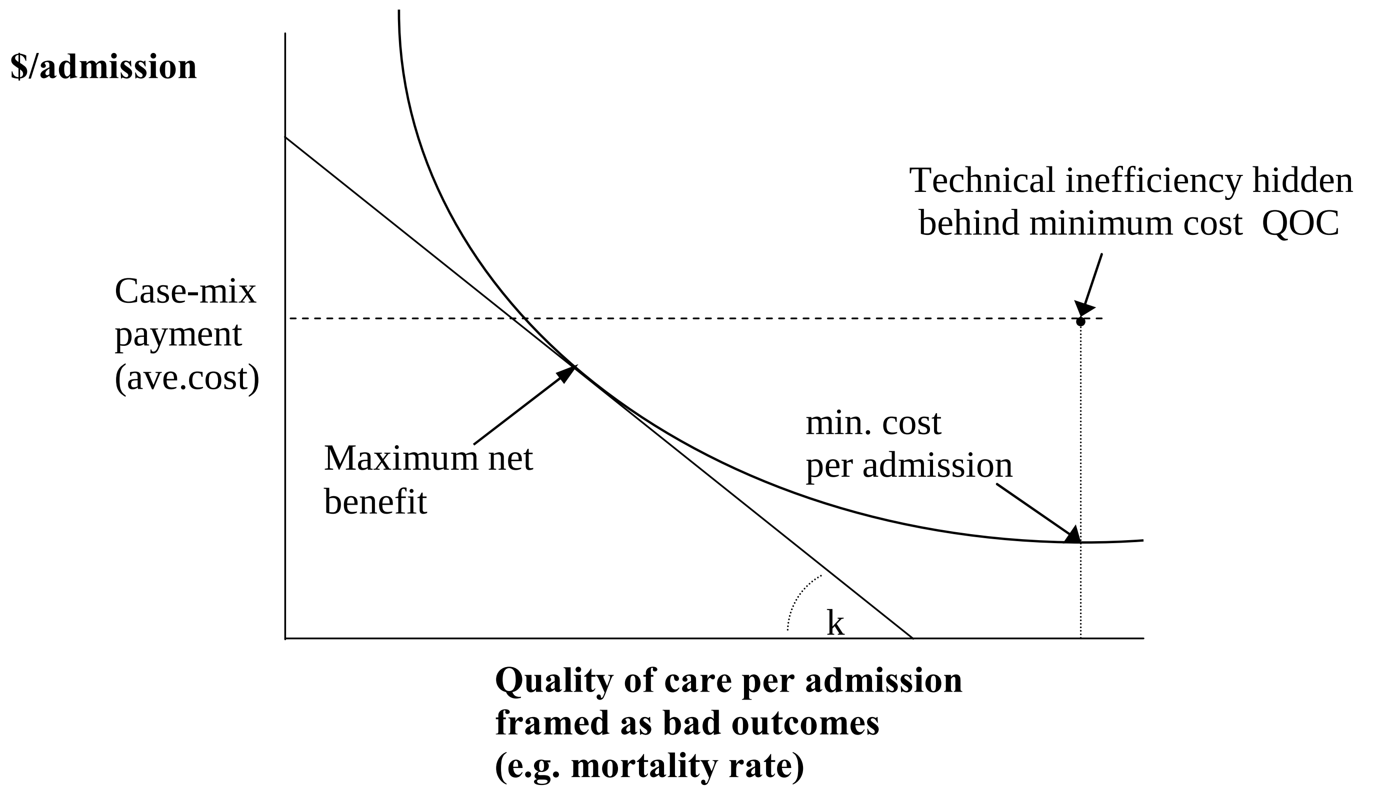
  - i.e. mortality, morbidity, readmission

Case-mix proponents described the lack of accountability for patient outcomes as:

'clinical neutrality of case-mix funding'

Brook (2002)

‘Clinical neutrality’ of case-mix funding ?



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Incentives with case-mix funding

- Case-mix funding of hospitals ignoring effects of care creates incentive to minimise cost per admission but also:
  - Minimum cost per admission QOC
  - Cost-shifting (e.g. high readmission rates)
  - Cream skimming (i.e. choosing less complex patients)

Eckermann (1994)

Problems with minimising cost per admission

- Minimum cost per admission quality of care has expected impacts post separation on higher:
  - Hospital readmission rates
  - Treatment in other institutional health care settings, general practice, specialist and aged care services
  - Informal care in non-institutional settings

