How to include health technology assessment and economic evaluation in your research proposal

Prof Rachel Elliott, Professor of Health Economics, Manchester Centre for Health Economics, School of Health Sciences, University of Manchester
Outline of session

• The state of play in economic evaluations of pharmacy/pharmacist-led services
• What does an economic evaluation look like?
• Basic questions you need to ask and answer
• The structure of your economic evaluation
• Data needs for an economic evaluation
• Interpreting economic evaluation for decision-making
• Sum up and some tips
• Useful resources
The state of play in economic evaluations of pharmacy services
Economic evaluations in pharmacy: why are they being carried out?

- Nos. & complexity of medicines & regimens, EBM, quality linked incentives, blurring of professional boundaries, multidisciplinary nature of healthcare
- Changing safety & patient-centred culture
- Financial constraints on medicines spending
- Pressures on services to show they are cost effective

⇒ Interest in the cost-effectiveness of pharmacy services

- Is a pharmacist/pharmacy-led service cost effective in no, some or all cases?
- Are the studies good enough to be used for decision making about service provision?
Economic evaluations in pharmacy: the evidence base

♦ Some very good recent reviews of the evidence:


• Perraudin C, Bugnon O, Pelletier-Fleury N. Expanding professional pharmacy services in European community setting: Is it cost-effective? A systematic review for health policy considerations. Health Policy. 120(12):1350-62.

Economic evaluations in pharmacy: a methodological critique

- Critique of 31 full economic evaluations of pharmacist-led interventions (published 2003-2013)
- Many challenges
  - Poorly designed RCTs or comparative studies in general
  - General methodological challenges common to all economic evaluations
  - General methodological challenges common to all economic evaluations of person-led interventions rather than drug A vs drug B
  - Specific methodological challenges: particular issues with pharmacy interventions

General methodological challenges common to all economic evaluations

- Underpowered or poorly designed RCT or comparative study
- ITT not used, Complete case analysis, loss to follow-up.
- Suite of outcomes rather than one overall outcome with no assessment of relative importance of specific outcomes
  - e.g. increased adherence vs reduced prescribing errors
- Follow-up long enough to measure effect is not common

- Incorrect handling of cost data
  - perspective, incorrect reporting or combining of costs, partial reporting, not dealing with skewness of cost data, estimation of indirect cost

- No ICER, not probabilistic, no CEACs, little sensitivity analysis
Methodological challenges common to all economic evaluations of person-led services

- Cant always do an RCT, so may do before and after non-random allocation of intervention sites.

- What is the comparator?

- Evidence-based intervention?

- Contamination between intervention and control arms

- Intervention delivered by researchers

- Ethical issues around the current practice arm
Specific methodological challenges for pharmacy interventions

- System-level versus individual level roles
- Interventions across multiple therapeutic areas
- Small effect on a lot of people
- “early warning system” nature of some of the interventions: pick up problems more often so may lead to an increase in costs & admissions

- Most evaluations designed to see if pharmacists \( \downarrow \) costs, rather than look more widely at other effects

- What is the actual input from the pharmacist?
- Variable delivery of intervention
- Reluctance to deliver service/barriers from other professions/systems
What does an economic evaluation look like?
How health economists view health care

INPUTS

Resources:
- Staff
- Equipment
- Drugs

Process of health care

OUTPUTS

Options:
1) Intervention A
2) Intervention B

Effectiveness
- Quality adjusted life years
- “Willingness to pay”

How health economists choose between different health care interventions

Incremental cost/effectiveness ratio (ICER)

\[
ICER = \frac{\text{Costs}_{\text{Treatment A}} - \text{Costs}_{\text{Treatment B}}}{\text{QALYs}_{\text{Treatment A}} - \text{QALYs}_{\text{Treatment B}}}
\]
Basic questions that need to be answered
Basic questions you need to ask

- What is the intervention?
- What is the comparator?
- Who is your population?
- What are you trying to achieve with this intervention in these people?
- What sort of comparative study can you do?
- What is/are your primary outcome(s)?
- Who will be paying for the intervention/service?
Some possible economic evaluations

Possible services to evaluate at HSRPP:

- diagnosis and management of dermatitis and acne by community pharmacists
- providing pharmaceutical care for older people with sensory impairment on polypharmacy
- smartphone application for optimising opioid utilisation in patients with persistent pain
- polypharmacy medication review service conducted by pharmacists in GP practices
- home-based medicines reviews for elderly patients no longer able to self manage their medicines
- Medicines Reconciliation (MR) by a highly specialist pharmacist within 4 hours of patient attendance to the Emergency Department (ED)
- Scottish Adherence to Antihypertensive Medication in the Elderly (SAAME)
- Community pharmacy services for patients with cancer pain
- a theory-based intervention to improve appropriate polypharmacy for older people in primary care
A reduced selection......

