

**POPLHLTH 720**  
**Cost Effectiveness Evaluation**

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Economics

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**What is Economic Evaluation?**

- A type of outcome evaluation
- Definition  
The *comparative* analysis of alternative courses of action in terms of both costs and effects
- Purpose  
To evaluate the relative *efficiency* of alternative courses of action.
- Process  
Identify, measure, value and compare costs and effects of the alternatives being considered.

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**Role of economic evaluation**

Question	Type of study
1. Can it work? (Efficacy)	1. Clinical trial
2. Does it work? (Effectiveness)	2. Clinical trial/outcomes research
3. Does it provide value for money? (Efficiency)	3. Economic evaluation
4. Who gains and who loses? (Equity)	4. Rarely included in economic evaluations

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**Economic evaluation:**

**What it is**

- A way of thinking about and formulating problems of choice
- A systematic framework for identifying and organising the information required for decision-making
- A set of techniques for the analysis of alternatives
- An aid for decision-making

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**Economic evaluation:**

**what it is NOT**

The decision-maker!!!



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**Uses of EE**

- Guiding clinical practice
- Guiding management and purchasing decisions
- Developing clinical and public health guidelines
- Developing public policy
- Developing insurance benefit packages
- Selecting pharmaceuticals for subsidies
- Setting priorities

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**Limitations of EE**

- Requires a single unit of outcome
- Requires data, expertise, resources, commitment
- Rarely incorporates distributional considerations
- Not as objective as it first appears
- Usually compares interventions within (not across) broad service categories

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**EE is most useful when**

- Options are significantly different
- There is evidence of effectiveness
- There are large resource implications

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**EE is least useful when**

- Over-riding political/cultural/environmental values:  
eg. commitments under Treaty of Waitangi  
ethical considerations
- Evidence of effectiveness is weak
- Democratic processes undermined
- Costs of evaluating greater than the benefits!

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## Efficiency

- **Technical efficiency**  
= inputs are minimised for any given level of output  
or producing maximum possible output with any given level of resources
- **Productive efficiency (or cost-effectiveness)**  
= costs are minimised for any given level of output  
or producing maximum possible output for any given cost
- **Operational efficiency**  
Combines technical and productive efficiency  
= both inputs and costs are minimised for any given level of output
- **Allocative efficiency**  
= producing the preferred mix of goods and services

NB: Note that text book uses the term "technical efficiency" when inputs *and* costs are minimised.

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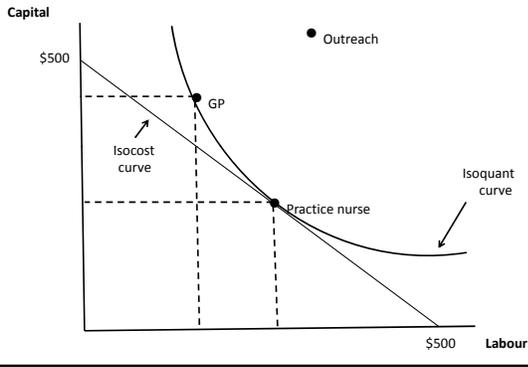
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## Operational efficiency: immunisation



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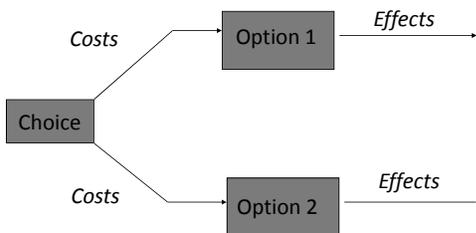
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## Analyses are *comparative*



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**EE requires:**

1. Some evidence of effectiveness
2. A choice between two or more alternatives  
NB: One alternative may be the status quo
3. Both costs and effects (benefits) are examined

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**Applications of economic evaluation**

- Methods of treatment
- Prevention strategies
- Screening programmes
- Diagnostic techniques
- Methods of health service organisation
- Locations of care
- Frequency of intervention

Examples of each? What is Option A and what might be your alternatives (B, C, Etc)

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**Types of economic evaluation**

Type of analysis	Measure of effect	Asks:
Cost-minimisation	None: assumed or proven equal	What is the least cost means of achieving a given benefit?
Cost-benefit	\$\$	Are benefits greater than costs?
Cost-effectiveness	Common unit	What is the cost per unit of benefit?
Cost-consequences	Variety of different natural units	What is the cost per unit of benefit?
Cost-utility	Quality-Adjusted-Life-Years (QALYs)	What is the cost per QALY?