Minimising cost per admission

≠ Minimum health system costs,

Let alone maximum net benefit

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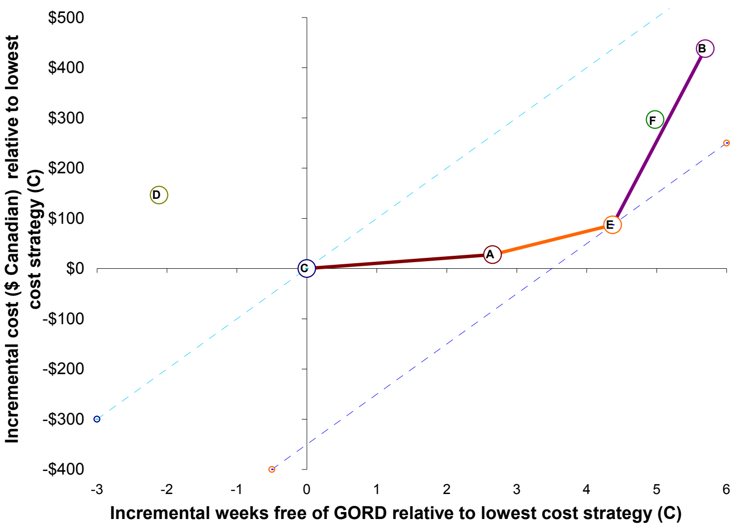
The challenge

- To create appropriate incentives for quality in practice, economic efficiency measures need to include the value as well as cost of quality
  - consistent with maximising net benefit to support evidence based medicine (EBM) in practice

Efficiency measurement consistent with maximising net benefit?

Efficiency measures require radial (ratio) properties.

The NB formulation NB=k×ΔE-ΔC doesn't have radial properties



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

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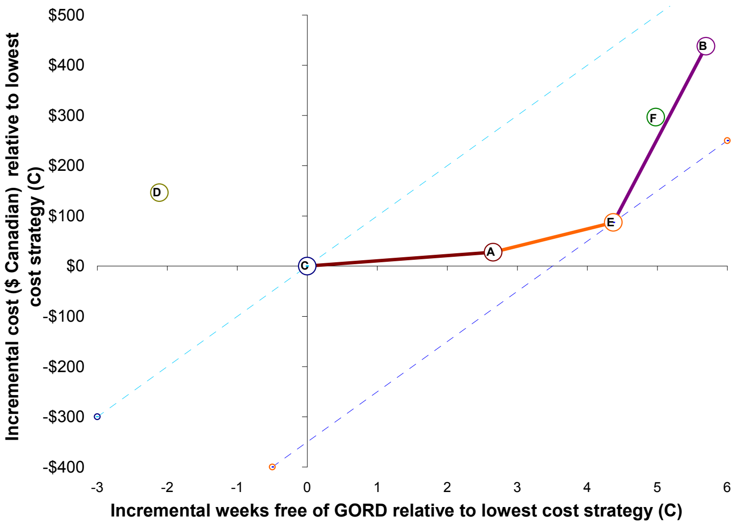
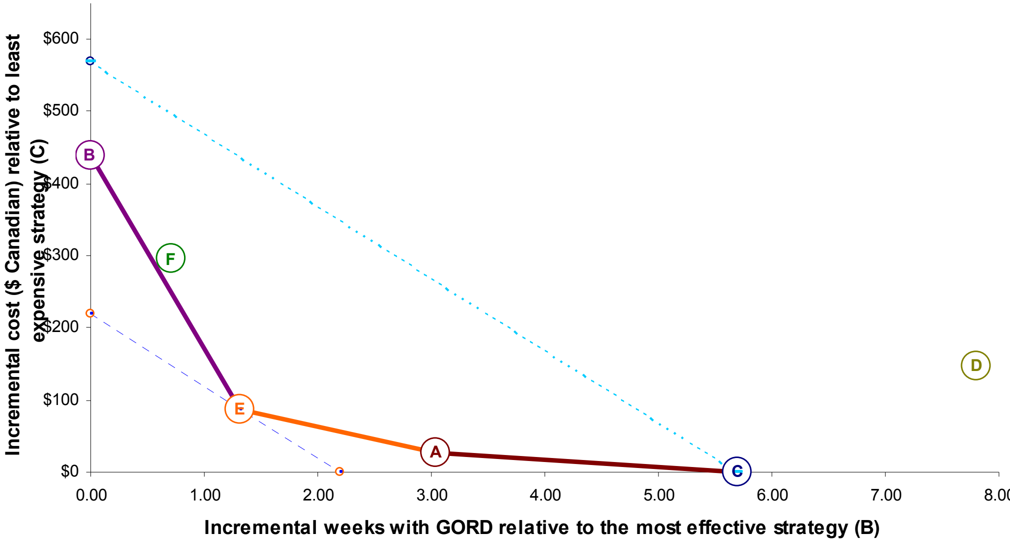
Radial properties on the cost-disutility plane