♦ Possible services to evaluate at HSRPP:
  ♦ diagnosis and management of dermatitis and acne by community pharmacists
  ♦
  ♦
  ♦
  ♦
  ♦
  ♦
  ♦
  ♦
  ♦
  ♦
  ♦
  ♦
  ♦
  ♦
  ♦
  ♦ Scottish Adherence to Antihypertensive Medication in the Elderly (SAAME)
  ♦ Community pharmacy services for patients with cancer pain
  ♦
  ♦
  ♦ OR PICK ANOTHER ONE THAT IS RELEVANT TO YOU OR YOUR GROUP
The structure of your economic evaluation
Types of economic evaluation design

Either: Primary economic evaluation eg data from a randomised controlled trial (RCT) or other comparative trial. (ie do it yourself)

or Secondary economic evaluation (economic & clinical data from many sources, combined)

Economic & clinical information preferably from RCTs or good observational studies

Modelling approaches:
- Decision analytic model
- Markov model
- Individual patient simulation (discrete event simulation):

Structure of an economic evaluation
Is NMS effective? Randomised controlled trial

- 504 participants from 47 pharmacies (East Midlands, South Yorkshire, London) randomised to NMS or current practice.

- **Main outcomes**: Adherence to new medicine 10 weeks post-recruitment.
- The NMS question: ‘Since we last spoke have you missed any doses of your new medicine, or change when you take it (prompt: when did you last miss a dose)(predicate)?

- **Follow up**: At 10 weeks 85% patients contacted by telephone (n=443), 52 patients withdrawn from study.

- **Adherence (NMS question)**: OR (95% CI) 1.64 (1.08, 2.50, p=0.02), p [adherence] CP: **0.67** (0.60, 0.74) vs. p [adherence] NMS: **0.78** (0.72, 0.84)

(Analysis: ITT, outcome adjusted for pharmacy clustering, NMS disease category, age, sex and medication count, multiple imputation for missing data)
Is NMS cost-effective?

• At 10 week follow-up: Mean (median, range) total NHS cost for patients in normal practice and NMS are £261 (£121, £0-1669), and £239 (£135, £25-1483), respectively (p= 0.1281).

• Economic models can tell you the long term health consequences and costs incurred by diseases and treatments.
• Need to understand (and therefore need data on):
  • Disease and treatment pathways
  • Probability of moving from one disease state to another, and the effect of treatment on that
  • The quality of life of a person in each disease state
  • The costs of treating the person in each disease state
• Economic models are disease-specific
• Safety and adherence interventions are often cross-therapeutic
  • Use of errors and adherence as proxy outcomes
  • OR.............
Structure of an economic evaluation

Markov model*

State 1

State 2

Death

New Medicines Service

usual practice

patient starting new medicine

adherent to medicine

adverse clinical event

no adverse clinical event

nonadherent to medicine

adverse clinical event

no adverse clinical event

Probability and resource use data from trial

Probability, resource use and utility data from published sources

*number and type of health states will depend on the disease/drug group
Chronic obstructive airways disease model
Simple Markov model for metastatic prostate cancer

- **Stable disease**: lack of disease progression
- **Progressed disease**: radiographic progression

Model cycle length 1 month
Lifetime horizon (model run until 99% patients in death state)
Transition probabilities for Markov model

<table>
<thead>
<tr>
<th>Comparator</th>
<th>Stable</th>
<th>Progressed</th>
<th>Death</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Abiraterone</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stable</td>
<td>0.940</td>
<td>0.041</td>
<td>0.019</td>
</tr>
<tr>
<td>Progressed</td>
<td>0.000</td>
<td>0.966</td>
<td>0.034</td>
</tr>
<tr>
<td>Death</td>
<td>0.000</td>
<td>0.000</td>
<td>1.000</td>
</tr>
<tr>
<td><strong>Prednisone</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stable</td>
<td>0.895</td>
<td>0.080</td>
<td>0.025</td>
</tr>
<tr>
<td>Progressed</td>
<td>0.000</td>
<td>0.964</td>
<td>0.036</td>
</tr>
<tr>
<td>Death</td>
<td>0.000</td>
<td>0.000</td>
<td>1.000</td>
</tr>
<tr>
<td><strong>Sipuleucel-T</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stable</td>
<td>0.803</td>
<td>0.171</td>
<td>0.027</td>
</tr>
<tr>
<td>Progressed</td>
<td>0.000</td>
<td>0.969</td>
<td>0.031</td>
</tr>
<tr>
<td>Death</td>
<td>0.000</td>
<td>0.000</td>
<td>1.000</td>
</tr>
</tbody>
</table>
Transitioning through Markov model

