Introduction to Economic Evaluation

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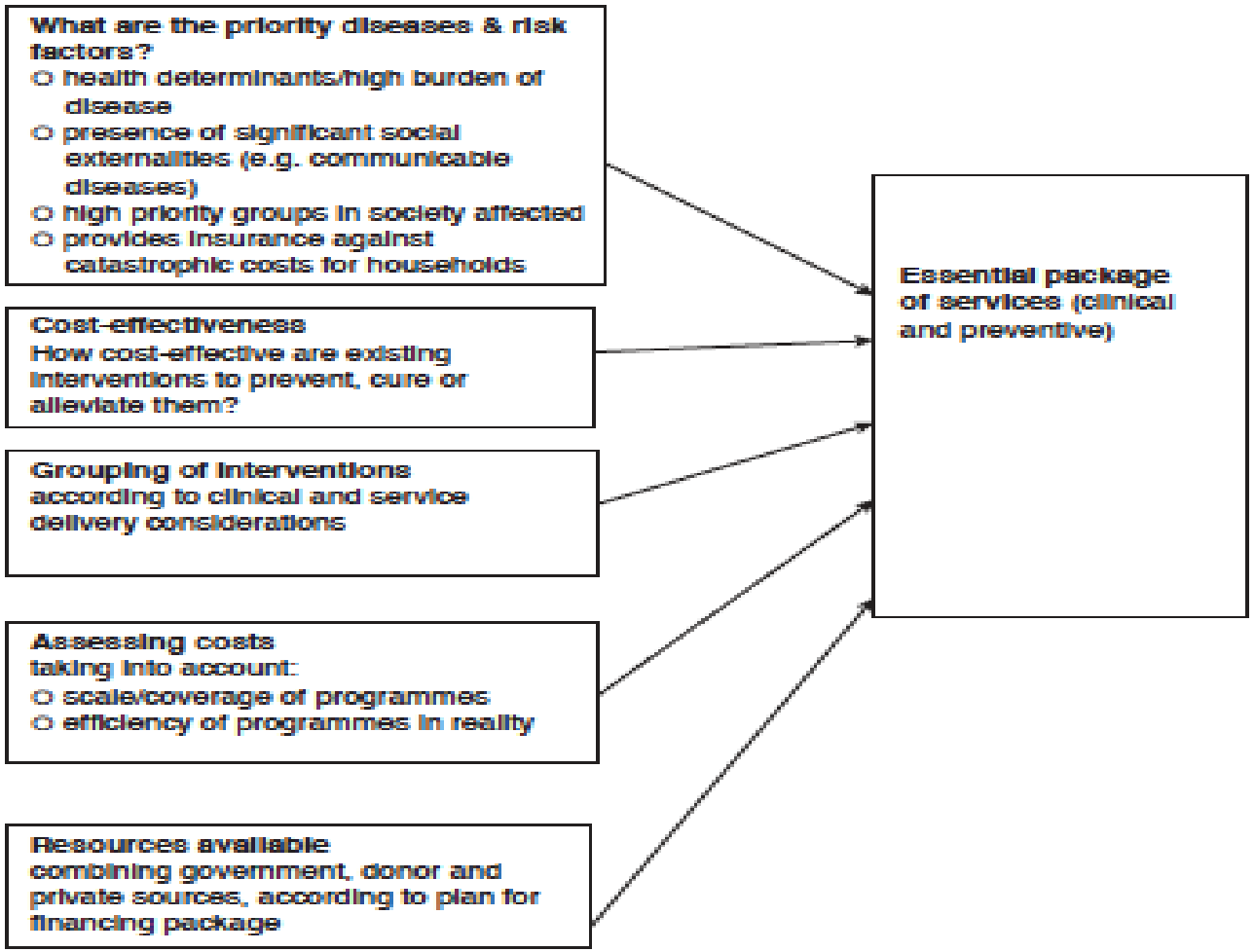
Acknowledgement: Dr. Luke Vale, Professor- Health Economics, Newcastle University, UK

Designing essential package of services- Context of UHC



Example: World Development Report 1983

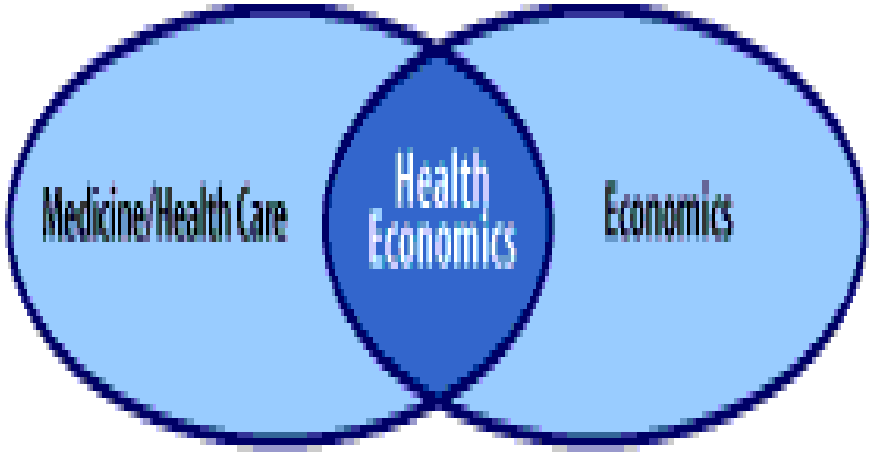
An example of this is the World Bank 'essential service package' idea, contained in the 1993

World Development Report. The criteria which were used to select services here included:

- High burden of disease caused by the condition in developing countries
- Cost-effectiveness of intervention
- Positive externalities associated with the treatment or prevention (see above: knock-on effects of reducing transmission etc.)

What is health economics?

- Health economics
  - A branch of economics that evaluates health care
  - "..provides a logical and explicit framework that enables health care workers, governments, decision makers and society to make choices as to how best to use health care resources"



What is health economics?

- Health economics
  - Evaluates costs and consequences of health care interventions, such as drugs, devices, procedures, services and programs
    - It will cost me £X to use intervention A in population P
    - As a consequence of using A, I will gain/lose Y (clinical outcome)
    - As a consequence of using A, I will save/lose £Z (economic outcome)

What is health economics?

- Health economics: marginal analysis
  - Usually health economics evaluates costs and consequences of a (small) change in health care interventions or the incremental costs and benefits between different options
  - Marginal cost: is the incremental cost of one extra unit of a healthcare intervention

Why do we need health economics?

- Because of...
  - a scarcity of resources be it money, nurses, equipment, hospital beds etc...
  - a need to make difficult choices
    - Is intervention A 'worth it' compared to other things we could do with the same resources
  - a need for a logical (objective) and explicit framework for making decisions and setting (justifying) health care budgets

But *why* do we need health economics?

- Criticisms of health economics
  - Health economics overrides clinical freedom: clinicians prefer to make decisions based on their own clinical experience
  - It is difficult/impossible
    - to make an objective evaluation of health interventions
    - or fair comparisons of disparate health interventions
  - Emotive subject area: patients (and industry?) find negative recommendations hard to accept
  - Seemly logical economic evaluations can lead to illogical clinical decisions,
    - e.g. ARMD it's more cost-effective to wait until patient has gone blind in one eye before starting treatment

But *why* do we need health economics?

- and some common misconceptions
  - Health economics is about cost-cutting
  - Health economics is about rationing

But *why* do we need health economics?

- For the pharmaceutical industry, health technology appraisals (HTAs; a formal economic evaluation) are now an unavoidable part of a new product launch
  - In Scotland all new medicines must be evaluated by the Scottish Medicines Consortium shortly after receiving a UK license
  - In England and Wales, the National Institute for Health and Clinical Excellence is likely to request manufacturers to submit an economic evaluation of their product
  - Without a positive recommendation from SMC or NICE it is difficult for manufacturers to get their product on a UK formulary

But *why* do we need health economics?

- Canada, Australia, The Netherlands, and Sweden all have some form of HTAs
- Many other countries are influenced by HTAs conducted by for example, NICE
- Examples of HTA in LMICs: HITAP (Thailand), HTAIn (India)

Economic Evaluation: What it is

- A way of thinking and formulating problems of choice
- Systematic framework for identifying and organising the information required for decision-making
- Set of techniques for the analysis of alternatives
- Aid for decision-making

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 subisidies
- Setting priorities

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

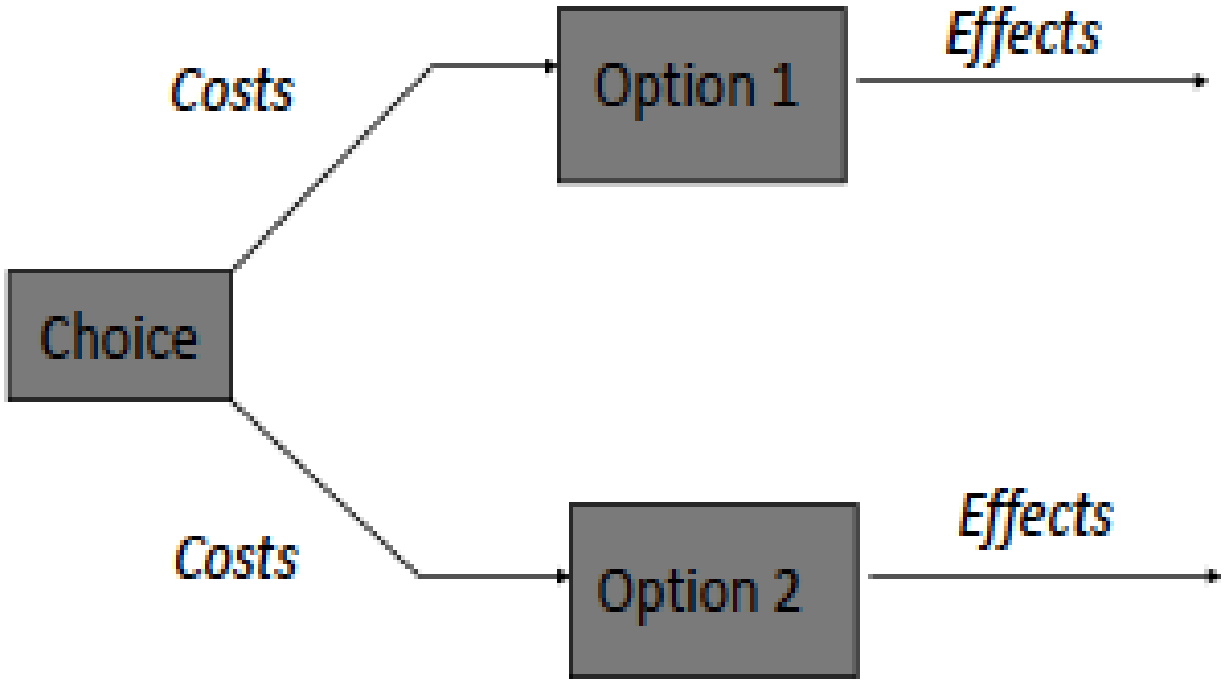
EE is not useful when

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

EE is least useful when

- Over-riding political/cultural/environmental values
- Evidence of effectiveness is weak
- Democratic processes undermined
- Costs of evaluating greater than the benefits

Analyses are comparative



EE requires

- Some evidence of effectiveness
- Choice between two or more alternatives
- Both costs and effects (benefits) are examined

Applications of EE

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

- Examples of each?

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

What should be considered when setting health care priorities

- **Effectiveness**

Clinical improvements such as extending life and/or improving aspects of quality of life

- **Efficiency**

Maximising benefits in the face of scarce resources

Ensure that the benefits of those activities which are pursued are greater than their opportunity costs (benefits foregone)

- **Equity**

Concerned with the fairness of how health care resources are distributed

The equity-efficiency trade-off

Five treatments for 5 different diseases which can save lives, up to a total of 100 each. Total budget is INR3 million.