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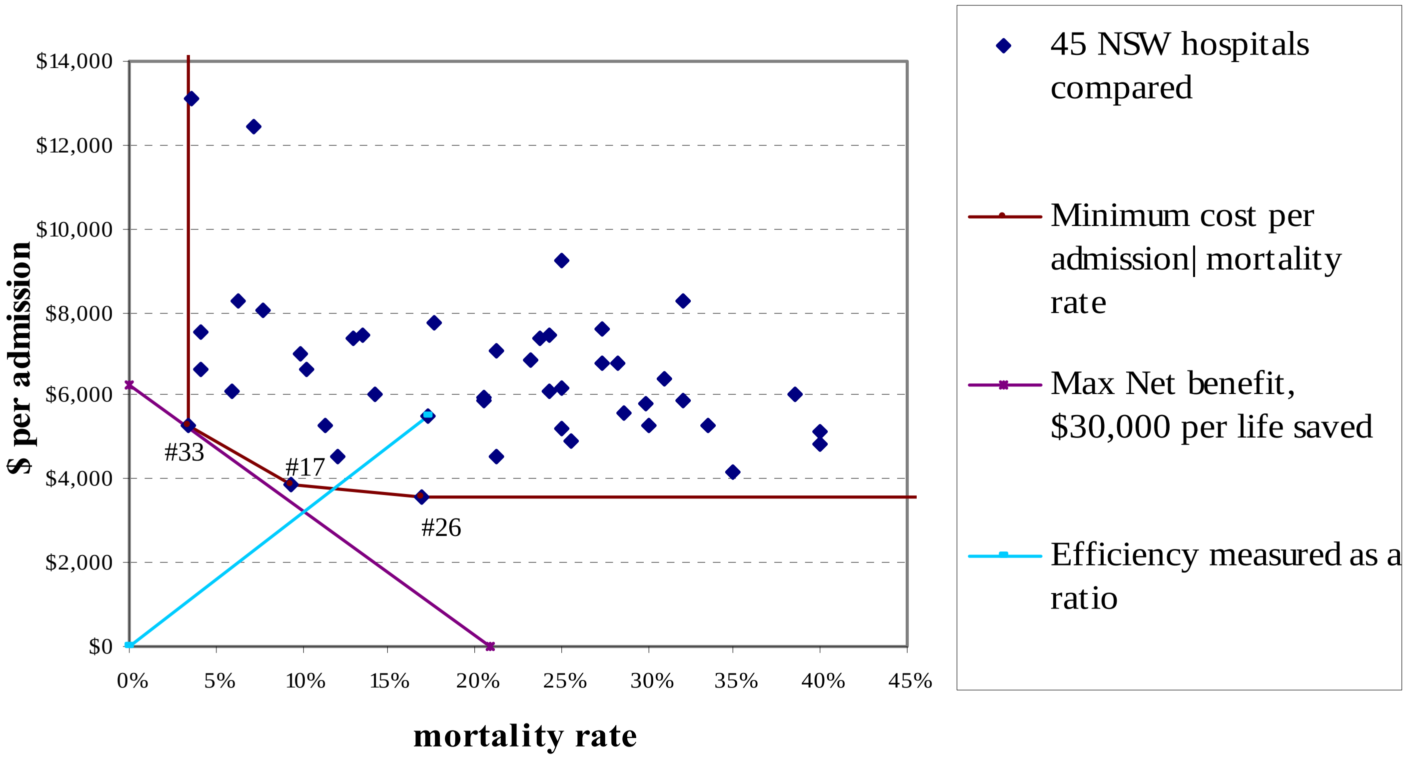
Net benefit correspondence theorem

There is a one-to-one correspondence between maximising $NB=k\times E-C$ and minimising $C+k\times DU$ where:

1. effects framed from a disutility perspective (DU) cover effects of care in NB (coverage condition)
2. differences in expected costs and DU are adjusted for (common comparator condition)

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

Comparing hospital efficiency for respiratory infection (DRG E62a)