What type of efficiency does each type of analysis address?

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**What do we mean by 'costs'?**

- Cost of resources:
  - Hospital treatments
  - Plasters
  - Taxi trips
  - Time spent giving care
  - Etc.
- Expenditure
  - = Resource inputs x Prices
- Price
  - Market price
    - = Cost of item (including distribution) + profits

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**Measures of 'benefit' in CMA, CEA, and CCA**

- Health outcomes
  - Mortality
    - Deaths avoided
    - Life years gained
  - Clinical measures
    - Cases avoided
    - Disease specific scales (eg. Beck Hopelessness Scale,)
    - Time to full recovery
    - Probability of recurrence
    - etc. etc.
- Intermediate indicators (how predictive is the indicator?)
  - Risk factors (serum cholesterol level, BMI, blood pressure, etc)
  - Number of cases detected
  - Immunisation rate
  - Side effects
- Personal measures
  - Satisfaction, comfort, etc.

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**What do we mean by 'Benefits'?**

- Cost benefit
  - Outcomes measured in monetary terms
  - Willingness to pay
- Cost utility
  - Preference-based health measures of 'utility'
  - EQ-5D, Health Utilities Index
  - QALY = utility value x time

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### Can General Health Profiles be used?

Eg. SF36, Nottingham Health Profile

- General rule: too many dimensions to use as comparisons of outcomes
- Some mapping to preference measures of outcome now being attempted
  - Map SF-36 to EQ-5D (John Brazier et al.)

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### Specialised stroke unit



1. What sort of alternatives might be considered?
2. What resources are used in this service?
3. What measures of effect or outcome?

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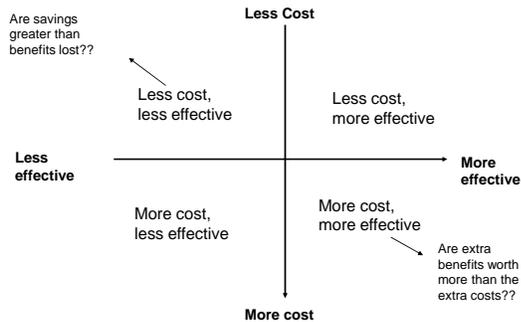
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### Economic quadrants



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**An option is cost-effective when**

- (a) less costly and more effective
- (b) less costly and equally effective
- (c) same cost and more effective
- (d) more costly and more effective and extra benefits worth more than extra costs
- (e) less costly and less effective and savings greater than value of lost benefits

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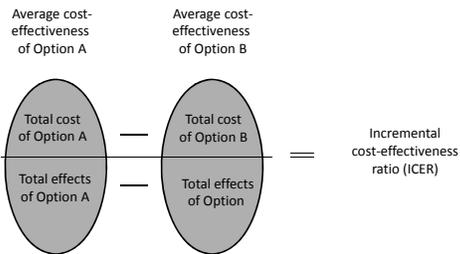
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**Relative efficiency measured by incremental cost-effectiveness**




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**Undertaking an Economic Evaluation**

1. Specify the study question and perspective
2. Identify and select alternatives
3. Assess costs and benefits
  - (i) identify
  - (ii) measure
  - (iii) value (for benefits, only in a CBA)
4. Adjust for
  - (a) timing (discounting)
  - (b) uncertainty (sensitivity analysis)
5. Analyse results and report

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### Whose perspective?

- An organisation (eg. a DHB or PHO)
- The government
- Health care system
  - Includes government and patient costs
- Societal perspective
  - Includes all health care resources + costs to other organisations + lost production + damage to property + etc. etc.

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### The perspective

The graph illustrates the expansion of perspective. The vertical axis (y-axis) is labeled 'Costs' and includes levels: 'The provider Eg. DHB, ACC', 'The payer Eg. Govt, insurer', 'Patient and family', and 'Society'. The horizontal axis (x-axis) is labeled 'Consequences' and includes levels: 'Health effects on patients', 'Health effects on carers', 'Health effects on everyone', and 'All effects'. A dashed arrow points from the origin towards the top-right corner, labeled 'Broadening the perspective'.