Treatment	Cost per patient (INR)
A	10,000
B	20,000
C	30,000
D	40,000
E	50,000

The equity-efficiency trade-off

Five treatments which can save lives, up to a total of 100 each. Total budget is INR3 million.

Treatment	Cost per patient (INR)	Number of patients
A	10,000	100
B	20,000	100
C	30,000	
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E	50,000	

The equity-efficiency trad off

Five treatments which can save lives, up to a total of 100 each. Total budget is INR3 million.

Treatment	Cost per patient (INR)	Number of patients
A	10,000	20
B	20,000	20
C	30,000	20
D	40,000	20
E	50,000	20

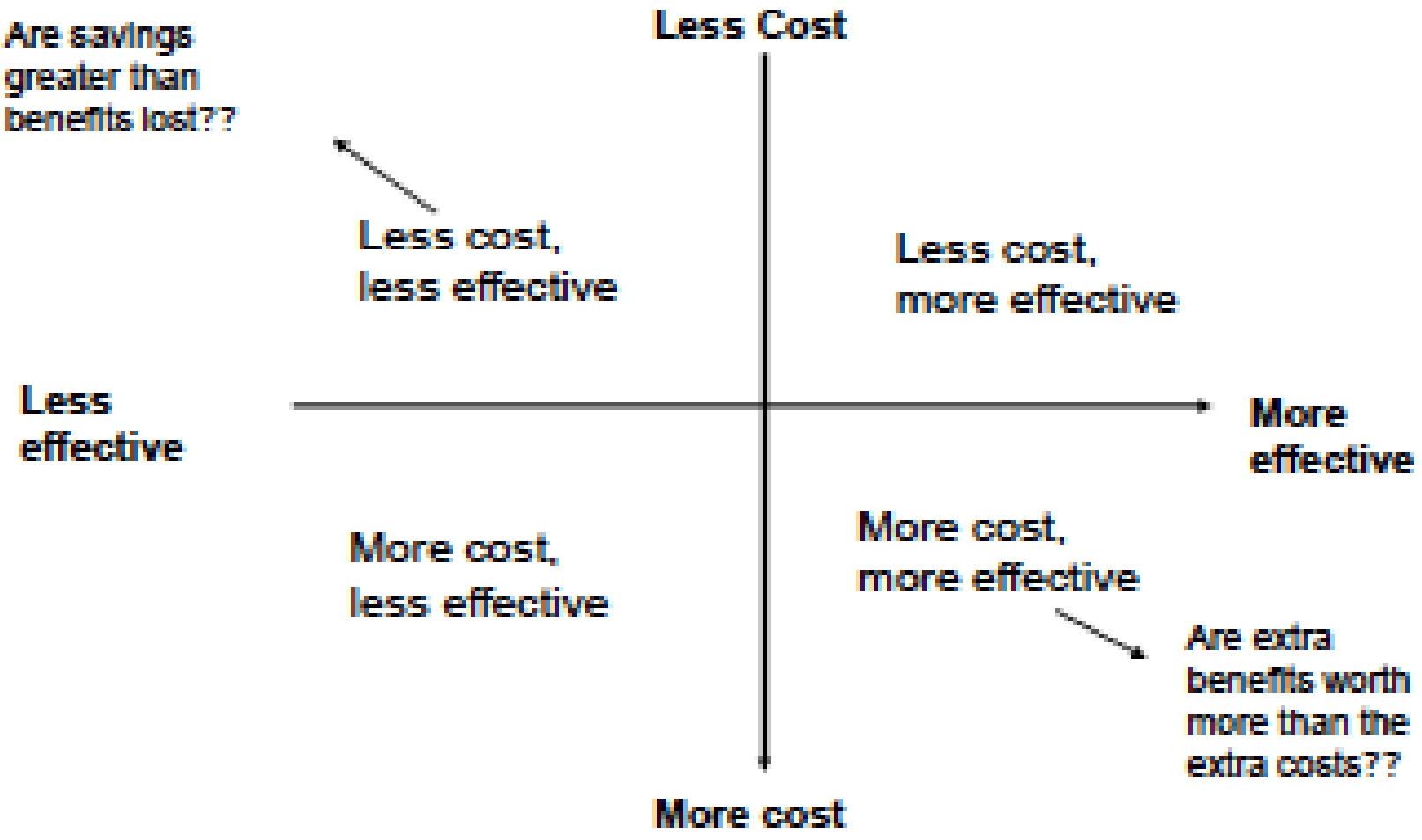
Incorporating the personal equity weights

- Economic evaluation focuses on creating the maximum effect from the resources available
- It tends not to consider the distribution of those effects
- Should it?

The role of economics in priority settings

- An assessment of efficiency is integral when allocating scarce health care resources amongst competing alternatives
- Assessing efficiency is the domain of economic evaluation
- Defined as comparative analysis of alternative courses of action in terms of both costs (use of health services) consequences (health effects)
- An economic evaluation can take many different forms, but the tasks involved remain very similar: to identify, measure and value all of the relevant costs and consequences of the programme or intervention being analysed

Economic quadrants



Measures of 'benefit' in EE

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

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

Methods of economic evaluation

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Healthcare Evaluation

Are both costs and outcomes of alternatives assessed?

Is the comparison of two or more alternatives?

	No		Yes
No	Examines only outcomes	Examines only costs	
	Partial evaluation Outcome description	Partial economic evaluation Cost of illness	Partial economic evaluation Cost outcome description
Yes	Partial evaluation Efficacy (Outcomes) analysis	Partial economic evaluation Cost analysis	Full economic evaluation Cost-consequences analysis Cost minimization analysis Cost effectiveness analysis Cost utility analysis Cost benefit analysis

Adapted from Drummond et al. Methods of Economic Evalua2on in Healthcare (2006)

Cost-of-illness (COI)

- COI identifies the economic burden of a disease or medical condition
- In general these studies evaluate the resources consumed as a direct result of an illness or condition
- COIs always take a specific cost perspective, e.g. UK NHS
- Also called cost-of-disease or burden-of-illness studies

Types of COI studies

Incidence-based studies

- Incidence-based studies, which estimate lifetime costs, measure the costs of an illness from onset to conclusion for cases beginning within the period of the study, usually a year.
- Incidence costs include the discounted, lifetime medical, morbidity, and mortality costs for the incident cohort. set.

Prevalence-based studies

- Prevalence-based studies, which estimate annual costs, measure the costs of an illness in one period, usually a year, regardless of the date of onset.
- Includes all medical care costs and morbidity costs for a disease within the study year. However, the mortality and permanent disability costs of prevalence-based studies are calculated differently from the other costs. Discounted mortality and permanent disability costs are calculated for all patients who die or become permanently disabled in the study year for that year and each year until the expected age of death.

Types of full economic evaluations

Method of analysis	Cost measurement	Outcome measurement
Cost-consequence analysis	$	Multi-dimensional listing of outcomes
Cost-minimization analysis	$	Equivalence demonstrated or assumed in comparative groups
Cost-effectiveness analysis	$	Single 'natural' unit outcome measure
Cost-utility analysis	$	Multiple outcomes-life-years adjusted for quality-of-life
Cost-benefit analysis	$	$

Cost-Consequences Analysis (CCA)

- Systematic description and measurement of a set of intervention attributes that should be considered when making a decision
- Need not describe a decision rule
- Like everyday attribute-specific decision making provides information in a simple disaggregated format for decision maker to make their own choice
- Weighting of different attributes left to individual decision makers

CCA- Example

ORIGINAL RESEARCH ARTICLE

Pharmacoeconomics 1999; 15 Suppl. 1: 23-37
1170-7690/99/0001-0023/$07.50/0

A Prospective Cost-Consequence Analysis of Adding Lamivudine to Zidovudine-Containing Antiretroviral Treatment Regimens for HIV Infection in the US

L. Lacey,[1] *J. Mauskopf,*[2] *R. Lindrooth,*[3] *S. Pham,*[4] *M. Saag*[5] and *W. Sawyer*[6]

1 Global Health Outcomes, Glaxo Wellcome, Greenford, Middlesex, England
2 Center for Economics Research, Research Triangle Institute, Research Triangle Park, North Carolina, USA
3 Institute for Health Services Research & Policy Studies, North Western University, Evanston, Illinois, USA
4 US Medical Affairs, Glaxo Wellcome Inc., Research Triangle Park, North Carolina, USA
5 University of Alabama, Birmingham, Alabama, USA
6 HIV Health-Economics Collaboration, Royal Free Hospital, Hampstead, Middlesex, England

Cost-minimisation analysis (CMA)

- A cost comparison of two or more interventions with comparable clinical and quality-of-life outcomes
- It is unlikely that the outcomes of two different interventions are equal so CMAs are rarely performed
- Useful for evaluating generically equivalent drugs where the outcomes have been demonstrated to be equivalent
- Useful for evaluating same intervention but given in different settings

Cost-effectiveness analysis (CEA)

- This analysis compares the monetary cost of an intervention with a measure of effectiveness (clinical or quality of life outcome)
- The outcomes are measured in natural units and usually expressed as the incremental gain/loss resulting from an intervention:
  - bed days avoided
  - deaths avoided
  - life years gained

Cost-utility analysis (CUA)

- An extension of cost-effectiveness analysis where effectiveness is expressed in utilities, such as QALYs
- This allows comparisons across different indications
- CUA very common form of economic analysis, e.g. Required for NICE/ SMC
- One criticism of CUA is how useful it is for acute (short-term conditions) or conditions where utility/quality-of-life difficult to measure

Cost-benefit analysis (CBA)

- Cost-benefit analysis (CBA) compares the net costs of an intervention with the net benefits where both costs and benefits are expressed in monetary units
- However, it is difficult to convert clinical and QOL outcomes to a monetary value
- 'Proper' CBA are hardly used (in the UK)

Types of costs

Cost type	Example of resources
Direct medical costs	Hospitalization (LOS)
	Outpatient visits
	Procedures & tests (X-ray, Blood tests, surgery)
	Devices (Wheelchairs, Pacemakers etc)
	Services (Home-care, Nursing care) hours or days
Direct non-medical costs	Transportation
	Services (Home help etc
	Devices & other investments
	Informal care (care by relatives)
Indirect costs	Sick leave (days or weeks)
	Reduced productivity (percentage or hours)
	Early retirement (years to normal retirement)
	Premature death (years to normal retirement)

Costs included in EE studies

Perspective	Medical Costs	Morbidity Costs	Mortality Costs	Transportation/ Nonmedical Costs	Transfer Payments
Societal	All costs	All costs	All costs	All costs	—
Health care system	All costs	—	—	—	—
Third-party payer	Covered costs	—	Covered costs	—	—
Businesses	Covered costs (self-insured)	Lost productivity (presenteeism/ absenteeism)	Lost productivity	—	—
Government	Covered (Medicare, Medicaid)	—	—	Criminal justice costs	Attributable to illness
Participants and families	Out-of-pocket costs	Lost wages/ Household production	Lost wages/ Household production	Out-of-pocket costs	Amount received

Note: Adapted from Luce et al.[8,27,34]

Steps in cost assessment

- Resource use: counts/number of units of each type of medical resources needed

4 steps:

- Identify the relevant resources used
- Quantify these resources in physical units, such as hospital days, admissions, surgical procedures, physician visits etc
- Value the different resources used in terms of their opportunity costs
- Adjust valuations to account for the differential timing at which resource use can occur (discounting)

Costing approaches

- Bottom up costing:
  - Quantifying the resource use and multiply by unit cost of that resource
    - Drugs and disposables
    - Inpatient stay, outpatient visits, A&E attendance
    - Consultations: GP, specialist, surgeon, nurse
    - Tests and procedures
- Top down costing
  - Estimate unit cost (or cost per patient) by dividing total costs by number of patients/units
  - Use of statistical databases and registries to estimate costs at regional or national level. E.g. NSSO data

Perspectives

- When conducting an economic evaluation need to state the perspective of the evaluation
  - Cost perspective – who pays?