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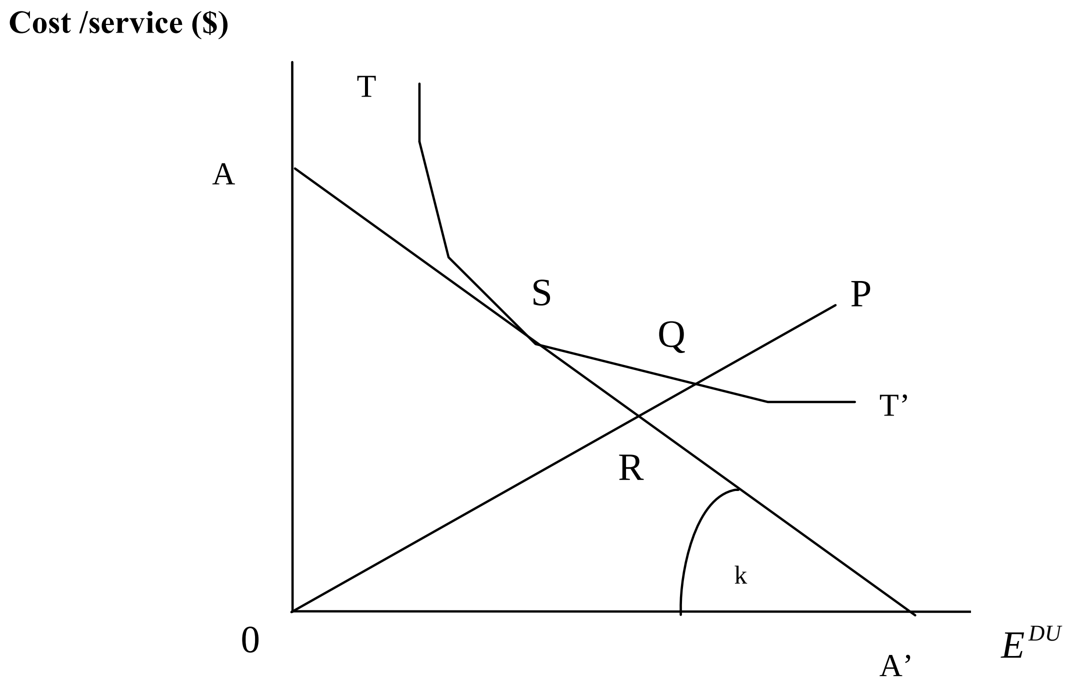
Decomposing net benefit efficiency into technical efficiency of net benefit (minimising cost per service | E^{DU}) and allocative efficiency



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 CRS	Technical efficiency VRS	Scale efficiency
1	0.74	1	0.74
2	0.41	0.74	0.56
3	0.61	1	0.61
4	0.47	1	0.47
5	0.7	0.84	0.83
6	0.62	1	0.62
7	0.26	0.31	0.83
8	0.87	0.98	0.88
9	0.65	0.82	0.79
10	0.58	0.68	0.86
11	0.8	1	0.8
12	0.8	1	0.8

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Economic (NB) efficiency | k

Hospital	$0	$5,000	$10,000	$25,000	$50,000	$100,000
1	0.74	0.63	0.54	0.41	0.28	0.19
2	0.39	0.41	0.41	0.4	0.32	0.25
3	0.45	0.51	0.54	0.61	0.58	0.55
4	0.29	0.34	0.37	0.43	0.43	0.44
5	0.7	0.61	0.53	0.4	0.28	0.19
6	0.44	0.51	0.54	0.62	0.61	0.59
7	0.87	0.73	0.63	0.47	0.32	0.22
8	0.6	0.64	0.65	0.64	0.53	0.42
9	0.49	0.54	0.55	0.57	0.5	0.42
10	0.54	0.63	0.68	0.8	0.8	0.8
11	0.48	0.56	0.6	0.71	0.72	0.74
12	0.43	0.44	0.42	0.38	0.29	0.21
13	0.59	0.54	0.48	0.39	0.27	0.19
14	0.27	0.33	0.36	0.44	0.47	0.52
15	0.54	0.61	0.63	0.66	0.59	0.51
16	0.58	0.58	0.55	0.49	0.37	0.28
17	**0.93**	**1**	**1**	**0.99**	**0.81**	**0.65**
18	0.48	0.5	0.49	0.45	0.36	0.27
19	0.79	0.84	0.84	0.81	0.66	0.52
20	0.59	0.59	0.56	0.5	0.38	0.28
21	0.48	0.53	0.54	0.56	0.49	0.41
22	0.74	0.7	0.64	0.54	0.39	0.28
23	0.61	0.63	0.6	0.56	0.43	0.33
24	0.68	0.64	0.58	0.48	0.34	0.24
25	0.79	0.77	0.72	0.62	0.46	0.33
26	**1**	**0.97**	**0.91**	**0.78**	**0.58**	**0.42**
27	0.59	0.67	0.71	0.8	0.76	0.71
28	0.46	0.5	0.5	0.5	0	0.34
29	0.68	0.74	0.75	0.75	0.64	0.52
30	0.61	0.58	0.53	0.44	0.32	0.23
31	0.65	0.68	0.66	0.62	0.49	0.38
32	0.53	0.53	0.5	0.45	0.34	0.25
33	**0.68**	**0.79**	**0.85**	**1**	**1**	**1**
34	0.51	0.58	0.6	0.65	0.58	0.51
35	0.48	0.5	0.49	0.46	0.36	0.28
36	0.69	0.67	0.62	0.53	0.39	0.29
37	0.62	0.59	0.54	0.46	0.34	0.24
38	0.52	0.54	0.52	0.48	0.38	0.29
39	0.56	0.54	0.5	0.43	0.32	0.23
40	0.61	0.62	0.6	0.55	0.43	0.33
41	0.64	0.61	0.57	0.48	0.35	0.25
42	0.51	0.53	0.52	0.49	0.39	0.3
43	0.67	0.62	0.55	0.45	0.31	0.22
44	0.47	0.48	0.46	0.42	0.33	0.25
45	0.53	0.53	0.5	0.44	0.33	0.25
Industry	0.57	0.56	0.54	0.51	0.4	0.34

