Introduction to Economic Evaluation

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The Horizon of New Health Technologies

- Diagnostics: Virtual colonoscopy
- Devices: Computerized knee
- Procedures: Breast MRI
- Drugs: Biologics

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Image description: Graphic detailing the inside of the M2A capsule

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Image description: Picture of a mountain climber on glacier with computerized knee

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Image description: Picture of a virtual colonoscopy x-ray

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Image description: Diagram of a Breast MRI

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New Technology #1

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Image description: a man's head with a cellphone strapped to it with a rubber band

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New Technology #2

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Image description: a woman blowing her nose using toilet paper that is from a roll strapped on to her head

Cost and outcomes evaluation

- Scarcity of resources
- Need to make choices: opportunity vs. cost
- Decisions need to be based on comparisons of costs and benefits
- Efficiency is not the same as cost cutting
- The emergence of genetic information and genetic-based technology will necessitate careful appraisal by payers and society as to
  - clear benefits of identification and treatment
  - clear patient sub-groups
  - cost implications

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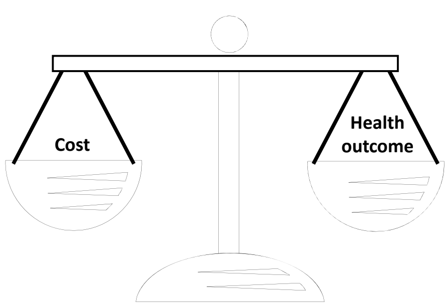
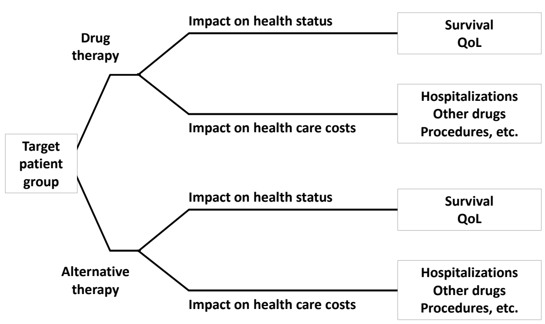
Value



Important types of economic analysis

- Cost-effectiveness analysis
  - used to decide between different treatments for same condition
  - measures cost (money) per unit of effect (outcome measures or natural units), e.g. cost per life years gained, cost per mmHg blood pressure decrease
  - the lower the cost-effectiveness ratio, the better
- Cost-utility analysis
  - a type of cost-effectiveness analysis that can compare treatments for different conditions since a common outcome measure is used
  - costs measured in benefits, outcomes as utility
  - best-known utility measure is the quality-adjusted life-year (QALY)

Nature of economic assessments



QoL = Quality of life

Outcomes for economic evaluation

Analysis	Outcome valuation
•Cost-consequences	Multiple outcomes in natural units 'Consumer Report'
•Cost-effectiveness	Single outcome Intermediate – blood pressure Final – life-years gained
•Cost-utility	Multiple outcomes combined into weighted index (e.g., QALYs)
•Cost-benefit	Monetary values (willingness-to-pay) Contingent valuation Conjoint analysis

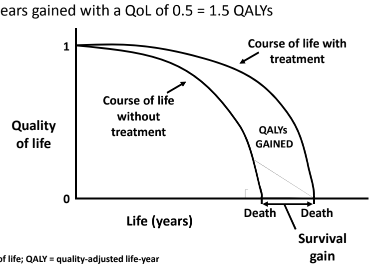
QALY = Quality-adjusted life-years

Quality-adjusted life-years (QALYs)

- Most therapies have multiple heath consequences
- Trade-offs between survival and quality of life (e.g., chemotherapy)
- Trade-offs between different aspects of health (e.g., depression and dry mouth from drug therapy)
- Policy makers need to compare across diseases
- QALYs and cost-utility analysis

QALYs are a statistical trade-off between length and quality of life

- The years of life gained from treatment are multiplied by a QoL score on a scale of 0 (worst) to 1 (best) to give QALYs
- e.g. 3 years gained with a QoL of 0.5 = 1.5 QALYs



QoL = quality of life; QALY = quality-adjusted life-year

Applying cost and outcomes assessment to decision making

Costs, survival, and QoL of treating patients with 2 alternatives

Treatment	Costs ($)	Survival	QoL	QALY
A	20,000	4.5 years	0.80	3.6
B	10,000	3.5 years	0.90	3.15

Which treatment would you select?
Which outcome do you value most?