Patient

Provider

Third-party payer

Society

Discounting

- Often health care involves investing resources now but the consequences will not be apparent for many years
- Discounting is used to adjust future costs and benefits to their 'present value'
- Discounting is based on the assumption that
  - we prefer to receive benefits now rather than in the future
  - we prefer to pay later rather than pay now
- The strength of this 'time preference' is expressed by a discount rate

Discounting

- In UK it is recommended that costs and health benefits are both discounted at 3.5% based on the following formulae:
  - If year 0 is the present then the present value (at the middle of year 0) of £1 (made at the middle of year n) is given by

    $D_n = 1/(1 + r)^n$

    where r is the discount rate and D_n is the discount factor.

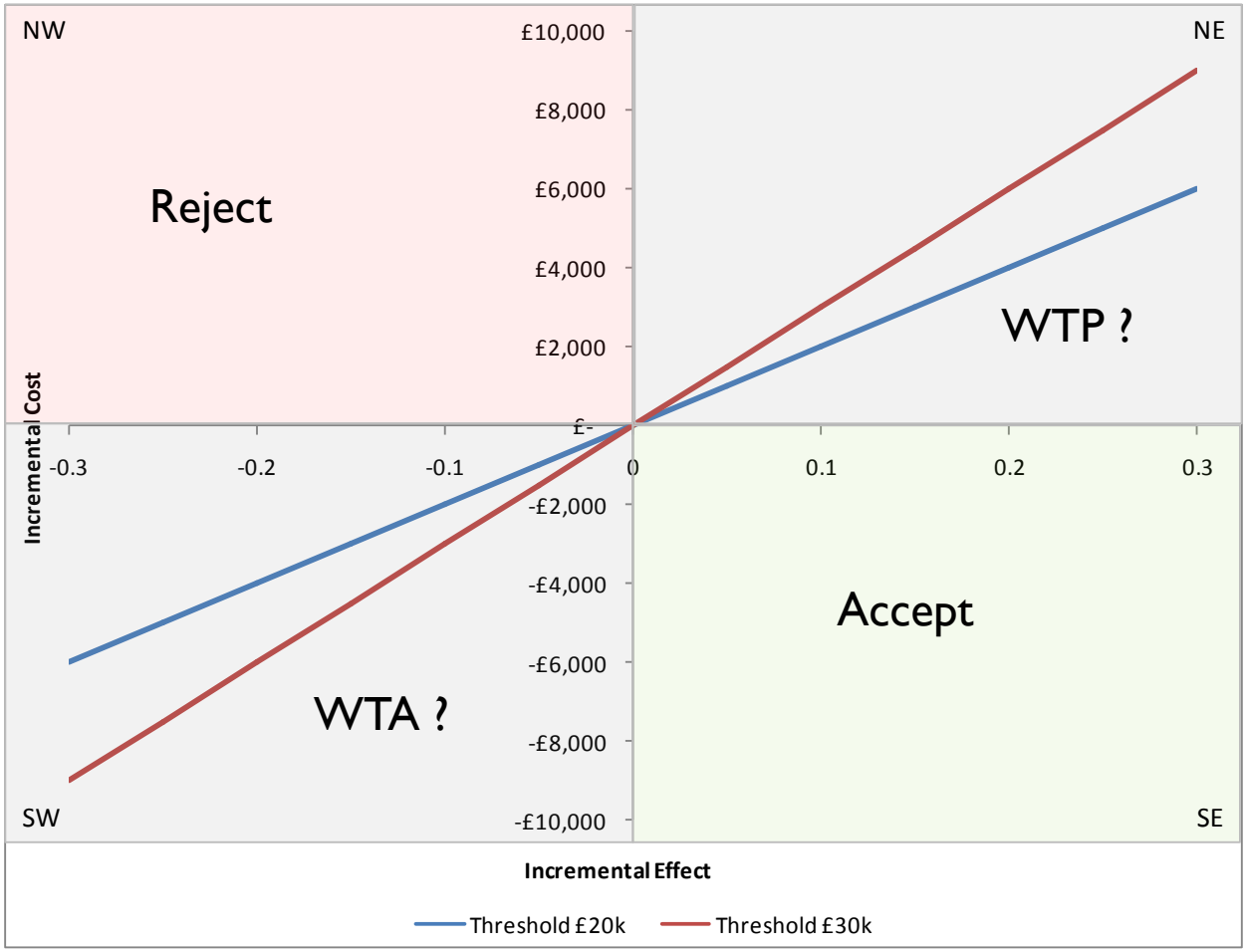
Source: UK Treasury (Green Book 2003)

ICERs

- As mentioned previously, we tend to compare different treatments options
- The incremental cost-effectiveness ratio (ICER) is the incremental cost divided by the incremental clinical benefits of one intervention compared to another
- e.g. If clinical outcomes expressed in QALYs then

$$\text{ICER} = \frac{\text{Cost of A} - \text{Cost of B}}{\text{QALYs with A} - \text{QALYs with B}}$$

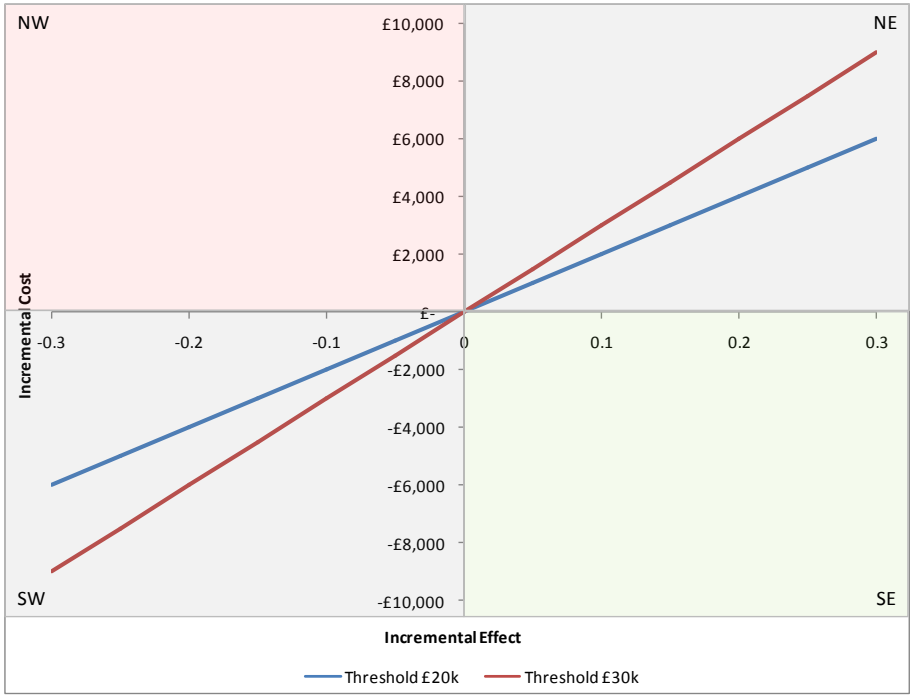
The cost-effectiveness plane



ICER thresholds versus net benefit

- ICERs are usually compared with a threshold value, e.g. An acceptable threshold of £20,000 or £30,000 per QALY are common in the UK

- However,
  - there is difficulty in interpreting negative ICERs
  - there is difficulty in interpreting ICERs that fall in the SW quadrant



Introduction to modelling in Economic Evaluation

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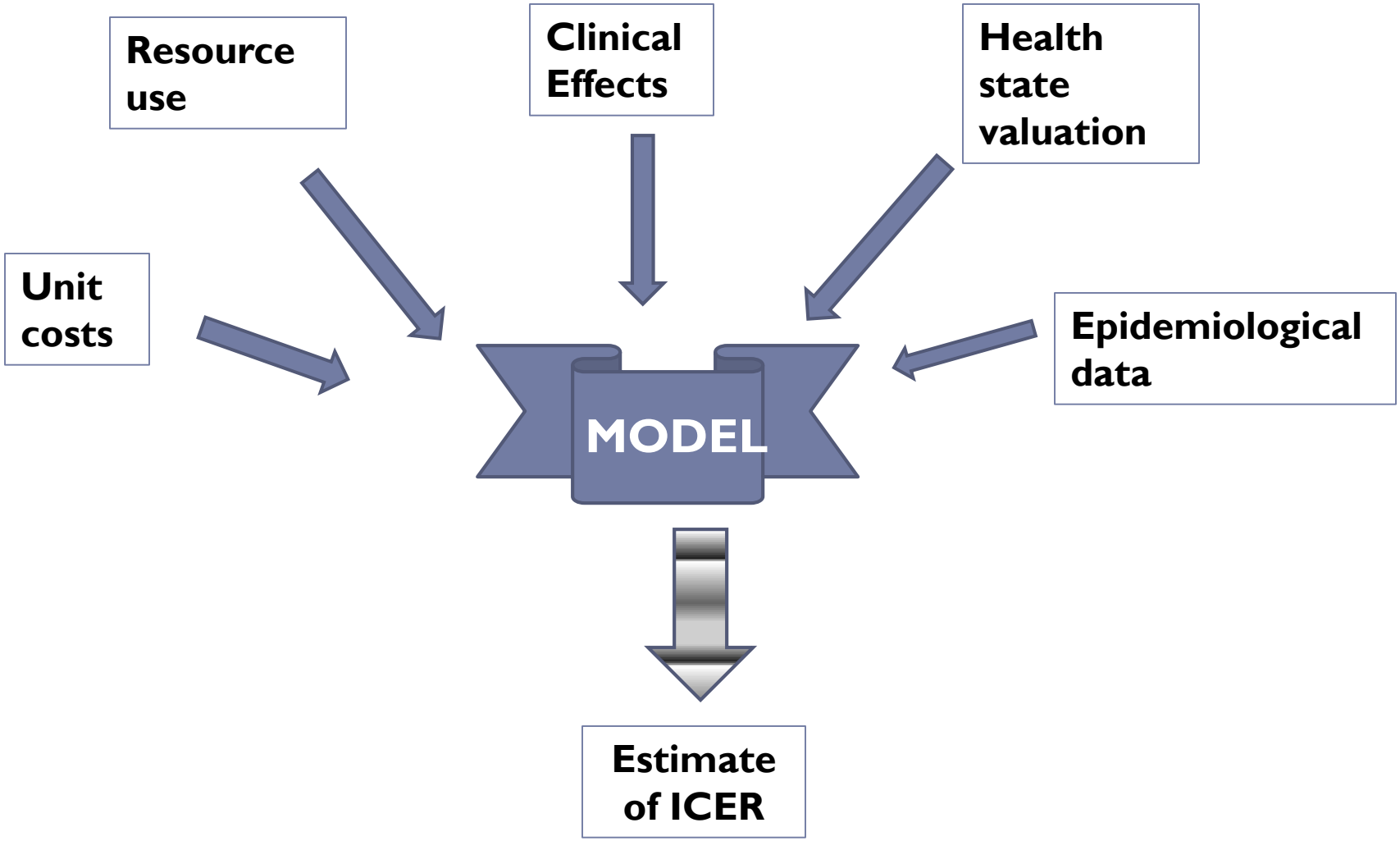
Overview of types of economic models

- Most economic evaluations are based on economic models
- Common types of models used in health economics are
  - Decision analysis models
  - Budget impact models
  - Care maps/ care pathways

Inputs and outputs to a model



Decision analysis

- Decision analysis is quantitative method to aid decision-making especially where you have less than perfect data
- A set of calculations laid out in a logical sequence
- Compares at least two alternative approaches; e.g. two treatment strategies, two screening programmes
- Decision analysis provides the *expected value*; by weighting events by the probability that they will occur (i.e. the weighted average)
- Informs a decision process; not intended merely to arrive at 'perfect' scientific answers
- Should be used as a decision aid
- Goal should be to provide decision-makers with information that can allow them to judge

When to Use Decision-Analytic Modeling?