Peer benchmarking

Hospital 27 peer from \$0 to \$3,523 per life saved

Hospital 18 peer from \$3,524 to \$24,356

Hospital 34 peer beyond \$24,356

Simply calculated comparing adjacent technically efficient providers (e.g. *i*,*j*) on the frontier

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

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

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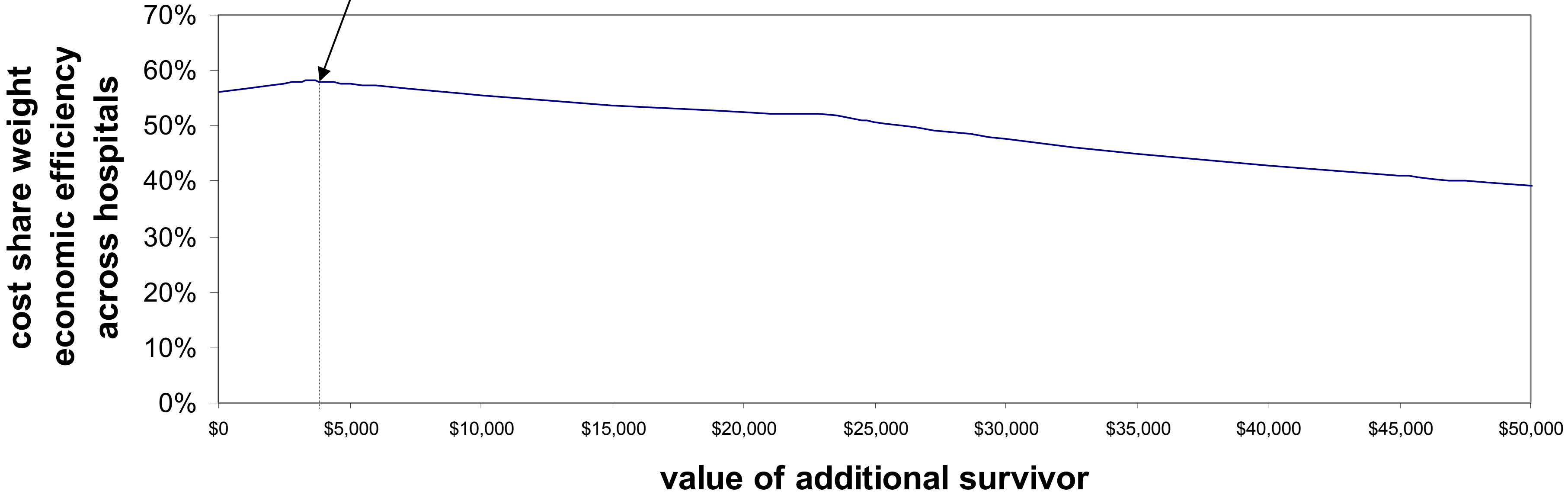
Industry shadow price - the implicit value of outcomes across hospitals

Shadow price for additional survivors = $3523



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Conclusion – efficiency measures

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 NB is maximised
- Shadow price for effects (quality of service) across provider behaviour

AND… a robust framework for preventing cost shifting and cream skimming incentives

Preventing cost and outcome shifting - Satisfying the coverage condition

- Satisfying coverage conditions in practice requires systematically including effects beyond service with:
  - data linkage and/or
  - modelling clinical outcomes post separation given outcome at separation

- Necessary and sufficient to prevent incentives for cost and outcome shifting

Preventing cream skimming incentives - Satisfying the comparability condition

- Satisfying comparability conditions in practice requires adjusting costs and effects for difference in patient populations at point of admission
- Necessary and sufficient to prevent cream skimming incentives – note: can only cream skim on observable patient population differences
- Note also while RCT evidence in HTA avoids selection bias, issues of translating evidence to jurisdiction (population, practice, prices etc,) are usually greater than in practice