How many patients will be in each state by the end of Cycle 2 if we model a hypothetical cohort of 1000 patients?

<table>
<thead>
<tr>
<th>Comparator</th>
<th>Cycle 0</th>
<th>Cycle 1</th>
<th>Cycle 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abiraterone</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Progressed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Death</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prednisone</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Progressed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Death</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sipuleucel-T</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Progressed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Death</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
How many patients will be in each state by the end of Cycle 2 if we model a hypothetical cohort of 1000 patients?

<table>
<thead>
<tr>
<th>Comparator</th>
<th>Cycle 0</th>
<th>Cycle 1</th>
<th>Cycle 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abiraterone</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stable</td>
<td>1000</td>
<td>940</td>
<td>884</td>
</tr>
<tr>
<td>Progressed</td>
<td>0</td>
<td>41</td>
<td>78</td>
</tr>
<tr>
<td>Death</td>
<td>0</td>
<td>19</td>
<td>38</td>
</tr>
<tr>
<td>Prednisone</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stable</td>
<td>1000</td>
<td>895</td>
<td>801</td>
</tr>
<tr>
<td>Progressed</td>
<td>0</td>
<td>80</td>
<td>149</td>
</tr>
<tr>
<td>Death</td>
<td>0</td>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>Sipuleucel-T</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stable</td>
<td>1000</td>
<td>803</td>
<td>645</td>
</tr>
<tr>
<td>Progressed</td>
<td>0</td>
<td>171</td>
<td>303</td>
</tr>
<tr>
<td>Death</td>
<td>0</td>
<td>27</td>
<td>54</td>
</tr>
</tbody>
</table>
Simple Markov model with utility and cost data

- **Stable disease:**
  - Utility: $U = 0.76$
  - Cost: £7000

- **Progressed disease**
  - Utility: $U = A/S: 0.65$
  - Probability: $P: 0.58$
  - Cost: £6000

- **Death**
  - Utility: $U = 0.00$
  - Cost: £0
Utilities for Markov model

How many QALYs will each comparator have generated by the end of Cycle 2 if we model a hypothetical cohort of 1000 patients?

<table>
<thead>
<tr>
<th>Comparator</th>
<th>Cycle 0</th>
<th>Cycle 1</th>
<th>Cycle 2</th>
<th>Total QALYs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abiraterone</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stable</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Progressed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Death</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prednisone</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stable</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Progressed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Death</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sipuleucel-T</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stable</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Progressed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Death</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Utilities for Markov model: answers

How many QALYs will each comparator have generated by the end of Cycle 2 if we model a hypothetical cohort of 1000 patients?

<table>
<thead>
<tr>
<th>Comparator</th>
<th>Cycle 0</th>
<th>Cycle 1</th>
<th>Cycle 2</th>
<th>Total QALYs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Abiraterone</strong></td>
<td></td>
<td></td>
<td></td>
<td>185</td>
</tr>
<tr>
<td>Stable</td>
<td>63</td>
<td>60</td>
<td>56</td>
<td></td>
</tr>
<tr>
<td>Progressed</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Death</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td><strong>Prednisone</strong></td>
<td></td>
<td></td>
<td></td>
<td>182</td>
</tr>
<tr>
<td>Stable</td>
<td>63</td>
<td>57</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>Progressed</td>
<td>0</td>
<td>4</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Death</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td><strong>Sipuleucel-T</strong></td>
<td></td>
<td></td>
<td></td>
<td>181</td>
</tr>
<tr>
<td>Stable</td>
<td>63</td>
<td>51</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>Progressed</td>
<td>0</td>
<td>9</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Death</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>
Data needs for economic evaluation
Measuring patient outcomes

♦ Clinical outcomes: outcome of an intervention or service measured in natural units
  ♦ Clinical indicators (mortality, mmHg, cholesterol, cases detected)

♦ Quality of life: impact on one or more domains of quality of life
  ♦ Disease specific (AIMS)
  ♦ Generic (HAQ)

♦ Utility: value attached by an individual for a specific level of health status or a specific health outcome
  ♦ EQ-5D-3L, EQ-5D-5L

♦ Willingness-to-pay
Pharmacist effect on costs & outcomes: what to measure in an economic evaluation

Quality of life and utility

Generic measures
• useful when looking at groups of patients who may have different illnesses
• can be used to compare outcomes in different patient groups.

