Economic evaluation

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The Inevitability of Trade-Offs

- The value of a medical intervention
- The inclusion of a drug on the formulary
- Paying for an experimental procedure
- Investing in new technology
- Is it worth it? How do we measure value to insure we get value for spending?

What is Economic Evaluation?

- A comparative analysis
- Evaluating alternative courses of action
- Examining both costs and consequences

Types of Economic Evaluation

- Cost of illness studies
- Cost-effectiveness studies
  - Average cost effectiveness
  - Incremental cost effectiveness
- Cost-utility studies
- Cost-benefit analyses
- Meta analyses

Cost of Illness Studies

- What does it cost?
- Burden of a disease
- Burden of 5 chronic conditions in US (Druss et al., 2001)
  - Mood disorders, diabetes, heart disease, asthma, and hypertension
  - Direct cost of treatment - $62.3 billion
  - Cost of treating coexisting conditions - $270 billion
  - Lost productivity - $36.2 billion
- Role in analysis – increased awareness

MD Australia

In 2005, the financial cost of MD was $435 million.

- $236.2 million (54.2%) productivity lost due to lower employment, absenteeism and premature death;
- $117.8 million (27.1%) value of the informal care provided by parents and other close family or friends;
- $42.4 million (9.7%) loss from Disability Support Pension and Carer Payment and taxation forgone;
- $29.7 million (6.8%) other indirect costs such as aids home modifications, formal care services, transport
- $7.4 million (2.2%) was the direct health system expenditure.

Cost-Effectiveness Analysis

- Developed outside traditional welfare economics framework
- Measures health benefit by health outcome, not the dollar value of life
- Using the decision makers approach
  - Maximize the level of health for a given population subject to a budget constraint
  - Practical guide for choosing between programs or treatment options when budgets are limited

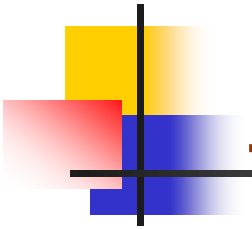
Average cost effectiveness ratio

$$ACER = \frac{E}{C}$$

E: is usually measured in terms of statistical years of life save

Assumptions

- Population of 100 patients aged 40
- Expected survival 80 years
- Risk of death: 50%
- Drug reduces risk by 50%
- Statistical years?



Expected deaths no treatment

100*0.5=50

Lost years

50*(80-40)=400

With treatment:

100*0,25=25

Lost years

25*40=200

Statistical years of life saved

400-200=200

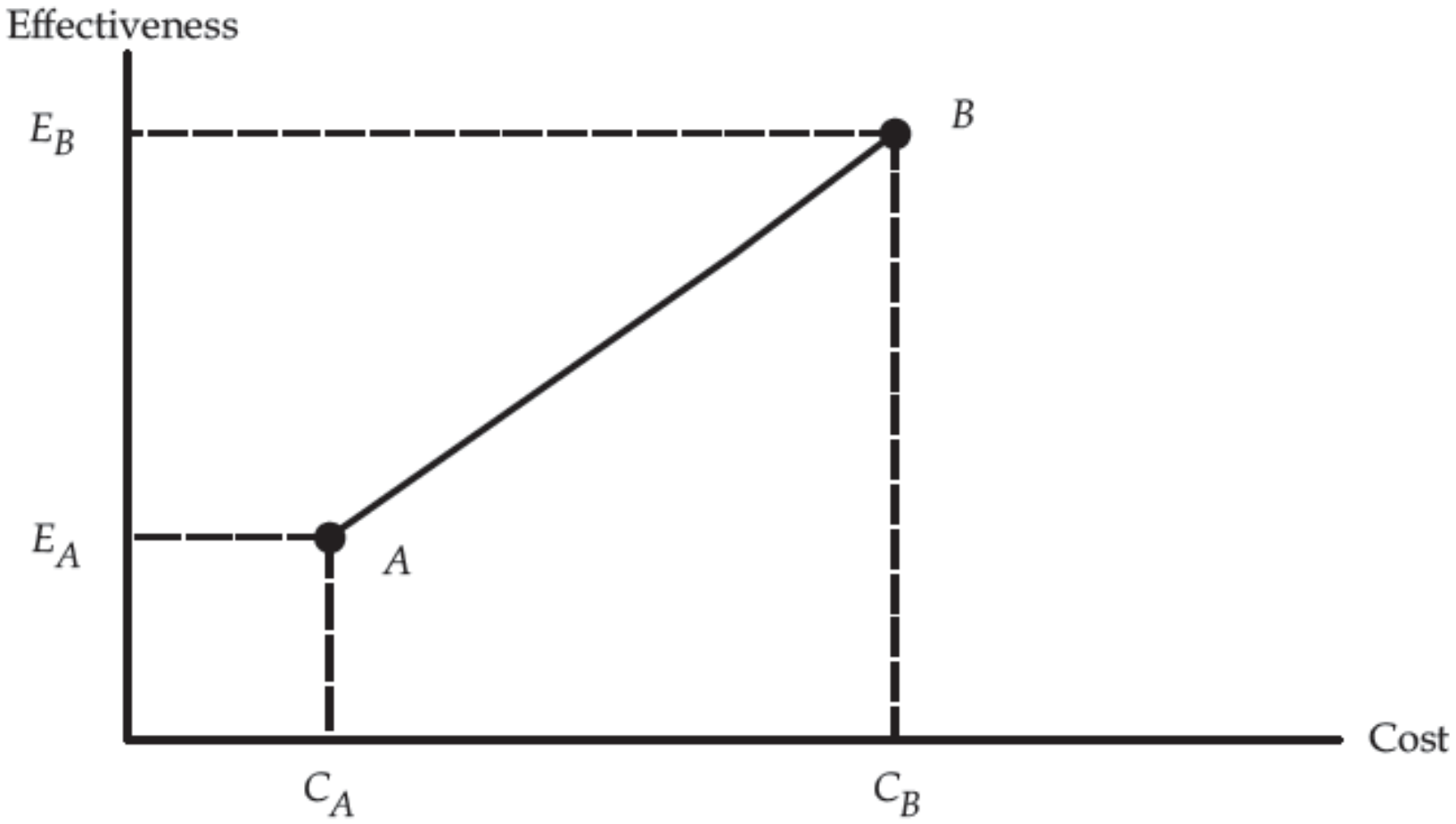
Incremental Cost-Effectiveness Ratio (ICER)

$$ICER = \frac{E_B - E_A}{C_B - C_A}$$

- If $C_A > C_B$ and $E_A < E_B$, then B dominates.
- If $C_A < C_B$ and $E_A > E_B$, then A dominates.
- If, however, $C_B > C_A$ and $E_B > E_A$, choice is not obvious. Use CE.