Policy Implications

- A 3-step process is suggested to satisfy correspondence conditions (prevent cream skimming and cost shifting incentives):

(i) Identify patient outcomes and predictive risk factors at admission (DA methods)

(ii) Measure costs and effects including those beyond discharge (data linkage or expected effects along clinical pathways given discharge state)

(iii) Adjust outcome rates and costs for patient population differences at admission

Example: Data linkage and standardisation

- Comparison of three SA hospitals in treating cardiac patients with Percutaneous trans-luminal coronary angioplasty (PTCA) DRGs (F10Z, F15Z):

1. Data linkage – mortality and readmission to 12 months from date of index admission

2. Standardisation of 12 month mortality, readmission rate and costs per patient for age and Charlson Co-morbidity Index at admission

Eckermann 2009

Logistic regression to standardise 12 mth mortality rate

DRG	Unadjusted OR	Industry Stand. (2) Risk	Adjusted OR	Adjusted and (2) Industry Stand. Risk
F10Z				
Age	-	-	1.06 (p=0.003)	-
Charlson Comorbidity Index	-	-	1.58 (p=0.003)	-
Hospital A	0.31	0.0153	0.26	0.0136
Hospital B	1.00	0.0478	1.00	0.0507
Hospital C	0.57	0.0276	0.53	0.0267
Total		**0.0302**		**0.0302**

Note standardising risk of binary events using odds ratio (OR) has distinct advantages over relative risk (RR) in ensuring consistent estimation of risk difference with alternative framing and bounding risk between 0 and 1.

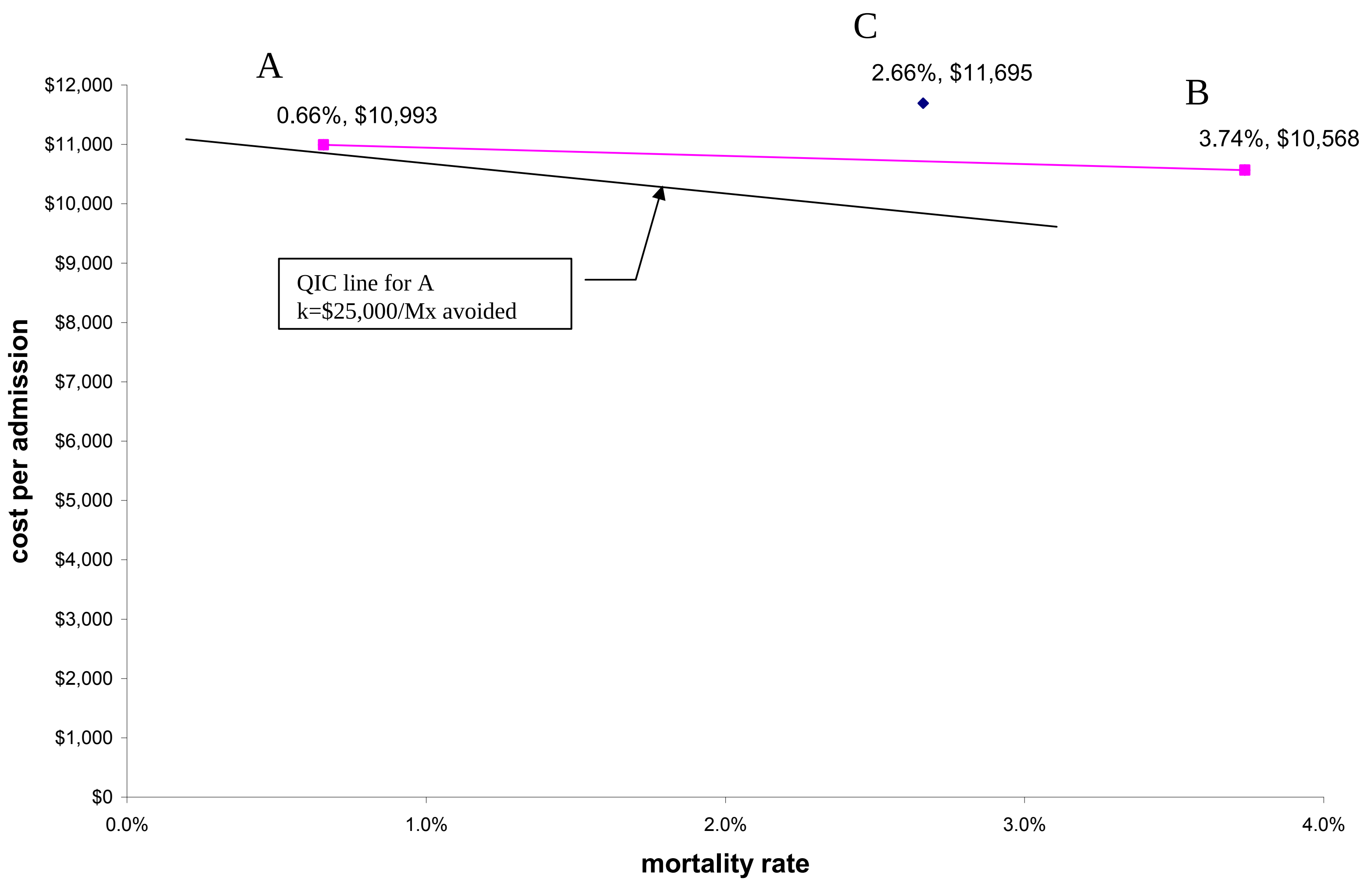
These advantages of OR over RR arise whenever evidence is translated, in indirect comparisons, from trial to jurisdiction or across providers in standardisation.