EQ-5D-3L
http://www.euroqol.org/fileadmin/user_upload/Documenten/PDF/Products/Sample_UK__English__EQ-5D-3L_Paper_Self_complete_v1.0__ID_23963_.pdf

EQ-5D-5L
http://www.euroqol.org/fileadmin/user_upload/Documenten/PDF/Products/Sample_UK__English__EQ-5D-5L_Paper_Self_complete_v1.0__ID_24700_.pdf
How do you use EQ-5D-3L to derive a utility value?

**EQ-5D-3L (Health status)**

**Scoring:**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Tariff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobility</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Self-care</td>
<td></td>
<td></td>
<td></td>
<td>0.069</td>
</tr>
<tr>
<td>Activities</td>
<td></td>
<td></td>
<td></td>
<td>0.104</td>
</tr>
<tr>
<td>Pain</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anxiety</td>
<td></td>
<td></td>
<td></td>
<td>0.094</td>
</tr>
<tr>
<td>Total</td>
<td>0.662</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

By placing a tick in one box in each group below, please indicate which statements best describe your own health state today.

**Mobility**

- I have no problems in walking about
- I have some problems in walking about
- I am confined to bed

**Self-Care**

- I have no problems with self-care
- I have some problems washing or dressing myself
- I am unable to wash or dress myself

**Usual Activities**

- I have no problems with performing my usual activities
- I have some problems with performing usual activities
- I am unable to perform my usual activities

**Pain/Discomfort**

- I have no pain or discomfort
- I have moderate pain or discomfort
- I have extreme pain or discomfort

**Anxiety/Depression**

- I am anxious or depressed
- I am moderately anxious or depressed
- I am extremely anxious or depressed
## EQ-5D-5L

Under each heading, please tick the ONE box that best describes your health TODAY.

### MOBILITY
- I have no problems in walking about
- I have slight problems in walking about
- I have moderate problems in walking about
- I have severe problems in walking about
- I am unable to walk about

### SELF-CARE
- I have no problems washing or dressing myself
- I have slight problems washing or dressing myself
- I have moderate problems washing or dressing myself
- I have severe problems washing or dressing myself
- I am unable to wash or dress myself

### USUAL ACTIVITIES (e.g. work, study, housework, family or leisure activities)
- I have no problems doing my usual activities
- I have slight problems doing my usual activities
- I have moderate problems doing my usual activities
- I have severe problems doing my usual activities
- I am unable to do my usual activities

### PAIN / DISCOMFORT
- I have no pain or discomfort
- I have slight pain or discomfort
- I have moderate pain or discomfort
- I have severe pain or discomfort
- I have extreme pain or discomfort

### ANXIETY / DEPRESSION
- I am not anxious or depressed
- I am slightly anxious or depressed
- I am moderately anxious or depressed
- I am severely anxious or depressed
- I am extremely anxious or depressed
Using utility data and deriving quality-adjusted life-years (QALYs)

Fictitious example of three services to manage palliative care in cancer:

1. How many QALYs does each service generate?
2. What would individuals prefer?
3. What are the issues often raised when using QALYs?

<table>
<thead>
<tr>
<th>Service</th>
<th>Life years gained vs current practice</th>
<th>Health state utility in each year of life</th>
<th>QALYs</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.3</td>
<td>0.8</td>
<td>?</td>
</tr>
<tr>
<td>B</td>
<td>0.4</td>
<td>0.7</td>
<td>?</td>
</tr>
<tr>
<td>C</td>
<td>0.5</td>
<td>0.5</td>
<td>?</td>
</tr>
</tbody>
</table>
Types of Costs

Costs of intervention

Fixed costs
- Overheads: (running the intervention)
- Capital: (setting up intervention)

Variable costs
- Resources used treating patients: eg: drugs, disposables
Costs of providing health care: the value of perspective