ICER

Figure 4.1: Incremental Cost-Effectiveness Comparing Two Treatment Options



Cost utility

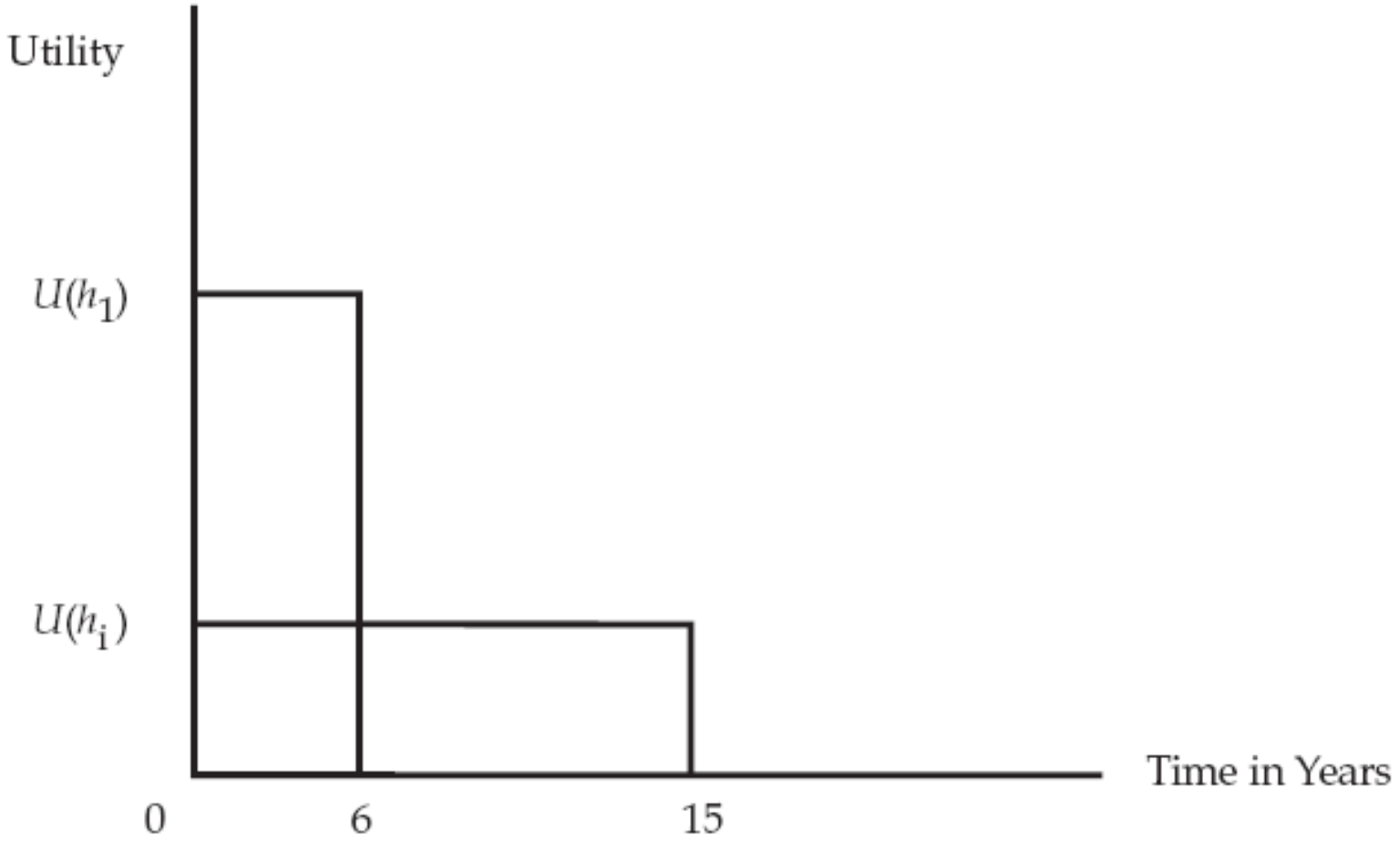
- Life expectancy is not the only measure of effectiveness of drugs/treatments
- Some of them may improve quality of life rather than life itself
- Important for chronical diseases
- How to measure quality?

Quality of Life Measures

- Attempt to measure value of life in terms of quality and quantity
- View QALY as life expectancy with a preference weight for perfect health attached to each year
- Measured on a preference scale anchored by death (0) and perfect health (1)

Quality of Life Measures

Figure 4.4: Using Preferences for Health States to Calculate QALY



How QALY are evaluated

- Identification of 243 different health statuts based on multidimensional health measures
- EQ-5D (Euroquol) mostly used :Evaluation on five dimensions: mobility, self-care, usual activities, pain/discomfort and anxiety/depression. Each dimension has 3 levels: no problems, some problems, extreme problems.

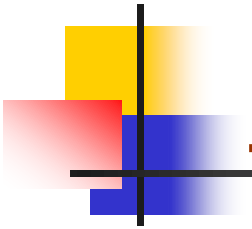
Performing an ICEA

- Rank the alternative treatment options by health benefit (beginning with the one with the lowest benefit).
- Eliminate treatment alternatives that are strictly dominated.
- Calculate the ICER between each treatment option and the next most expensive option.
- Eliminate treatment options that display extended dominance.
- Determine which treatment options have an ICER that is below the cut-off ICER.