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### Economic evaluation of hospital care versus hospital-at-home

**Objective:** To compare:  
(a) Usual hospital care  
(b) Early discharge + intensive home management by Quick Response Team (QRT)

**Perspective:** Health care system + patient and family

Harris, Ashton, et al. The effectiveness, acceptability and costs of a hospital-at-home service compared with acute hospital care. Journal of Health Services Research and Policy, 2005.

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### Method

- Quick response team of
  - 4 - 6 registered staff nurses, medical registrar, social worker, home support workers, other health professionals as required
  - Provided intensive home support and rehab, inc up to 10 hrs nursing, 7 days per week
- 285 patients randomised to receive either standard hospital care or hospital-at-home care
- Patients assessments at 10 days, 30 days and 90 days

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### Identify, measure and value costs

- Hospital costs
  - individual treatments
  - per day hospital costs
  - overheads
- QRT
- Community services
  - GPs, meals-on-wheels, community health services, home help services, etc
  - includes patient costs

	QRT	Normal care
Hospital care	\$\$	\$\$
QRT	\$\$	\$0
Community services	\$\$	\$\$
<b>Total</b> - per patient - per patient day	\$\$	\$\$

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### Identify and measure benefits

- Measures of patient health
  - SF36
  - cognitive function
  - daily activities, etc. etc
- Patient satisfaction
- Carer's satisfaction
- GP satisfaction

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### Results

**Effectiveness:**

- No significant difference in almost all of the measures of health outcome
- Scores for patient satisfaction, relative satisfaction and carer strain index generally favoured QRT.

**Average episode**

**costs:**

**Hospital care = \$3,498**

**Hospital-at-home = \$6,904!!**

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### Adjust for timing and uncertainty

- No adjustment for timing as all costs and benefits fell within one year time period
- Sensitivity analyses of
  - Increases in patient from 150 per year to
    - 280 per year (3 months post-trial)
    - 400 per year (full capacity)
  - No sensitivity of costs or outcomes as these were actual costs and outcomes, not estimated

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### Question for decision-makers

Is the incremental benefit worth the incremental cost?

Incremental benefit =  
Extra satisfaction of patients, relatives and carers

Incremental cost = Cost (A) – Cost (B)  
= \$6904 - \$3498  
= \$3406

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**Why was the hospital-at-home so costly?**

- New service
  - operating below full capacity
  - conservative approach
- Very comprehensive service inc. 24 hr cared if needed
- Some patients had high readmission rates – inappropriate placement??

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**Study conclusion**

- Hospital-at-home services can be safe and effective BUT...
- Can be very costly for highly dependent patients
- Extra benefit not worth the extra cost
- Further work required to examine how costs of these services can be reduced without undermining safety and acceptability

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**Strengths of the study**

- Key outcomes measures were final measures of health gain (activities of daily living)
- Patient-level (micro) costing

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### Weaknesses

- Study undertaken when service not operating at full capacity
- Research may have affected outcomes (eg. higher readmission rates)
- Short follow-up time
- Did not adjust for skewed cost data
- Only one-way sensitivity analyses undertaken

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### An Economic Evaluation of Universal Newborn Hearing Screening (UNHS) in New Zealand

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**Background – PCHI in New Zealand**

- Estimated prevalence = **3/1000 births**
- 56,000 births pa in NZ = **168 infants w PCHI**
- Age **6 months** = key milestone for intervention
- In New Zealand, approx **10** infants born with PCHI are diagnosed by the age of 6 months (5.8% of 168)

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**Purpose**

- **POLICY** – to investigate the cost effectiveness of several screening programme options for national implementation in New Zealand
- **ECONOMIC** – to determine the cost effectiveness of a truly universal screening programme including hospital and community-based initiatives

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**Methods**

- Decision tree
- Probabilities: (New Zealand Data Sources)
- Perspective: Government/Societal
- Outcomes: # early detections
- Costs: National, Screening, Diagnostic, Lifetime

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**Probabilities**

- Primary Sources of data (New Zealand)
  - National Minimum Data Set (hospital discharge)
  - Deafness Notification Database
  - Waikato Screening Programme data
- Subset of the NSU's Advisory Group
- Existing literature

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**Outcomes**

- Number of diagnoses by the age of 6 months (early detections)

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**Cost Categories**

1. National programme management
2. Screening unit costs
3. Diagnostic costs
4. Costs associated with early and late detection