Costs and benefits of treatments are compared using the incremental cost-effectiveness ratio (ICER)

- Compares costs of different treatments using same measure of effectiveness or utility, e.g. cost per QALY
- When drug A has higher treatment costs and higher outcomes than that of drug B, the decision is based on the ICER

$$\text{ICER} = \frac{\text{Treatment cost of A} - \text{Treatment cost of B}}{\text{Effectiveness of A} - \text{Effectiveness of B}}$$

QALY = quality-adjusted life-year

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Example: t-PA versus Streptokinase

Treatment	Costs ($)	Survival at 1 year	Projected life expectancy	QoL
t-PA	27,420	91.0	15.41	0.90
Streptokinase	24,990	89.9	15.27	0.90

The NNT is 110 and the CNT is $243,000 to save one life

NNT = number needed to treat; CNT = cost needed to treat

t-PA versus Streptokinase: cost-effectiveness differs by age and location of the infarction

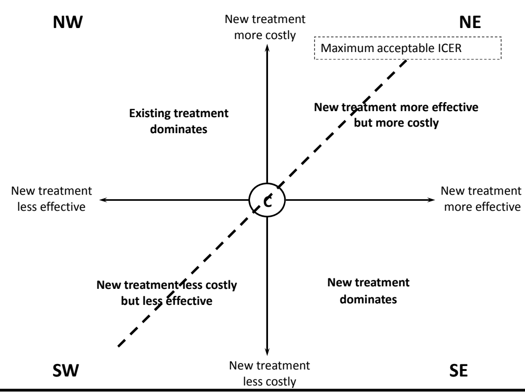
Group of patients	Increased life expectancy with t-PA	Cost-effectiveness ratio ($)
Primary analysis	0.14	32,678
Inferior MI, age <40	0.03	203,071
Anterior MI, age <40	0.04	123,609
Inferior MI, age 40–60	0.07	74,816
Anterior MI, age 40–60	0.10	49,877
Inferior MI, age 61–75	0.16	27,873
Anterior MI, age 61–75	0.20	20,601
Inferior MI, age >75	0.26	16,246
Anterior MI, age >75	0.29	13,410

MI = myocardial infarction

Framing the problem

- Viewpoint of study determines which data to collect
  - hospital
  - health care system
  - society
- Time of study should be long enough to capture main costs and effects

THE HEALTH TECHNOLOGY VALUE PLANE



GRADES OF RECOMMENDATION FOR THE ADOPTION OF NEW TECHNOLOGIES

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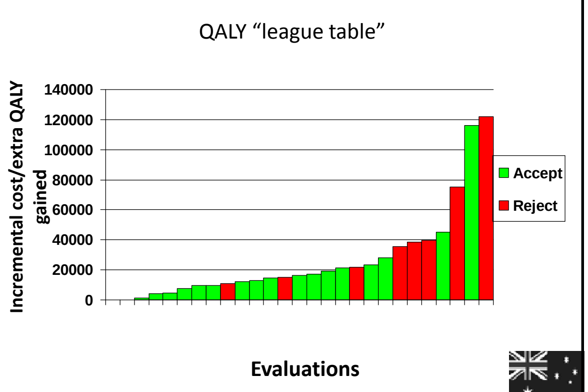
Image description:

This figured can be viewed at Laupacis, et al, CMAJ, 1992.

The figure displays a box with 4 quadrants representing the intersection of cost and QALY continuum. The upper left quadrant represents interventions that are less effective and more costly. The lower left quadrant represents interventions that are less costly and less effective, and includes as examples interventions with a $/QALY ratio of $100,000 and $20,000. The lower right quadrant represents interventions that are more effective and less costly. The upper right quadrant represents interventions that are more costly and more effective, including as examples interventions with a $/QALY ratio of $100,000 and $20,000.