- When important questions can't be answered by direct observation because of

–Comparators (may differ from clinical trials)

–Time periods (extrapolation beyond trial)

–Patient selection (narrower/broader populations than in trial)

–Scope of disease impact (wider impact on health and economic endpoints)

–Endpoint relevance (impact of clinical endpoints on future health decisions)

–Uncertain evidence base (impact of uncertainty in effect size)

–Scoping (data from a range of disparate sources in a single transparent framework)

–Setting (alternative countries/health care settings)

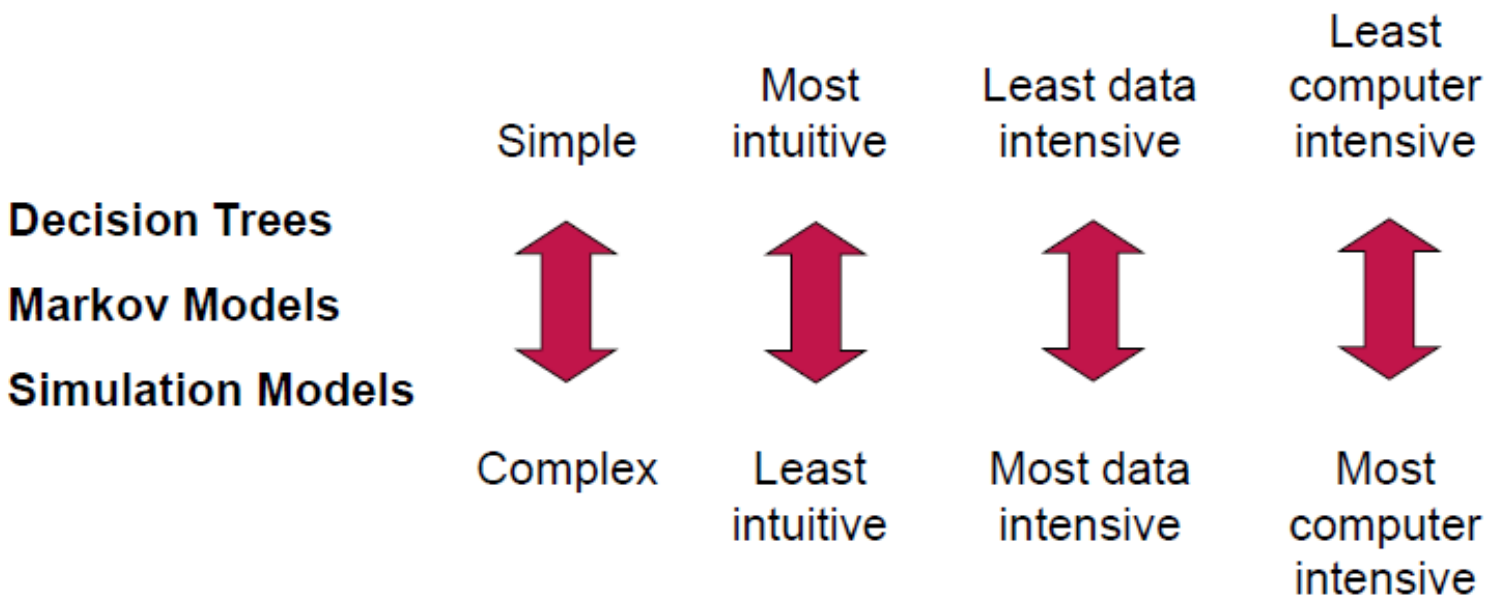
Properties of a good decision analytical model

A good decision analytic model for the economic evaluation of health technologies is one that:

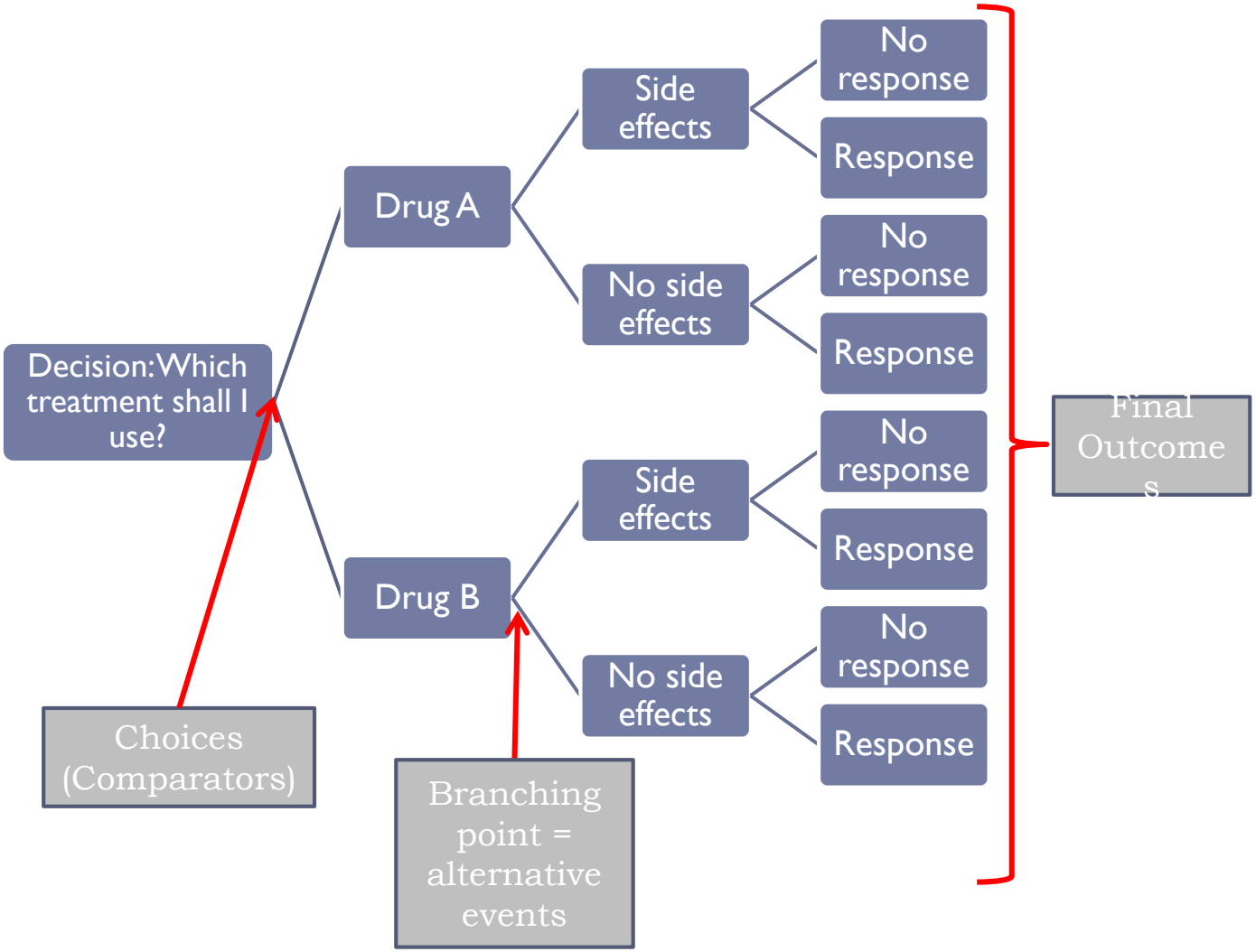
- is tailored to the purposes for which it is to be used
- is useful for informing the decisions at which it is aimed
- is readily communicated.

Transparency	Internal consistency
Reproducibility	Interpretability
Exploration of uncertainty	Statement of scope
External consistency	Parsimony
Inferential soundness	

Modeling options



Decision Tree Model



When Do We Use a Markov Model?

- For modeling chronic conditions for which there are clear stages of progression and severity
- or acute diseases with a lot of circulation between states
- When long-term data are not available to tell the whole story
- To simplify the presentation of a recursive tree structure

Markov Model Components and Considerations

- Health states
- Cycle length and model time horizon
- Transition probabilities
- Matrix/vector multiplication
- Markov assumption: memoryless property
- Parameters associated with health states
- Discounting
- Half-cycle correction
- Comparing interventions
- Sensitivity analysis

Identifying Health States

- Health states should be clinically and/or economically relevant
- The selected set of health states must be exhaustive and mutually exclusive

–Exhaustive: at every point in time, a person must be in one of the health states

–Mutually exclusive: at any point in time, a person can be in only one health state

- Example:

Types of Health States

- Transient state: probability of transitioning to at least one other state is positive
- Absorbing state: probability of transitioning to any other state is zero (e.g., death)
- Tunnel state: probability of remaining in the state in the next cycle is zero

How Many Health States?

- Enough states to ensure that individuals in any state are relatively homogenous

–Transition probabilities for individuals in the state are the same

–Costs and quality of life for individuals in the state are the same

- Few enough states to be able to obtain good data for each state

Transition Probabilities

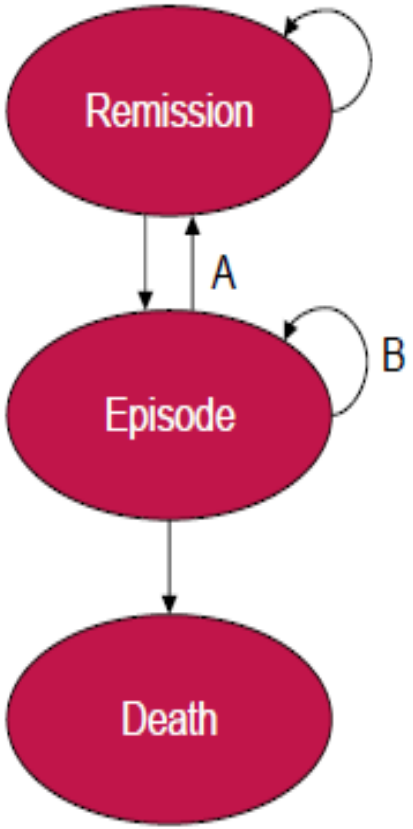
- A transition probability is the probability of moving from one health state to another during a given cycle

–Example: probability an individual is in remission next year given he/she had an episode this year (arrow A)

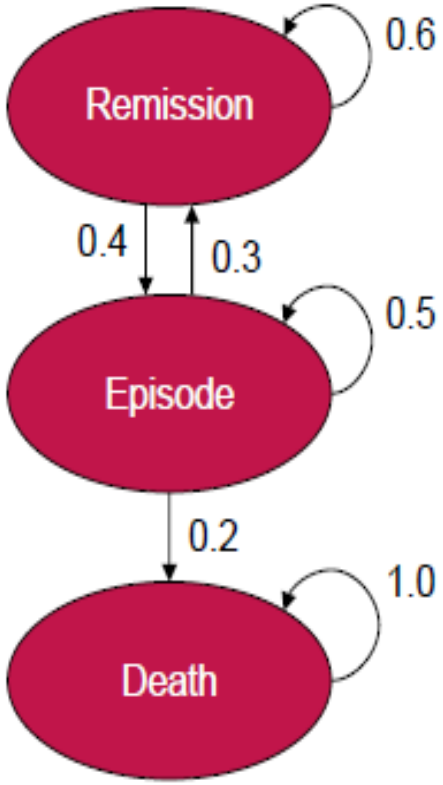
–Individuals can stay in their current state with some probability (arrow B)

- Some transitions may have a probability of zero

–In this example, the probability of death during remission is zero



Transition Probability Matrix



From \ To	Remission	Episode	Death
Remission	0.6	0.4	0
Episode	0.3	0.5	0.2
Death	0	0	1.0

Note: all probabilities of staying in or leaving a health state must sum to 1.0. Thus, in the transition probability matrix, each row sums to 1.0. Numerical values in all examples are hypothetical.