- Costs to social services
- Costs to primary care
- Costs to secondary care

Hospital: operating theatre, ward, surgeon, anaesthetist, nurses, pharmacist, physiotherapist, drugs, prosthesis, X-rays etc

GP visits, drugs

Domestic help, disability allowance

hospital
health service
A taxonomy of costs

Direct cost

- Direct medical cost
  - fixed cost: Capital & overheads
  - Semi-fixed cost: Staff
  - variable cost: Drugs, blood products, disposable equipment

Indirect cost

- Society’s productivity losses due to sickness
- Patient & family out-of-pocket expenses, other parts of public sector

Total cost
Measuring resource use

- **Trial-based economic evaluations**
- Clinical trials or prospective studies important for capturing data on healthcare resource use
- Methods typically rely on:
  - Patient (or carer) recall (e.g. questionnaires, diaries or interviews)
  - Prospective forms completed by trial researchers or healthcare professional
  - Routinely available data (e.g. hospital and GP records, hospital episode statistics)
  - Expert panels

- **Model-based economic evaluations**
  - Published data
  - Expert panels
Unit costs

Try to use publicly available unit costs such as:


DIRUM

Database of Instruments for Resource Use Measurement

http://www.dirum.org
Interpreting economic evaluation for decision-making
Incremental Economic Analysis

Derive cost/outcome ratios for intervention, compared with alternatives.

Dominant therapy or

Cost required to achieve each extra unit of outcome is calculated.

Generate incremental cost effectiveness ratios for the comparators as appropriate using the following equation:

\[
ICER = \frac{\text{Costs}_{\text{Treatment A}} - \text{Costs}_{\text{Treatment B}}}{\text{QALYs}_{\text{Treatment A}} - \text{QALYs}_{\text{Treatment B}}}
\]
Generators ICERs using QALYs

<table>
<thead>
<tr>
<th></th>
<th>New palliative care service</th>
<th>Current palliative care service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total lifetime LYG</td>
<td>2.70</td>
<td>2.28</td>
</tr>
<tr>
<td>Total lifetime QALYs</td>
<td>1.87</td>
<td>1.44</td>
</tr>
<tr>
<td>Lifetime costs</td>
<td>214,584</td>
<td>44,583</td>
</tr>
</tbody>
</table>

Generate incremental cost effectiveness ratios for the comparators as appropriate using the following equation:

\[
\text{ICER} = \frac{\text{Costs}_{\text{Treatment A}} - \text{Costs}_{\text{Treatment B}}}{\text{QALYs}_{\text{Treatment A}} - \text{QALYs}_{\text{Treatment B}}}
\]

Which service should be chosen?
Generating an incremental cost effectiveness ratio (ICER)

- NW quadrant: decreased effect, dominated
- NE quadrant: increased cost, increased effect
- SW quadrant: decreased cost, £2000
- SE quadrant: increased effect, 0.2 QALYs

- £2000
- λ
- Dominant
- λ
- NE quadrant

The University of Manchester
Importance of sensitivity analysis
Dealing with uncertainty

◆ Sensitivity analysis
  ◆ Systematically examining the influence of uncertainties in the variables and assumptions employed on the estimated results
  ◆ E.g. change in a unit cost value of 10% lead to change in result of >10% (sensitive) or <10% (insensitive)?

◆ Further SCENARIO analysis might include
  ◆ Alternative (sub)perspectives
  ◆ Use of intermediate outcome measures
  ◆ Subgroup analysis
Process of sensitivity analysis

1. Identifying the (uncertain) variables
   – All variables in the analysis are potential candidates
   – Give reasons for *exclusion* rather than *inclusion*

2. Specifying the plausible range over which they should vary
   – Reviewing the literature
   – Consulting expert opinion
   – Using a specified confidence interval around the mean

3. Recalculating results based on combinations of the best guesses, most and least conservative, usually based on...
   – One-way analysis (each variable separately)
   – Multi-way analysis (number of variables together)
   – Extreme scenario analysis (all variables in extreme combinations)
   – Threshold analysis (amount of variance needed to achieve specified result)
   – Probabilistic sensitivity analysis (PSA)
What is a bootstrapped ICER?
What is a cost-effectiveness acceptability curve and how is it derived?
How do you use a CEAC to decide if a treatment is cost-effective?
## Economic analysis results (NMS)