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### Costs – National Oversight

- Staff Costs
- Advisory Groups
- Monitoring and Evaluation Costs
- Research Programme Costs
- Health Promotion and Education Campaign
- National Data System

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### Costs – Screening Unit

- Approach:
  - Each screening unit assumed to cover a hospital area
  - Important factor: Staffing to ensure proper coverage in hospital
  - Result: Each screening unit does not operate at capacity, but this is required to ensure coverage
- Costs associated with each screening unit
  - Screening equipment and consumables
  - Computers and printers
  - Technician time
  - Programme coordination
  - Oversight by an Audiologist
  - Transportation (community prog only)

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### Determining Screening Prog Costs

	WAIKATO births 4,800	NATIONAL births 56,000	New Zealand
Waikato Region			
1 Secondary & Tertiary Hospitals (54%)			24 Secondary & Tertiary Hospitals (73%)
11 Primary Hospitals & Birth Centres (32%)			65 Primary Hospitals & Birth Centres (13%)
No Hospital (14%)			No Hospital (14%)
<b>Total Resources Required</b>	<b>3,19</b>	<b>77</b>	
Screening Techs	0.4	9.8	
Prog Costs	0.5	12	
Audiologist	1	24	
DME machines	1	24	
SABR machines	3	72	
Combo machines	4	96	
computers	4	96	
printers	4	96	
bills	4	96	

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### Diagnostic Costs

- Estimated at \$300 per 1.5 hour session
- Diagnostic Equipment includes
  - Diagnostic ABR machine, Diagnostic OAE
  - Audiometer, Tympanometer
  - Soundproof room (and calibration)
  - Loudspeakers and amplifier
  - Toys

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### Costs – Early & Late Detection

\$1.8 million (NZ) per late detection of severe or profound hearing loss which includes:

- Lost productivity
- Special education
- Vocational rehabilitation
- Assistive devices
- Medical costs

Mohr et al (2000) The societal costs of severe to profound hearing loss in the United States. *International Journal of Technology Assessment in Health Care*, 16:4, 1120-1135.

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### Current Methods of Detection

- High-risk or Risk Factor Referrals
  - 10-15 % of all births should be referred (**8400**)
  - 5-7.5% are actually referred (**4200**)
  - 5.8% of all infants with PCHI are diagnosed by 6 months of age (**9.7 of 168 detected early**)
- School entry mandatory testing (Age 5)

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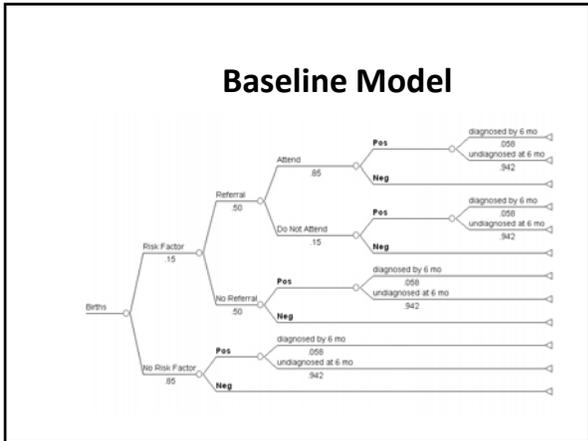
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### Other Strategies

1. NICU infants only
2. Secondary & Tertiary Hospitals Only  
(NICU and well infants)
3. Universal Screening (hospital & community)
  - a) OAE + aABR protocol in the hospital
  - b) aABR + aABR protocol in the hospital
  - c) OAE/aABR + OAE/aABR protocol in hospital

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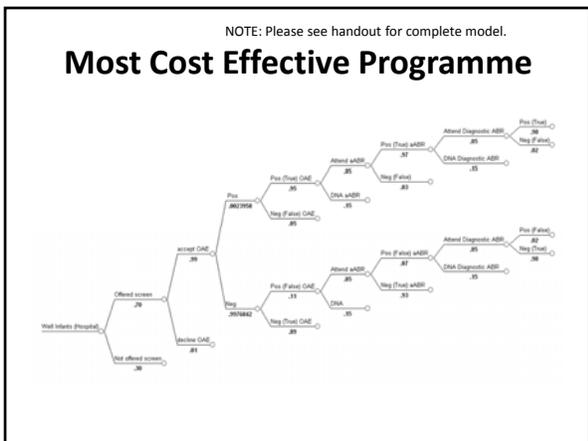
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## Results