Discounting

- Discounting accounts for the time value of money

–A dollar today is worth more than a dollar next year

- Separate discount rates can be applied to costs and health outcomes
- The discount factor applied in each year, where α is the annual discount rate and n is the year, is:

$$\frac{1}{(1+\alpha)^{n-1}}$$

- Example: discount factor for year 5 with α = 3%:

$$\frac{1}{(1+0.03)^4} = 0.8885$$

Sensitivity Analysis

- One-way sensitivity analysis
  - Transition probabilities, costs, utilities, etc.
  - Used to assess drivers of model results
- Two-way sensitivity analysis
  - Combine parameters above
- Probabilistic sensitivity analysis
  - Vary all parameters simultaneously using Monte Carlo simulation
  - Used to assess uncertainty in model results as a result of joint parameter uncertainty
- Subgroup and scenario analyses

Software Used for EE Modeling

Advanced spreadsheet packages such as Microsoft Excel

- Strengths: Most individuals have the software, models can be set up to be user friendly, calculations can be customized and programmed to be transparent
- Limitations: Markov calculations must be programmed from scratch, programmer must be familiar with Excel equations (and ideally Visual Basic for Applications)

TreeAge Pro

- Strengths: Software presents model structure in a visual diagram, Markov calculations are built-in and executed automatically
- Limitations: Programmers and users need to purchase software, final model is less user friendly for basic users, calculations are less transparent for basic users

Matlab

- Strengths: Computational powerhouse
- Limitations: Programmers and users need to purchase software, programmer must be familiar with Matlab programming, final model is less user friendly for basic users, calculations are less transparent for basic users

Budget Impact Models

- Budget impact models look at the *affordability* of implementing a new intervention or switching between interventions
  - An intervention may be very expensive but the indication may be very rare, e.g. enzyme replacement therapy for Gaucher's disease
  - An intervention may be cheap but the indication very common, e.g. statins for secondary prevention of MI

Budget impact models

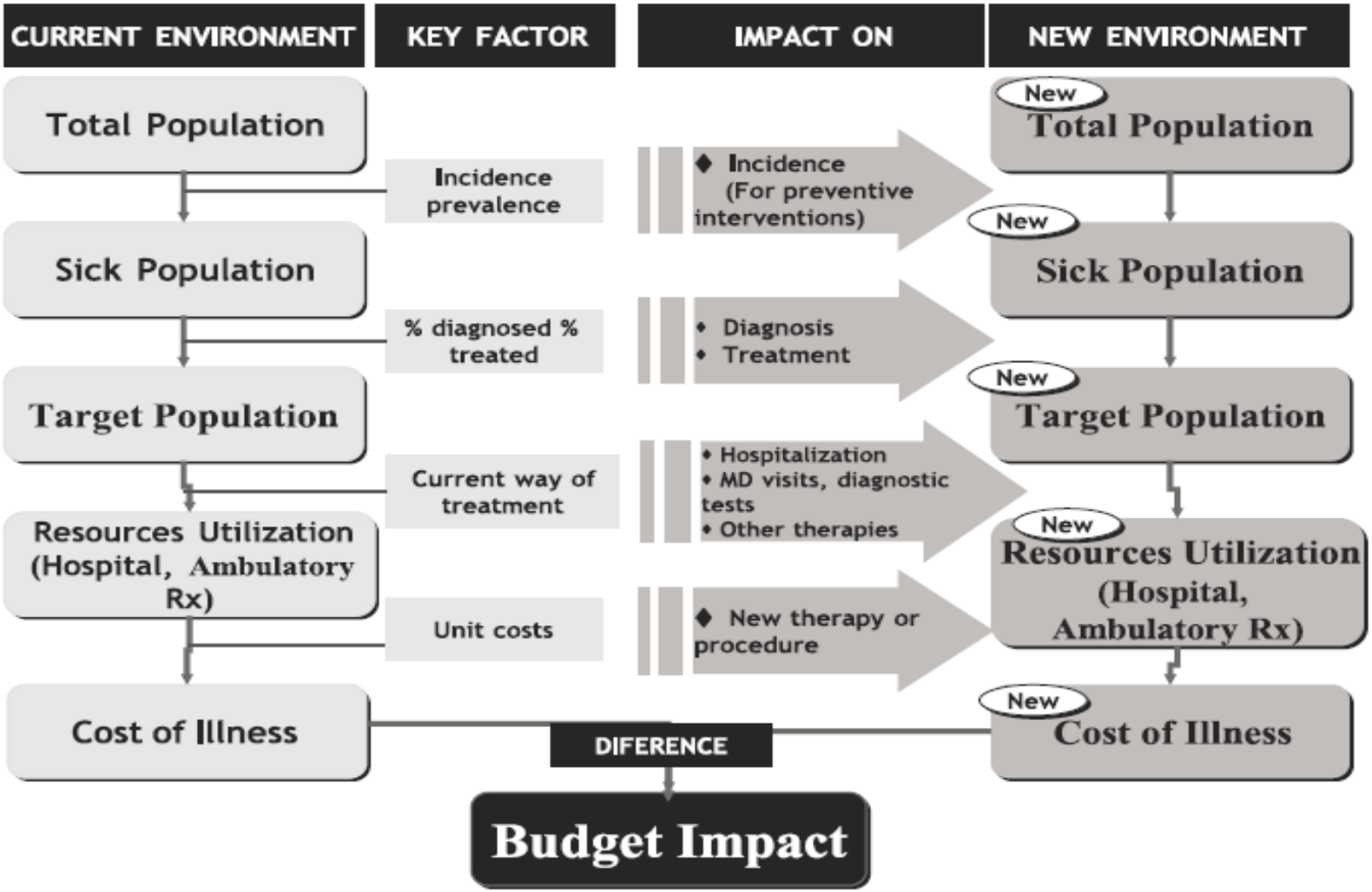
- Budget impact models usually incorporate
  - the number of patients who would be eligible for the new intervention
  - the resources/costs per patient needed to implement the new intervention
  - the resources/costs per patient saved from displaced interventions
  - the timing the uptake of a new intervention

Budget Impact Analysis

- Analysis of provider's expenditures for a program over a short period (often 1-3 years), including the effect of any offsetting savings.
  - Evaluates a scenario rather than a single action
  - Includes comparison to the *status quo*
  - Includes sensitivity analysis

- BIA excludes patient- incurred costs, *but * BIA should reflect impacts on enrollment and retention that could result from affecting patients.*
- Does not measure utility

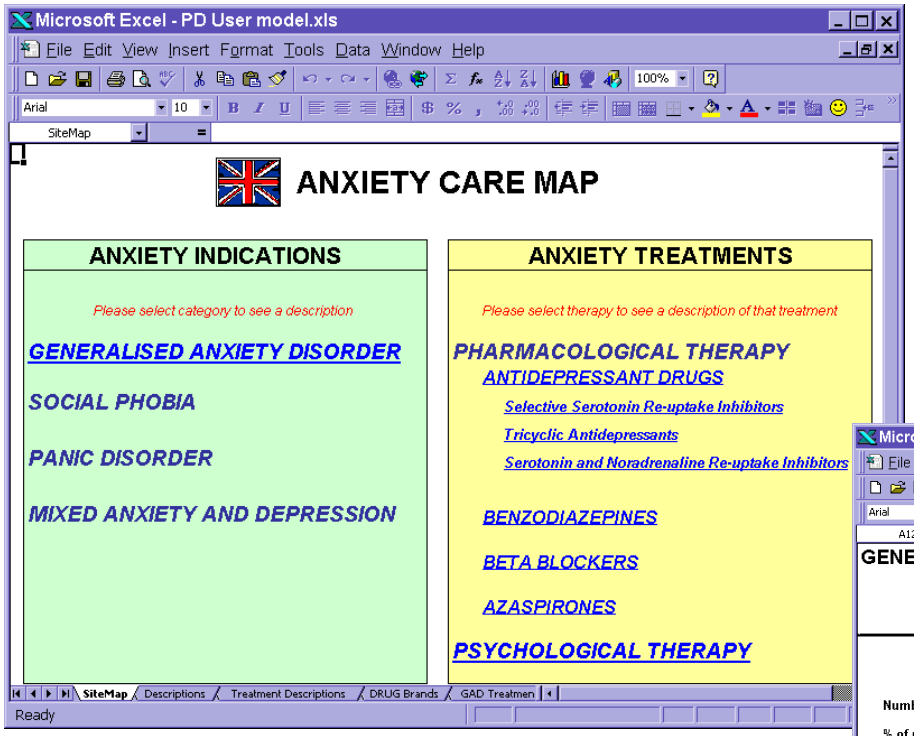
BIA

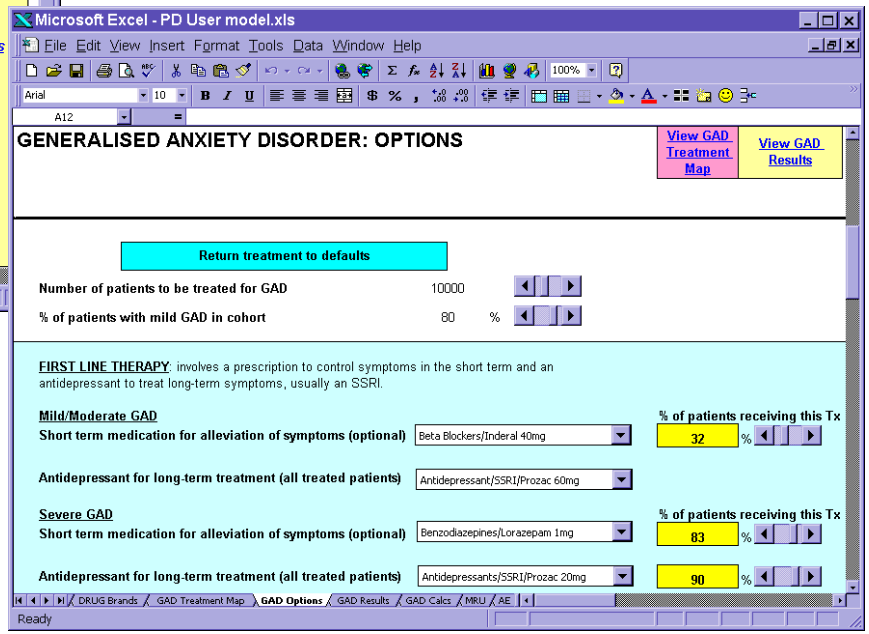

CURRENT ENVIRONMENT
KEY FACTOR
IMPACT ON
NEW ENVIRONMENT
Total Population
Incidence prevalence
Incidence (For preventive interventions)
New Total Population
Sick Population
% diagnosed % treated
Diagnosis
Treatment
New Sick Population
Target Population
Current way of treatment
Hospitalization
MD visits, diagnostic tests
Other therapies
New Target Population
Resources Utilization (Hospital, Ambulatory Rx)
Unit costs
New therapy or procedure
New Resources Utilization (Hospital, Ambulatory Rx)
Cost of Illness
DIFERENCE
New Cost of Illness
Budget Impact