Example

Patient with severe illness. With available treatrment he has an expected life span of one year and Qol=0.4. QALYs = 1 * 0.4 = 0.4

Innovative drug allows to increase survival by 25% (to 1,25 years) and quality by 50% (to 0.6) QALYs = 1.25 * 0.6 = 0.75

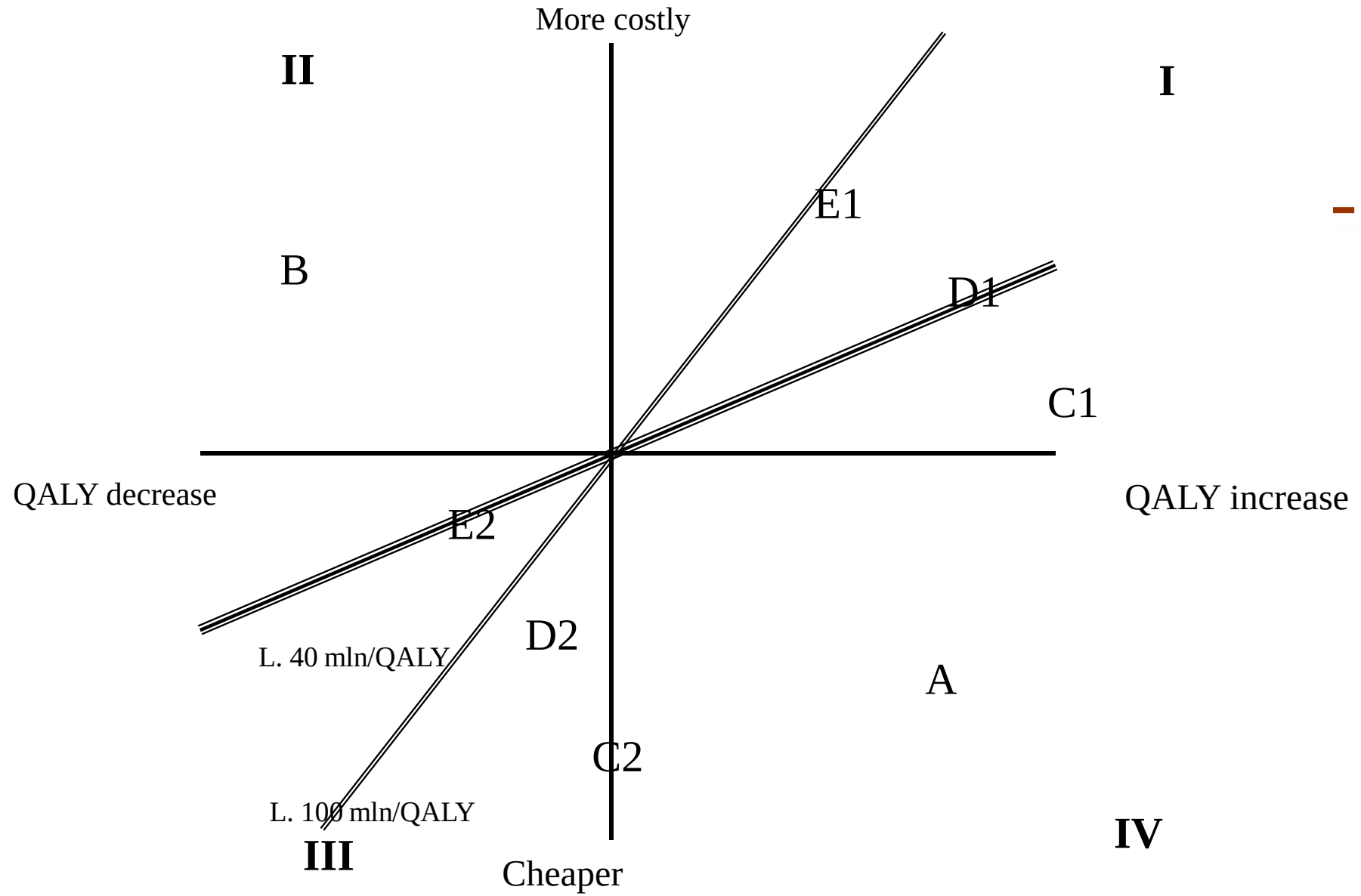


The cost of the two competing treatmens are 3000 and 10000

Incremental cost: 10000-3000=7000

Incremental effectivenss: 0.35 QALYs (0.75 – 0.4).