The authority's view

– example from UK NICE

- Below an ICER of £20,000/QALY, the acceptability of a treatment as an effective use of NHS resources is judged primarily on cost effectiveness
- Above £20,000/QALY, acceptability is also judged on other factors:
  - the degree of uncertainty in the calculation of ICERs
  - the innovative nature of the treatment
  - the particular features of the disease and the unmet need in the population benefiting from the new treatment
  - the wider societal costs and benefits
- Above £30,000/QALY, the case for supporting the treatment on these factors has to be increasingly strong

NICE = National Institute for Clinical Excellence (UK); ICER = incremental cost-effectiveness ratio;
QALY = quality-adjusted life-year; NHS = National Health Service (UK)
NICE Guide to the Methods of Technology Appraisal, April 2004

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UK NICE

Cost per QALY	Accepted	Restricted	Rejected
< £20,000	14	3	1
£20,000 - £30,000	0	4	0
> £30,000	1	4	3

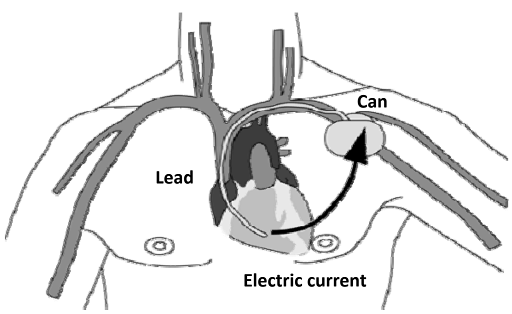
Examples of estimated ICER thresholds

	Unit	Lower boundary	Upper boundary
USA	QALY	US$50,000	US$100,000
Canada	QALY	US$17,600	US$87,800
Australia	LYG	US$28,200	US$51,000
NICE	QALY	US$32,000	US$48,000
	Unit	Lower boundary	Upper boundary
WHO	GDP/capita/DALY averted		<3
Australia PBAC	GDP/capita/life-year gained	1.26	2.29
UK NICE	GDP/capita/QALY	1.4	2.1

ICER = incremental cost-effectiveness ratio; QALY = quality-adjusted life-year; LYG = life-years gained; GDP = gross domestic product; WHO = World Health Organization; DALY = disability adjusted life-years; NICE = National Institute for Clinical Excellence (UK); PBAC = Pharmaceutical Benefits Advisory Committee
Value in Health 2004;7:518.

Example:

Cost-effectiveness of the implantable cardioverter-defibrillator (ICD)



Canadian Implantable Defibrillator Study (CIDS):
Gains in life expectancy

	Life expectancy (years)*:	
	Non-parametric: Kaplan-Meier (95% CI)	Parametric exponential
ICD	4.91	4.88
No-ICD	4.65	4.60
Difference	0.26 (–0.09, 0.55)	0.28

***Bounded in 6-year intervals; no discounting**

ICD = implantable cardioverter-defibrillator

O'Brien B et al. Circulation 2001;103:1416–21

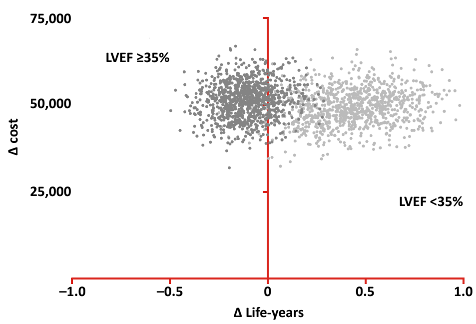
Cost-effectiveness of ICD versus non-ICD (discounting at 3%/year)

	ICD	non-ICD	Difference (ICD–non)
Total cost per patient ($)	87,715	38,600	49,115
Life expectancy (years)	4.58	4.35	0.23
Incremental CE of ICD:			
CA $213,543 per life-year gained			

O'Brien B et al. Circulation 2001;103:1416–21

Willingness to pay for health gain

Bootstrap (ΔC, ΔE) by left ventricular ejection fraction (LVEF)



Conclusions

- Increasing demand for economic evaluation
- Payers focus on value for money
- Economics helps but it does not make decisions
- Evidence from trials and the need for models
- Emerging role of pragmatic trials with CE
- Patient-centered outcomes; QoL, utility
- Need for transparency of studies
- Need to educate consumers of studies

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References & Resources

1. Laupacis A, Feeny D, Detsky AS, Tugwell PX. How attractive does a new technology have to be to warrant adoption and utilization? Tentative guidelines for using clinical and economic evaluations. Canadian Medical Association Journal. 1992; 146:(4).

2. O'Brien BJ, Connolly SJ, Goeree R, et al. Cost-effectiveness of the implantable cardioverter-defibrillator: results from the Canadian Implantable Defibrillator Study (CIDS). Circulation. 2001;103:1416–1421.

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