Care maps/ care pathways

- Care maps/ care pathways cover an indication as a whole rather than individual treatment decisions
- They are a representation of the (current) patient management and treatment patterns
  - Pathway leading to diagnosis
  - Pathway for initiating treatment and subsequent treatment
  - Pathway for following-up/ managing patient
- Care maps can be overlaid with costs to evaluate cost of managing a patient or to calculate total budget impact of implementing a new treatment pathway

Care maps/ care pathways





Measuring and valuing health

Denny John
Evidence Synthesis Specialist. Campbell Collaboration

Quality-of-life

- Quality-of-life (QOL) is a measurement of how health, and therefore an intervention, impacts on an individual's well-being

- Quality-of-life instrument measures the impact of health on different domains:
  - physical well-being
  - mental well-being
  - social well-being

Methods for valuing HRQoL weights

- First step: Defining health states of interest
- Next step: valuing these health states i.e. individuals assess different health states and place a value on each of them

- Direct elicitation methods: Visual Analogue Scale, Time trade-off, Standard gamble
- Generic preference-based measures
- Condition-specific measures

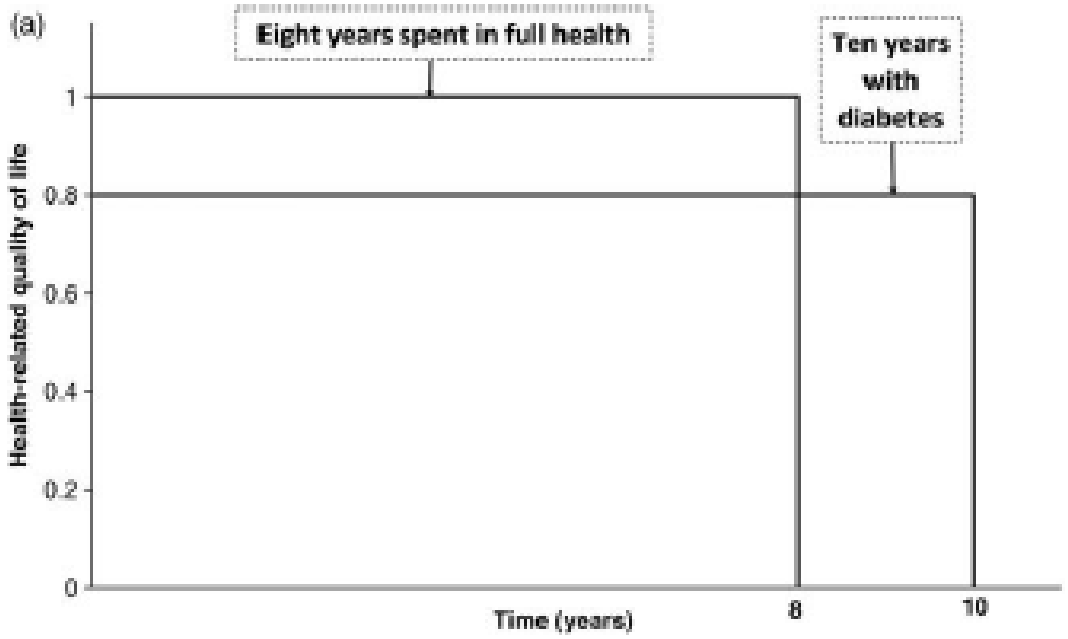
Visual Analogue Scale

- Subject asked to judge where his/her current health would be on a visual scale of 0 (dead) to 1 (perfect health)

E.g. EQ-VAS

Time trade-off

- Individuals decide how many years of remaining life expectancy they would exchange in return for perfect health



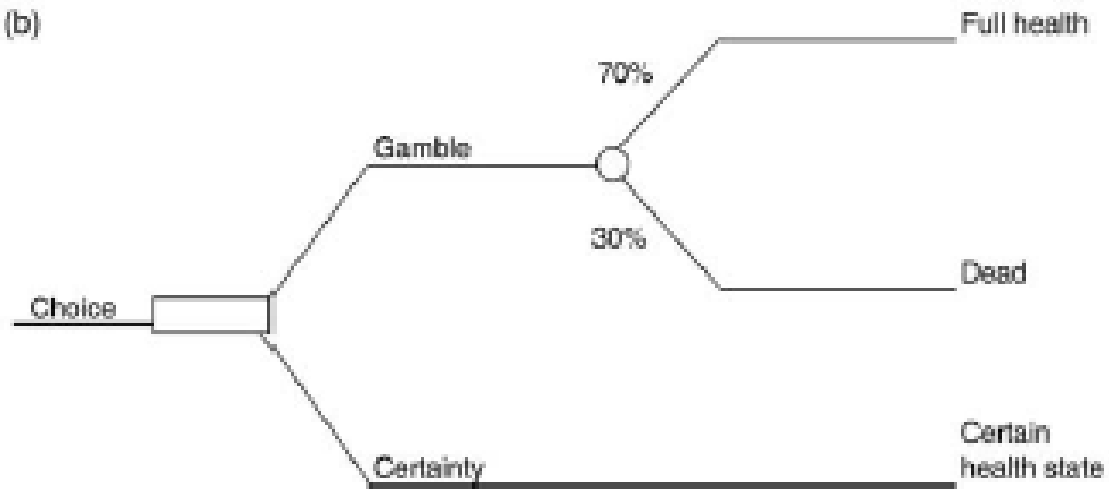
Standard Gamble

Individuals chose between

A) remaining in their current health state or

B) the gamble: an X% chance of perfect health but (1-X%) chance of death

X is varied until individuals are indifferent between choices A and B



Generic instruments

e.g. EQ-5D, SF-36

- Used to compare across indications
- *Preference*-based instruments:
  - integrate all factors contributing to QOL and provide a single measure of how patients value their current health state

Instrument	Domains	Levels of response	Potential Health state	Valuation method used	Original population are based on
EQ-5D	5	3	245	TTO	Random sample of approximately 3000 adults in the UK

The EQ-5D questionnaire

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 *(e.g. work, study, housework, family or leisure activities)*

- I have no problems with performing my usual activities ☐
- I have some problems with performing my 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 not anxious or depressed ☐
- I am moderately anxious or depressed ☐
- I am extremely anxious or depressed ☐

Source: adapted from the EuroQol Group: www.euroqol.org

Specific instruments

e.g. Hospital Anxiety and Depression Scale, EORTC QLQ-C30

- Disease-specific or population specific
- Can be more sensitivity than generic instruments

Utility and QALYs

- A QALY is quality-adjusted life year
- It is used in economic evaluations as a global measure of both the quantity and quality-of-life
- A QALY is a utility-based measure (preference based measure)

Utility and QALYs

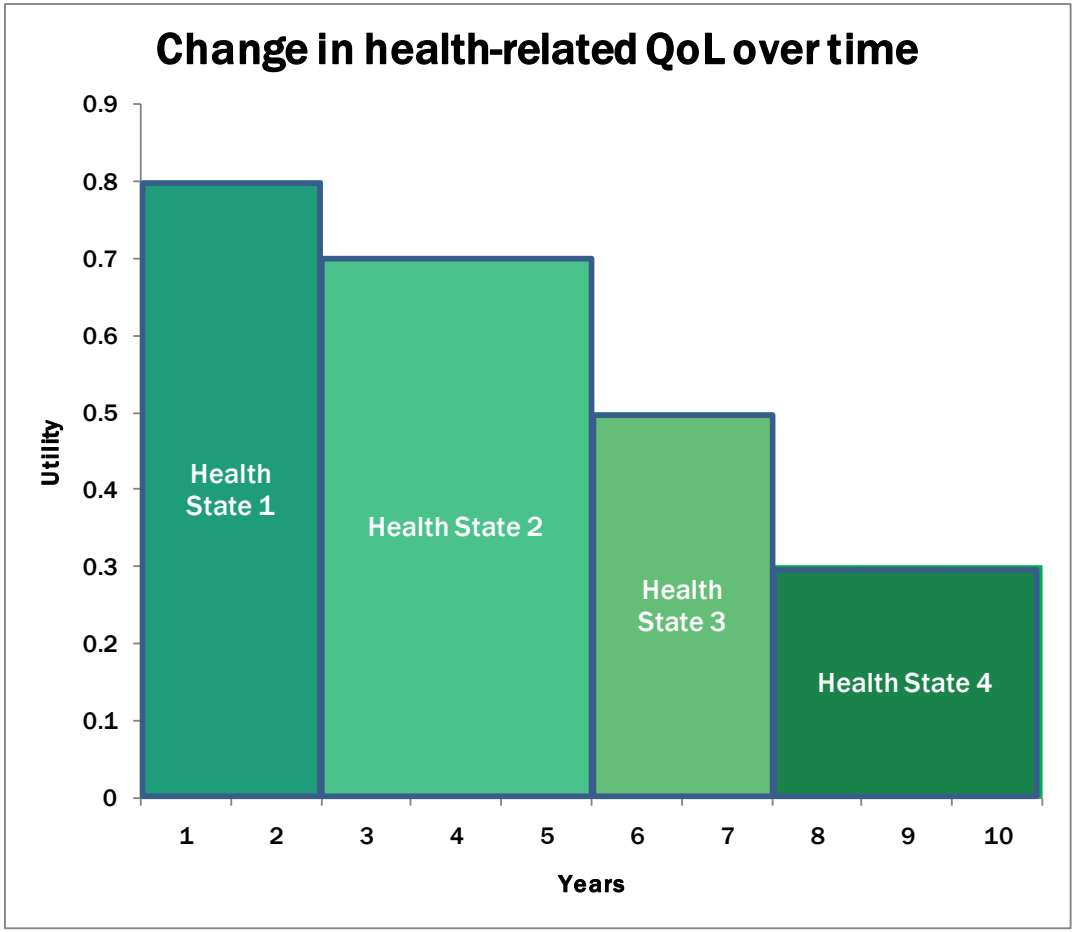
- A utility is an concept used in economics to measure the desirability or usefulness of one thing over another
- In health economics it is used to indicate a preference for one health state over another
  - It provides a ranking between health states
  - It provides the weighting between health states
- In general a utility is a value between 0 (dead) and 1 (perfect health) though can have negative utilities