The cost effectiveness of the new treament is 20000 (7’000 / 0.35).


More costly
II
I
E1
B
D1
C1
QALY decrease
QALY increase
E2
D2
L. 40 mln/QALY
A
C2
L. 100 mln/QALY
III
IV
Cheaper

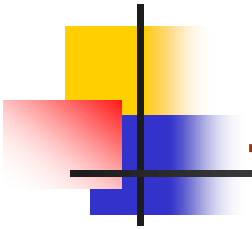
Cost-Benefit Analysis

- Simple extension of capital budgeting
- Developed to help public sector make decisions that maximize public welfare from tax spending
- Optimization in the absence of market pressure

Origin of BCA

- Born in US in the sixties for budget planning
- Used in ‘70’s and ‘80’s by the World Bank and national agencies

- Aims at identifying the best project among the alternatives, or to verify (when there is only a project) that the benefits are higher than the costs



- It uses techniques that are similar to those used in accounting to evaluate the feasibility of a project.
- The difference is represented by the objectives of the analysis, for the benefits that are considered and for the costs included

Cost and Benefit analysis

OBJECTIVE: MAX BN_0

WHERE:

$BN_0 = (B_0-C_0)$ net benefits (present value)

B_0 = social benefits (present value)

C_0 = social costs (present value)

- **Project is feasible if benefits are higher than costs**
- **Best project maximises social benefits**

Benefit-Cost Criterion

$$B/C = \sum_{t=1}^{n} \frac{B_t}{(1+r)^t} \Big/ \sum_{t=1}^{n} \frac{C_i}{(1+r)^t}$$

- If ratio is greater than one, project is acceptable

$$NB = \sum_{t=1}^{n} \frac{B_t - C_t}{(1+r)^t}$$

- If net benefit stream is positive, project is acceptable.

- Internal rate of return

$$IRR = \sum_{t=0}^{n} \frac{B_t - C_t}{(1+i^*)^t} = 0$$

Challenges of Cost-Benefit Analysis

- Valuing benefits
  - How do you place a value on a human life?
- Choosing a discount rate

The value of life

- Human capital approach
- Willingness to pay

Human capital approach

Can be valued in several ways

- Value of investment
- Value of replacement
  - Medical expenses
  - Defensive costs

Some examples

- Value of a life saved= 1,4 milion dollars. This is the implicit value for doing some specific road maintenance interventions in Sweden.

- Salary differentials for jobs with different professional risks: value obtained is 3/7 milioni di dollari.

Willingness to pay

- Can we value life through how much individuals are open to pay to save a life
- No as a general question
- Yes at the margin

Willingness to pay

When applied to health depends on

- wealth
- life expectancy
- current health status
- possibility of substituting current consumption x future consumption

Measuring willingness to pay

- Expected utility
- Revealed preferences
- Contingent evaluation
- Conjoint analysis
- Defensive expenses

- CVM involves directly asking people, in a survey, how much they would be WTP for health related issues
- In some cases, people are asked for the amount of compensation they would be WTA to give up the same good
- It is called "contingent" valuation, because people are asked to state their WTP or WTA, *contingent* on a specific hypothetical scenario.

CVM- Application

- Applying the contingent valuation method is generally a complicated, lengthy, and expensive process.
- In order to collect useful data and provide meaningful results, the contingent valuation survey must be properly designed, pre-tested, and implemented.

CVM- Application

- The results of CV surveys are often highly sensitive to what people believe they are being asked to value, as well as the context that is described in the survey.
- Thus, it is essential for CV researchers to clearly define the services and the context, and to demonstrate that respondents are actually stating their values for these services when they answer the valuation questions.