(Eckermann, Coory and Willan 2008, 2009)

12 month standardised mortality rate, readmission rate and hospital costs

	Std. mortality rate (12 moths)	***Std. rate of re-admission (12 months)***	Std. cost of admissions (12 months)
F10Z and F15Z Combined			
Hospital A	0.66%	0.5105	$10,993
Hospital B	3.74%	0.5065	$10,568
Hospital C	2.66%	0.5714	$11,695

Comparison of standardised costs and mortality across SA hospitals



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Policy cost

- The method focuses current Australian policy initiatives for data linkage and risk adjustment for patient characteristics at a clinical activity level

- Many of these initiatives are already occurring – the correspondence theorem provides a systematic approach to combine these efforts, prevent their replication at different levels & across jurisdictions and time (reinventing the wheel)
  - hence the incremental policy cost is at worst marginal and likely cost saving, particularly in the long-term

Conclusion – cream skimming, cost and effect shifting

- Correspondence conditions (coverage and comparability) provide a robust framework to prevent cream skimming and cost-shifting incentives

- Support policy initiatives for data linkage and adjust for differences across hospitals in patient populations treated

Bottom line efficiency measurement

- Measuring performance consistent with maximising net benefit creates economic incentives for EBM in practice
- Supports risk adjustment and data linkage to prevent cream skimming and cost-shifting incentives
- Supports HTA in choice and use of available technology (allocative and technical efficiency)

References

Efficiency measurement and funding for evidence based medicine (EBM) in HTA and practice

- Eckermann S, Briggs A, Willan A. (2008). Health technology assessment in the cost-disutility plane. ***Medical Decision Making.*** 2008; 28: 172-181**.**
- Eckermann, S & Coelli, T. 2008. Including quality attributes in a model of health care efficiency: A net benefit approach, Centre for Efficiency and Productivity Analysis Working Paper Series No. WP03/2008 available at http://www.uq.edu.au/economics/cepa/docs/WP/WP032008.pdf
- Eckermann S. 2006. Measuring performance consistent with evidence based medicine in practice. CAER Working paper 8. http://www.caer.unsw.edu.au/CAER_WP_series.html
- Eckermann S. (2004) "**Hospital performance including quality: creating incentives consistent with evidence-based medicine**" PhD Dissertation, UNSW, Sydney. http://www.library.unsw.edu.au/~thesis/adt-NUN/public/adt-NUN20051018.135506/
- Eckermann S. (2009a). Measuring health system efficiency and funding for net benefit maximisation: the health economics of quality of care. Clinical Change Working Paper number 4 2009. http://clinicalchange.flinders.edu.au/publications.html
- Eckermann S. (2009b). Funding to maximise quality of care within a budget: bringing net benefit to casemix funding. Clinical Change Working Paper number 5 2009. http://clinicalchange.flinders.edu.au/publications.html

Linking research, reimbursement & practice

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

i. Performance (efficiency) measurement consistent with net benefit maximisation in practice
   (Eckermann 2004, 2009a,b Eckermann and Coelli 2008)
ii. The expected net loss frontier - linking research and reimbursement in HTA
   (Eckermann Briggs and Willan, 2008)
iii. Support of the joint nature of optimal research and reimbursement decisions using VOI methods
   (Eckermann & Willan 2007, 2008a,b, 2009; Willan and Eckermann 2009)

These health economics methods inform efficient research design and prioritisation, regulation and reimbursement decisions.

References

Using odds ratios for binary event rates

Eckermann, SD, Coory, M, and Willan AR. (2009) Indirect comparison: relative risk fallacies and odds solution. J Clin Epidemiol. Published Online: January 2009. DOI: 10.1002/hec.1353.