Option	Late Diag	Early Diag	Total Prog Cost	(Prog) Cost per Early Diagnosis	Total Lifetime Costs	Lifetime Cost Savings
High-Risk Referral (current)	158	10	\$ 1.26 mil	\$126,000	\$ 165 mil	
Well (OAE+aABR) + NICU + Community	85	83	\$ 5.75 mil	\$ 69,277	\$ 137 mil	<b>\$ 28 mil</b>

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## Sensitivity Analysis

- Factors varied:
  - # infants offered a screen (hospital)
  - # infants contacted for a screen (community)
  - Lifetime costs associated with early and late detection
  - Overhead rate
  - Cost of diagnostic assessment
  - Sensitivity/Specificity of Screening Tests
- Result: No difference...clearly cost effective

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## Discussion

- Introduction of universal screening programme would be cost effective
- Consistent with previous results, but current study:
  - Tailored to the NZ health care system
  - Truly universal programme – reaching the community and hospital
  - Includes national monitoring and oversight costs
- Additional research:
  - Model can be used to test other screening scenarios
  - Relies on Cost of Illness studies...could be better
  - Implications of early and late detection
    - Little information on long term changes in quality of life
    - Requires more global measure of quality of life

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### **RCTs v. modelling**

- Comparisons can be undertaken by:
  - (a) Undertaking an economic evaluation alongside a randomised controlled trial

OR

- (b) Developing a model based upon existing evidence and literature

OR

- (c) Extending results of an RCT via a model (eg. Over longer time period or to wider populations)

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### **Background**

- Economic evaluations need to be based on good quality clinical evidence
- Economic evidence is required early in life cycle of new interventions
- Clinical trials provide a useful vehicle for collecting economic as well as clinical data

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### **Advantages of RCTs**

- Use of individual patient data
- Costings are population, country and time specific
- Randomisation means differences in costs can be linked to different interventions

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### Disadvantages of RCTs

- Results based on single study
- Sample size almost always based on benefits, not costs
- Alternative sometimes inappropriate (eg placebo rather than current practice)
- Problem of exclusions
- Trial setting is study specific (eg. One country, one location, highly motivated investigators, etc)
- Limited time period – economic consequences are often long term
- Some costs may be research-related (eg. extra visits to monitor patient)

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You have been asked by the Ministry of Health to undertake an economic evaluation of offering vaccinations for H1N1 flu to all front line health workers, How would you go about doing this?

- What question are you trying to answer in this study?
- Whose perspective?
- What comparator(s)?
- What costs to include?
- What outcomes would you use?

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### Cost of Illness (COI) studies

- Aim is to measure economic burden of disease
- No comparison group
- Not an 'evaluation'
- Does not provide information about
  - which costs are avoidable
  - costs of prevention
  - possible benefits (eg. of alcohol)

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**Types of study**  
eg Cost of alcohol-related illness

- **Prevalence or incidence?**
  - *Prevalence*: Snap-shot of alcohol-related costs in one year including costs of cases occurring in previous years but excluding future costs
  - *Incidence*: Present value of current and future costs of cases occurring in current year
- **Total or incremental?**
  - *Total*: Total cost of alcohol-related events
  - *Incremental*: Cost of events that are *attributable* to alcohol. (Attributable costs can be determined by matched controls or regression analysis)
- **Bottom-up v. Top-down?**
  - *Bottom-up*: Calculate (current and future) costs from actual events
  - *Top-down*: Estimate costs based on % of total expenditure
- **Prospective v. Retrospective?**
  - *Prospective*: Follow patients up over time
  - *Retrospective*: Use existing data

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**Uses of COI studies**

- **Prevalence studies**
  - Draw attention to problem
  - Plan cost containment policies
- **Incidence studies**
  - Consider options for reducing costs through prevention
  - Consider how disease can be managed over time
- **If a study**
  - (a) Is an incidence study, AND
  - (b) Is incremental (measures only attributable costs) AND
  - (c) Considers the extent to which costs are preventable, THEN
  - ....it may be a useful first step towards a full economic evaluation of a prevention measure.

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**Exercise**

You have been asked to undertake a study of the cost of obesity. How would you go about doing this?

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