CVM-Example

- Exxon Valdez oil spill (1989) is caused by the oil tanker running into the rocks releasing 11 million gallons of crude oil

- Largest oil spill in US waters resulted in environmental damage of unprecedented proportions

CVM-Example I

- CVM and non-use (passive use) values entered the dictionary of economics, law and public policy
- US court decided that damage claim for environmental losses should also include passive use values
- Most of the damages from the spill was passive use since active use of the area was modest
- State of Alaska sued Exxon for natural resource damage for lost passive use value

CVM-Example I

- The only environmental valuation method that can estimate passive use values is CVM
- A CV study was carried out to estimate the loss of passive use value from Exxon Valdez spill
- Respondents were asked their WTP to prevent a future accident that would cause an equivalent damage in the same area
- 1472 respondents randomly sampled from the US population took part in the CV survey

CVM-Example I

- Median WTP was found to be $27-46 and mean $67-220
- WTP increases with the respondents' income, likelihood of visit to Alaska, environmentalism, attitude for conservation of wilderness, perception of importance of the accident
- Total passive use values amount to $2.81-9.33 billion

Conjoint analysis

- A quantitative analysis used to estimate customers' value systems
- Requires that a product be broken down into a set of attributes
- Value system: how much value a consumer puts on each level of each of the attributes

	Advantages	Disadvantages
“Implicit” or “Revealed” preference	Real preferences	Difficult to isolate value of benefit confounders
“Contingent” or “Survey” valuation	Direct valuation of benefit of good	Hypothetical market “Survey problems”

C/E vs willingness to pay

	COSTI	***BENEFICI***		
		Persone salvate	Wtp individuale	Wtp totale
Progetti alternativi				
A	1miliardo	2.000(2‰)	500mila	1miliardo
B	600milioni	1.000(1‰)	800mila	800milioni

Let us now assume that we have 3 billion to spend. Which project should we implement?

Solution

Progetti alternativi		COSTO TOTALE	PERSONE SALVATE	WTP TOTALE	RAPPORTO B/C	COSTO PER PERS. SALVATA
TIPO	N.					
A	3	3miliardi	6.000	3miliardi	1,00	500.000
B	5	3miliardi	5.000	4miliardi	1,33	600.000

Discounting utility

- Effects of discounting: future values (costs or benefits) have a lower present value
- Very important when benefits and costs have a different time sequence.
- Prevention is a very good example

Some numbers

If we adopt i=5% this means that we are indfferent between saving one life today, 7 in 40 years time and 1 billion in 500 years time

Most of the mainstream literature adopts 3-5% discount for life these days

Discounting utility

- Should utility deriving from health care being discounted?
- Time preferences vs intergernational equity

Measuring Costs

- Direct – associated with use of resources
  - Medical
  - Non-medical
- Indirect – related to lost productivity
  - Medical
  - Non-medical
- Intangible – associated with pain and suffering, grief, anxiety, and disfigurement

Which cost?

- Price and opportunity cost
- Costs or price
- Average or marginal cost?

Repeated tests	People found ill	Total cost ($US)	Average cost ($US)
1	65,946	77.511	1.175
2	71,442	107.690	1.507
3	71,900	130.199	1.811
4	71,938	148.116	2.059
5	71,941	163.141	2.268
6	71,942	176.331	2.451

	People found ill with new round	Total incremental cost ($US)	Marginal cost ($US)
1	65,946	77.511	1.175
2	5,496	30.179	5.491
3	0,458	22.509	49.146
4	0,038	17.917	471.500
5	0,00372	15.025	4.038.978
6	0,00028	13.190	47.107.143

Sensitivity analysis

- Some of the parameters of the analysis needs to be estimated and sometimes the average expected value is used
- Discounting
- Uncertainty
- To show how the results are robust to changes in the parameters a sensitivity analysis can be performed

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The key parameters of the analysis are changed according to specific rules and the analysis is performed again

In this way we can test how sensitive are the results to a change in the scenario and the data

Key instruments in sensitivity analysis

- Simple analysis
- Analysis of the extremes
- Threshold analysis
- Probabilistic analysis

META ANALYSIS

A **meta-analysis** combines the results of several studies that address a set of related research hypotheses in order to determine whether a specific treatment/guideline is effective or not

Meta-analyses are often, but not always, important components of a *systematic review* procedure.