<table>
<thead>
<tr>
<th></th>
<th>Mean cost (95% CI), £</th>
<th>Mean QALY (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NMS</td>
<td>Current Practice</td>
<td></td>
</tr>
<tr>
<td></td>
<td>19 168 (9 822, 51 034)</td>
<td>19 358 (9 850, 51 808)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Incremental</th>
<th>ICER(£/QALY), (2.5% and 97.5% percentiles)</th>
<th>Probability of dominance</th>
</tr>
</thead>
<tbody>
<tr>
<td>cost (95% CI), £ QALY (95% CI)</td>
<td>-189.9 (929.2, 87.2) 0.06 (0.00, 0.16)</td>
<td>-3 005.2 (-17 212.5, 4 542.5)</td>
</tr>
</tbody>
</table>
Some concluding thoughts
Some concluding thoughts

♦ Do current EE frameworks allow us to capture all the benefits of pharmacists?
♦ How to capture other effects, such as raising awareness of safety, long term reductions in antibiotic resistance
♦ Willingness to pay to reduce errors that don’t reduce quality of life, valuing trust, valuing error prevention
♦ Why are some professions looked at in health economic terms and not others? How do we separate the effect of the pharmacist on the intervention?
Some tips.....

♦ Don’t fall into obvious traps....
♦ Get a health economist involved early in the design of your study
♦ Focus on quality and integration of economic evaluation into study design
♦ Copy good practice 😊 (eg DIRUM)
♦ Use standard design/reporting criteria to help design the study
CONSOLIDATED HEALTH ECONOMICS REPORTING STANDARDS - CHEERS:
GOOD REPORTING PRACTICES

A brief list of recommendations subdivided into the five sections generally found in an economic evaluation paper:

- Title and Abstract
- Introduction
- Methods
- Results
- Discussion
<table>
<thead>
<tr>
<th>Section/Item</th>
<th>Item No</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title and abstract</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Title</td>
<td>1</td>
<td>Identify the study as an economic evaluation, or use more specific terms such as &quot;cost-effectiveness analysis&quot;, and describe the interventions compared.</td>
</tr>
<tr>
<td>Abstract</td>
<td>2</td>
<td>Provide a structured summary of objectives, perspective, setting, methods (including study design and inputs), results (including base case and uncertainty analyses), and conclusions.</td>
</tr>
<tr>
<td>Introduction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Background and objectives</td>
<td>3</td>
<td>Provide an explicit statement of the broader context for the study.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Present the study question and its relevance for health policy or practice decisions.</td>
</tr>
<tr>
<td>Methods</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Target Population and Subgroups</td>
<td>4</td>
<td>Describe characteristics of the base case population and subgroups analyzed including why they were chosen.</td>
</tr>
<tr>
<td>Setting and Location</td>
<td>5</td>
<td>State relevant aspects of the system(s) in which the decision(s) need(s) to be made.</td>
</tr>
<tr>
<td>Study Perspective</td>
<td>6</td>
<td>Describe the perspective of the study and relate this to the costs being evaluated.</td>
</tr>
<tr>
<td>Comparators</td>
<td>7</td>
<td>Describe the interventions or strategies being compared and state why they were chosen.</td>
</tr>
<tr>
<td>Time Horizon</td>
<td>8</td>
<td>State the time horizon(s) over which costs and consequences are being evaluated and say why appropriate.</td>
</tr>
<tr>
<td>Section/Item</td>
<td>Item No</td>
<td>Recommendation</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>---------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Discount Rate</td>
<td>9</td>
<td>Report the choice of discount rate(s) used for costs and outcomes and say why appropriate.</td>
</tr>
<tr>
<td>Choice of Health Outcomes</td>
<td>10</td>
<td>Describe what outcomes were used as the measure(s) of benefit in the evaluation and their relevance for the type of analysis performed.</td>
</tr>
<tr>
<td>Measurement of Effectiveness</td>
<td>11a</td>
<td><strong>Single Study-Based Estimates:</strong> Describe fully the design features of the single effectiveness study and why the single study was a sufficient source of clinical effectiveness data.</td>
</tr>
<tr>
<td></td>
<td>11b</td>
<td><strong>Synthesis-based Estimates:</strong> Describe fully the methods used for identification of included studies and synthesis of clinical effectiveness data.</td>
</tr>
<tr>
<td>Measurement and Valuation of Preference-Based Outcomes</td>
<td>12</td>
<td>If applicable, describe the population and methods used to elicit preferences for outcomes.</td>
</tr>
<tr>
<td>Estimating Resources and Costs</td>
<td>13a</td>
<td><strong>Single Study-based Economic evaluation:</strong> Describe approaches used to estimate resource use associated with the alternative interventions. Describe primary or secondary research methods for valuing each resource item in terms of its unit cost. Describe any adjustments made to approximate to opportunity costs.</td>
</tr>
<tr>
<td></td>
<td>13b</td>
<td><strong>Model-based Economic Evaluation:</strong> Describe approaches and data sources used to estimate resource use associated with model health states. Describe primary or secondary research methods for valuing each resource item in terms of its unit cost. Describe any adjustments made to approximate to opportunity costs.</td>
</tr>
<tr>
<td>Section/Item</td>
<td>Item No</td>
<td>Recommendation</td>
</tr>
<tr>
<td>------------------------------</td>
<td>---------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Currency, Price Date and Conversion</td>
<td>14</td>
<td>Report the dates of the estimated resource quantities and unit costs. Describe methods for adjusting estimated unit costs to the year of reported costs if necessary. Describe methods for converting costs into a common currency base and the exchange rate.</td>
</tr>
<tr>
<td>Choice of model</td>
<td>15</td>
<td>Describe and give reasons for the specific type of decision-analytic model used. Providing a figure to show model structure is strongly recommended.</td>
</tr>
<tr>
<td>Assumptions</td>
<td>16</td>
<td>Describe all structural or other assumptions underpinning the decision-analytic model.</td>
</tr>
<tr>
<td>Analytic Methods</td>
<td>17</td>
<td>Describe all analytic methods supporting the evaluation. This could include methods for dealing with skewed, missing or censored data, extrapolation methods, methods for pooling data, approaches to validate or make adjustments (e.g., half-cycle corrections) to a model, and methods for handling population heterogeneity and uncertainty.</td>
</tr>
<tr>
<td>Results</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Study parameters</td>
<td>18</td>
<td>Report the values, ranges, references and if used, probability distributions for all parameters. Report reasons or sources for distributions used to represent uncertainty where appropriate. Providing a table to show the input values is strongly recommended.</td>
</tr>
<tr>
<td>Incremental costs and outcomes</td>
<td>19</td>
<td>For each intervention, report mean values for the main categories of estimated costs and outcomes of interest, as well as mean differences between the comparator groups. If applicable, report incremental cost-effectiveness ratios.</td>
</tr>
<tr>
<td>Section/Item</td>
<td>Item No</td>
<td>Recommendation</td>
</tr>
<tr>
<td>--------------</td>
<td>---------</td>
<td>----------------</td>
</tr>
<tr>
<td><strong>Characterizing Uncertainty</strong></td>
<td>20a</td>
<td><em>Single study-based economic evaluation:</em> Describe the effects of sampling uncertainty for estimated incremental cost, incremental effectiveness and incremental cost-effectiveness, together with the impact of methodological assumptions (e.g. discount rate, study perspective).</td>
</tr>
<tr>
<td></td>
<td>20b</td>
<td><em>Model-based economic evaluation:</em> Describe the effects on the results of uncertainty for all input parameters, and uncertainty related to the structure of the model and assumptions.</td>
</tr>
<tr>
<td><strong>Characterizing Heterogeneity</strong></td>
<td>21</td>
<td>If applicable, report differences in costs, outcomes or cost-effectiveness that can be explained by variations between subgroups of patients with different baseline characteristics or other observed variability in effects that are not reducible by more information.</td>
</tr>
<tr>
<td><strong>Discussion</strong></td>
<td></td>
<td>Summarize key study findings and describe how they support the conclusions reached. Discuss limitations and the generalizability of the findings and how the findings fit with current knowledge.</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td></td>
<td>Describe how the study was funded and the role of the funder in the identification, design, conduct and reporting of the analysis. Describe other non-monetary sources of support.</td>
</tr>
<tr>
<td><strong>Source of Funding</strong></td>
<td>23</td>
<td>Describe any potential for conflict of interest among study contributors in accordance with journal policy. In the absence of a journal policy, we recommend authors comply with International Committee of Medical Journal Editors’ recommendations.</td>
</tr>
</tbody>
</table>
THANK YOU

rachel.a.elliott@manchester.ac.uk
Useful resources (1)

Useful resources (2)

- Database of Instruments for Resource Use Measurement (http://www.dirum.org)
Useful resources (3)