Eckermann, SD, Coory, M, and Willan AR. (2008) Consistently estimating risk difference in a jurisdiction of interest: odds solution to relative risk fallacies. *Value in Health* 2008; 11(6): A577-A578. Full text available online at Centre for Clinical Change and Health Care Research Working Paper Series, 2008 Working Paper 1 at: http://clinicalchange.flinders.edu.au/publications.html, sourced 1 June 2009.

Optimal trial design, research and reimbursement decisions

- Eckermann S, Willan AR (2007) . Expected Value of Information and Decision Making in HTA. *Health Economics* 2007; 16:195-209.
- Eckermann S, Willan AR. (2008a). The option value of delay in health technology assessment. *Medical Decision Making*. 2008; 28: 300-305.
- Eckermann S, Willan AR. (2008b). Time and EVSI wait for no Patient. *Value in Health*. 2008; 11: 522-526.
- Eckermann S, Willan AR. 2009. Globally optimal trial design for local decision making. *Health Economics*.

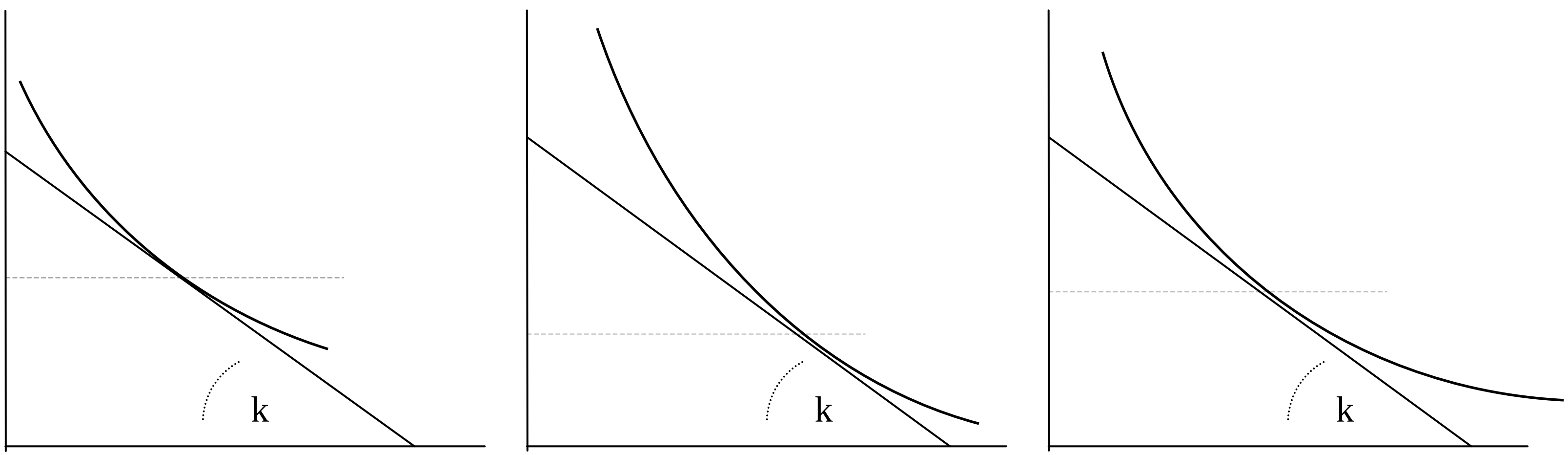
Postscript – in response to questions

Following the presented slides a pertinent question was raised in relation to the extent to which comparison consistent with maximising net benefit is captive to the value of effects reported in the media and willingness to pay studies

In response, Brita Pekarsky's research in this area was pointed to and an additional slide presented from Eckermann (2009b) to demonstrate that under a constrained health budget the threshold value for effects is **not** that reported in willingness to pay studies. Rather, the threshold value given a budget constraint is the common value for quality across activities that can be achieved if technical and economic efficiency are eliminated and health benefit maximised, following program budgeting and marginal analysis (PBMA) principles.

Maximising outcomes across DRGs for any given budget

$ cost per admission



DU – effect framed from a disutility perspective

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Final comments in response

Further, while net benefit (economic) efficiency requires consideration of threshold values for effects:

(1) Technical and scale efficiency (see slides 22 and 23) and the shadow value for quality in current industry behaviour (slide 26) do not require consideration of threshold values;

(2) Net benefit (economic) efficiency measures can be conditioned on the threshold value of effects (slide 24); and

(3) Determination of the threshold value and maximum health under a health system budget constraint requires consideration of technical feasibility as well as industry value for quality for each activity (see slides 21, 26 and 42).