Utility and QALYs

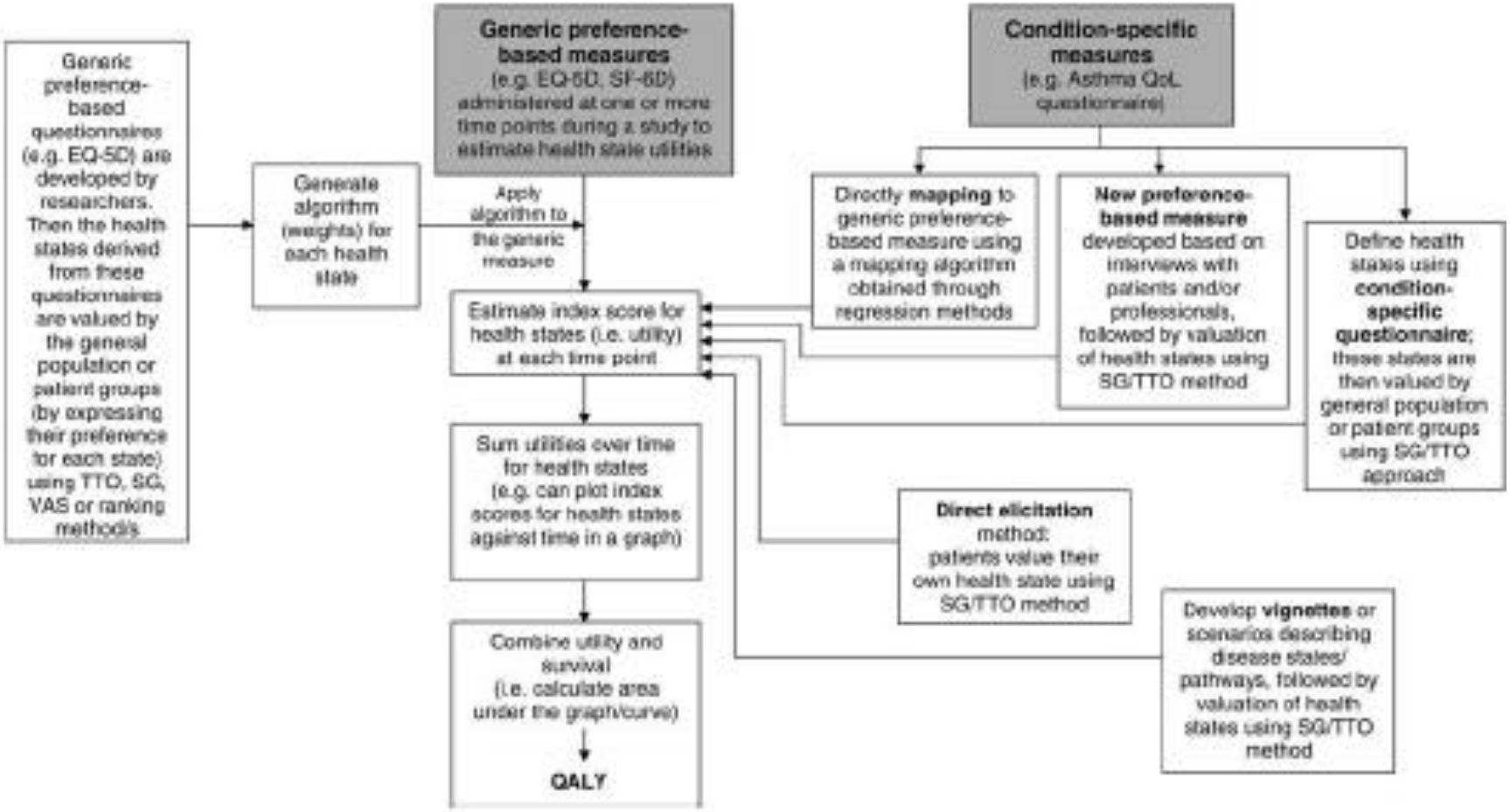
- A QALY is a measure of the quantity and quality-of-life
- For example,
  - if a treatment extends life expectancy by three years
  - but at only 60% of full health (i.e. a utility of 0.6)
  - then the QALY gain associated with the treatment is 1.8 QALYs (3 years x 0.6).
- The advantage of using QALYs is that this measure allows for comparisons across different indications as well as the evaluation of different therapy options within a particular disease area.

Example of QALY calculation

- Health State 1:
  - 2 years @ 0.8 =
    - 1.6 QALYs
- Health State 2:
  - 3 years @ 0.7 =
    - 2.1 QALYs
- Health State 3:
  - 2 years @ 0.5 =
    - 1 QALY
- Health State 4:
  - 3 years @ 0.3 =
    - 0.9 QALYs
- Total 5.6 QALYs



Methods for valuing HRQoL weights



Criticisms to QALYs

- Utility theory
- Does not take into account all dimensions of health benefits
- 'QALY is a QALY is a QALY'- an intervention that results in a small loss of QALYs for some but a greater gain of QALYs for others will result in net efficiency gains and hence social improvement, irrespective of the resulting distribution
- Issues with Equity (some methods of equity weights, ECEA, DCEA) and efficiency

Alternatives to QALYS- DALY

Disability Adjusted Life Year (DALY)

- Summary measure of population health to estimate global burden of illness.
- DALY is an indicator of the relative impact of illnesses and injuries on losses of healthy life years.
- Disability weights are applied to time intervals with the disease. Disability weights were obtained in a valuation exercise with a group of healthcare professionals

While QALY weights reflect relative preferences of an individual for health states, DALY weights reflect the degree to which health is reduced by a disease condition.

DALY-Calculation

- DALY: YLD + YLL
- YLD = Number of cases x duration till remission or death x disability weight
- YLL = Number of deaths x life expectancy at the age of death
- Age weighting: Value of life depends on age. Higher weight is given to the healthy life years lived in the (assumed) socially more important life span between 9 and 56 (Murray, 1994)

Alternative to QALY- HYE

Healthy year equivalent

- QALY measure is not consistent with utility theory
- HYE is an alternative, and is measure of quality of the life that is based on a two-stage procedure using an SG question to elicit preferences
- Better approach in principle compared to QALYs
- Criticism: Difficult of implementation

Alternative to QALY- WTP

- Willingness-to-pay

- Used within CBA (instead of CEA/CUA)
- Obtain valuations of health benefits in monetary terms by asking individuals how much they would be willing to pay to obtain or avoid the health effects.

- Criticism: WTP is closely associated with ability to pay

Cost of illness

Case Study

Cost-of-illness (COI)

- COI identifies the economic burden of a disease or medical condition
- In general these studies evaluate the resources consumed as a direct result of an illness or condition
- COIs always take a specific cost perspective, e.g. UK NHS
- Also called cost-of-disease or burden-of-illness studies

Severity and cost of hospitalization for dengue in public and private hospitals in Surat city, Gujarat, India, 2017-18

Viral R Bajwala, Denny John, Daniel Rajasekar, Manoj V Murhekar

Forthcoming publication

Background

- India accounts for approximately half of the 205 billion people who are at risk of dengue fever
- High medical costs on dengue treatment in India
- All previous studies in India estimated cost of treatment for dengue illness in private hospitals

Study Objective

Estimate economic cost of dengue hospitalization for the year 2017-18 in Surat city

Methodology

- 5 tertiary care hospitals (2 semi-government hospitals, 1 government hospital, 2 private hospitals) as study sites
- Review of medical records of patients hospitalized in any of the selected hospitals with a clinical diagnosis of dengue or laboratory confirmed dengue infection
- Use of pre-tested data extraction form to collect information about socio-demographic, clinical and cost details
- Cost of illness estimated using incidence-based approach using societal perspective

Methodology

Direct medical costs	ICU & Hospital Stay Laboratory tests Radiology investigations Doctor visits Intravenous blood transfusions Procedures (fluid tapping, lumbar puncture etc) ICU management (Oxygen, infusion pump, monitor, bipap ventilator)
Indirect medical cost	Minimum wage as per wage floor index reported by Ministry of Labour

Cost calculation

- Cost in private adult hospital and government hospital was calculated as follows:

Cost of variable= Number of units X per unit cost of that variable.....(1) (per unit cost was obtained from same hospital, pharmacy and lab). For other hospitals, the direct medical costs were obtained directly from bills

- Wage loss=Duration of hospital stay X 160 (INR 160 is minimum wage per day).....(2)

- Per day cost of hospitalization per patient = (Mean cost/Average length of stay)..... (3)

Description of cost of hospitalization in USD (2018 prices) for dengue patients in Surat city, India, 2017-18

Type of cost	Government hospitals (n=257)	Semi government hospitals (n=302)	Private hospitals (n=173)	Total (n=732)
Direct Medical				
Mean±SD[a]	1.0±1.4	17.4±22.7	311.3±221.6	81.1±168.0
Median(IQR[b])	0.9 (0.6-1.0)	11.7 (8.8-16.0)	270.2 (193.5-368.2)	10.1 (1.0-62.2)
Wage loss				
Mean±SD	11.9±4.2	13.0±7.0	12.1±4.5	12.3±5.5
Median(IQR)	8.2 (0.9-13.4)	17.3 (9.9-27.8)	274.9 (197.8-380.4)	12.5 (10.0-15.0)
Total cost				
Mean±SD	7.5±6.8	23.6±26.5	320.5±225.1	88.2±170.3
Median(IQR)	8.2 (0.9-13.4)	17.3 (9.9-27.8)	274.9 (197.8-380.4)	15.8 (8.3-67.3)
Fee exempted				
Mean±SD	0.8±0.2	20.2±24.5	0	15.3±22.8
Median(IQR)	0.9 (0.6-0.9)	12.3 (8.5-20.7)	0	9.0 (0.9-17.9)
Final cost after exemption				
Mean±SD	7.5±6.8	20.2±19.4	320.5±225.1	86.9±170.7
Median(IQR)	8.2 (0.9-13.3)	15.3 (8.3-25.2)	274.9 (197.8-380.4)	14.8 (7.3-65.9)

Cost-effectiveness/Cost-utility analysis

Case Study

Cost-effectiveness analysis (CEA)

- This analysis compares the monetary cost of an intervention with a measure of effectiveness (clinical or quality of life outcome)
- The outcomes are measured in natural units and usually expressed as the incremental gain/loss resulting from an intervention:
  - bed days avoided
  - deaths avoided
  - life years gained

Cost-utility analysis (CUA)

- An extension of cost-effectiveness analysis where effectiveness is expressed in utilities, such as QALYs
- This allows comparisons across different indications
- CUA very common form of economic analysis, e.g. Required for NICE/ SMC
- One criticism of CUA is how useful it is for acute (short-term conditions) or conditions where utility/quality-of-life difficult to measure

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Public Health

journal homepage: www.elsevier.com/puhe

Original Research

Cost-effectiveness and cost utility of community screening for glaucoma in urban India

Denny John [1,*], Rajul Parikh [2]

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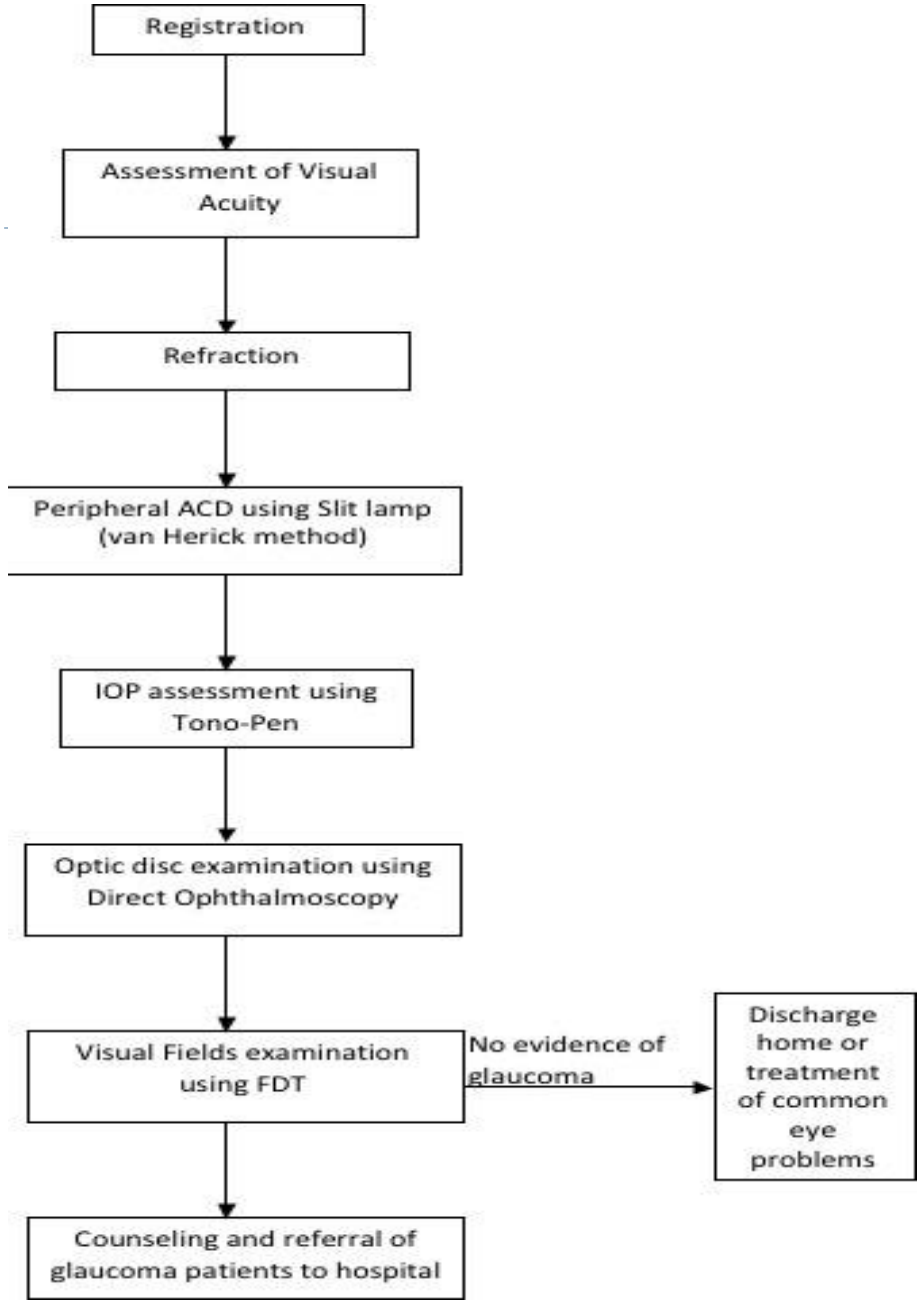
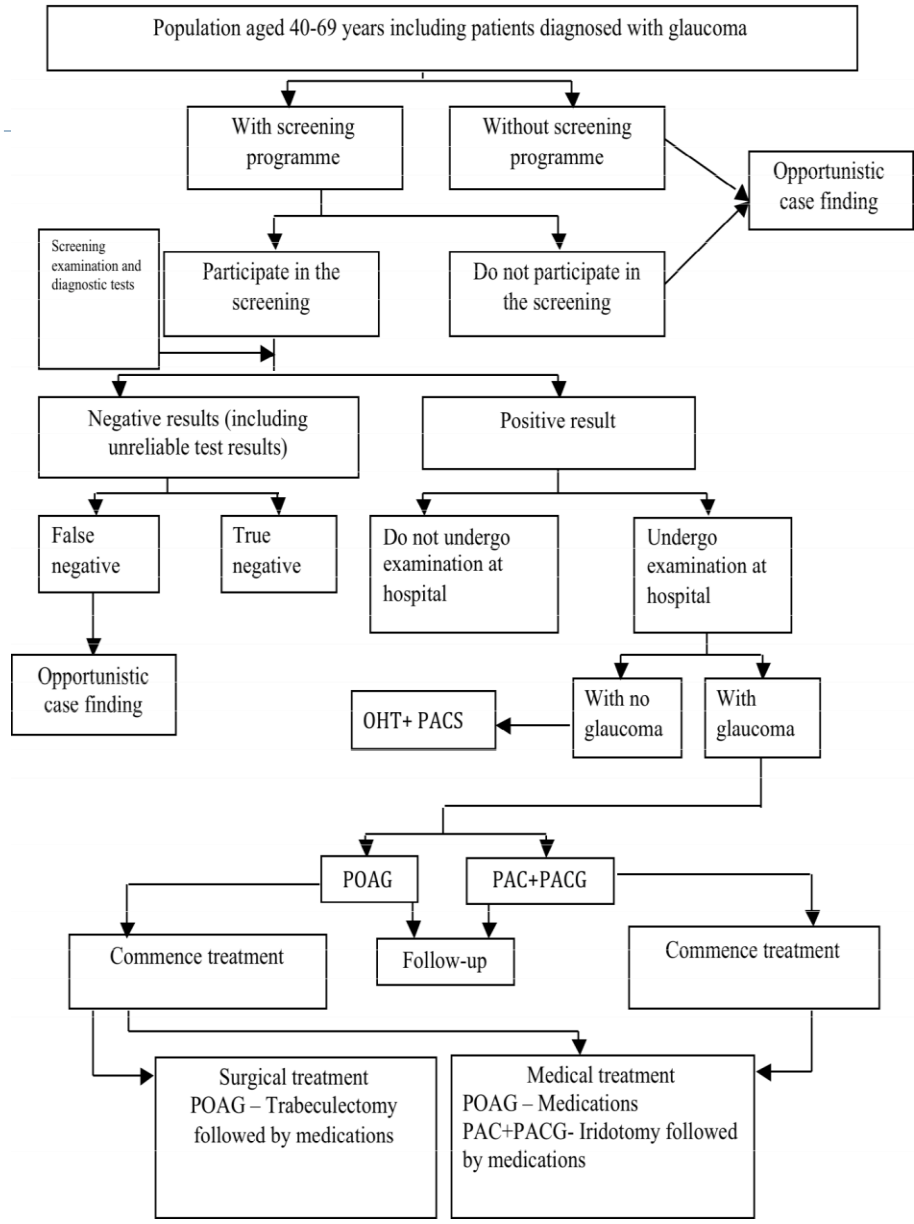
[2] Consultant & Glaucoma Specialist, Shreeji Eye Clinic & Palak's, Glaucoma Care Center, Samrat Building, M Vasanji Road, Andheri (East), Mumbai, India

Screening Protocol



Simulated screening & treatment pathway



Screening strategies & Outcomes

- Option 1: Inviting population aged 40-69 years from low-income urban areas.
- Option 2: Inviting population aged 40-69 years from rural areas.

The main outcomes of the study were defined as

(a) Total net cost of each strategy (i.e. costs of screening minus costs of case finding)

(b) Additional cases treated in the screening arm

(c) Cost per QALY gained by screened.

Methods

- Hypothetical population of 1 million aged 40-69 years in both urban and rural parts of India
- Time-horizon: 10 years
- Discount rate: 3 %
- Perspective: Health system

Probabilities- With no screening

(1) Population seeking eye examination

(2) Glaucoma detection

(3) Proportion of POAG/PACG in eye clinics/hospitals

(4) Probability of POAG and angle closure disease (PAC + PACG) cases requiring treatment

(5) Probability of POAG and angle closure disease (PAC + PACG) requiring medical and surgical treatment

Probabilities- With screening

(1) Screening uptake
(2) Post test probabilities of screening tests
(3) Negative screening results (including unreliable test results)
(4) Eye examination compliance post-screening
(5) Probability of cases diagnosed with glaucoma after examination in the hospital
(6) Proportion of POAG and PAC+PACG cases
(7) Probability of POAG and angle closure disease (PAC + PACG) cases requiring treatment
(8) Probability of POAG and angle closure disease (PAC and PACG) requiring medical and surgical treatment

Utility values

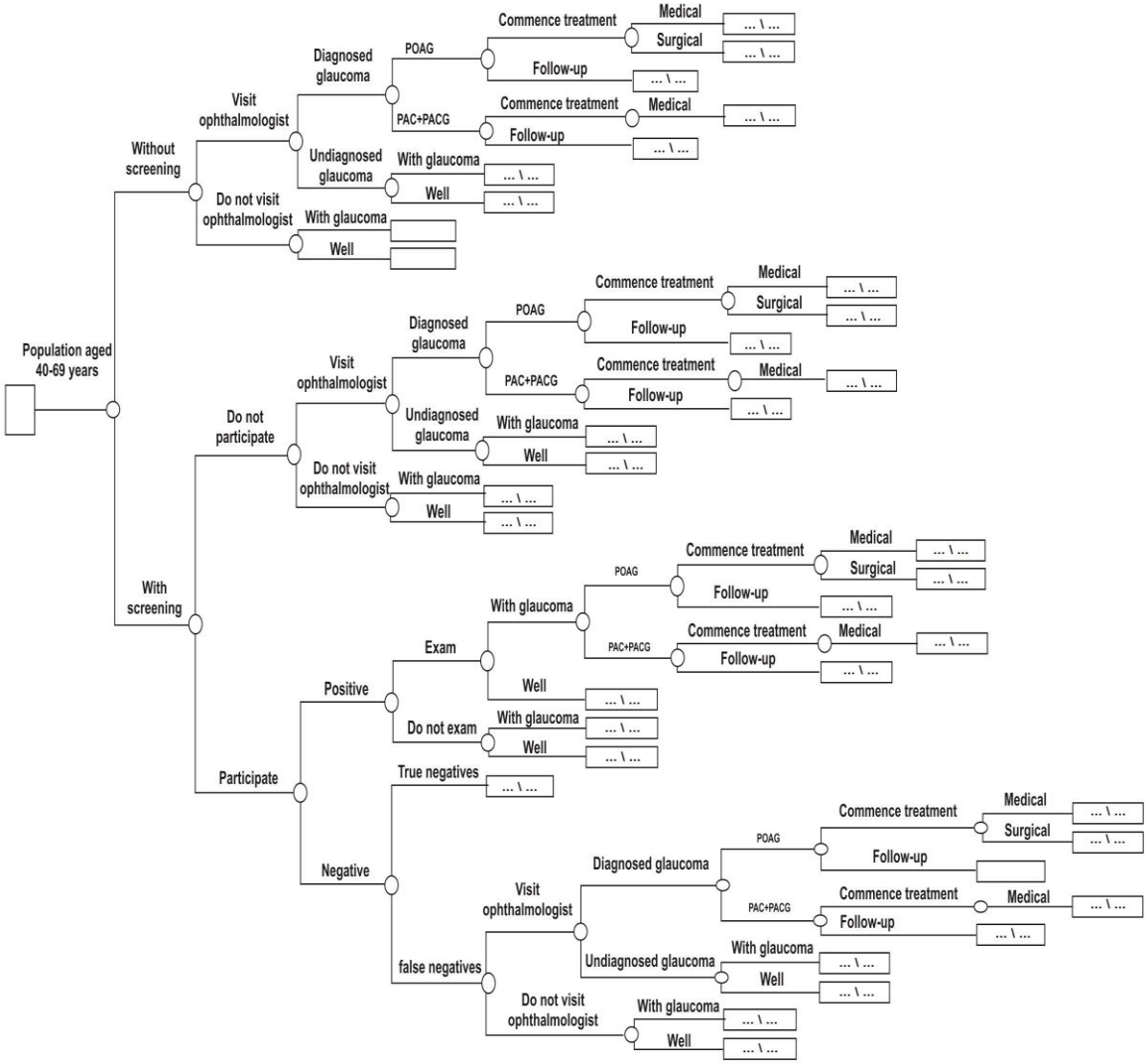
Variable	Time trade-off	Gamble 1 (for death)	Gamble 2 (for blindness)
Glaucoma (Mean value)	0.64 (SD 0.69, 95% CI, 0.58 to 0.70)	0.86 (SD 1.00, 95% CI, 0.81 to 0.90)	0.97 (SD 1.00, 95% CI, 0.94 to 0.99)
Diagnosis			
POAG	0.66	0.99	1.00
PACG	0.60	0.85	0.98
Medications (2 Nos)	0.66	0.88	0.97
Glaucoma Surgery	0.62	0.87	0.96

Source: Gupta et al., 2005

Costs

(1) Screening costs- Screening invitation costs, Screening clinic costs
(2) Examination costs
(3) Costs of treatment

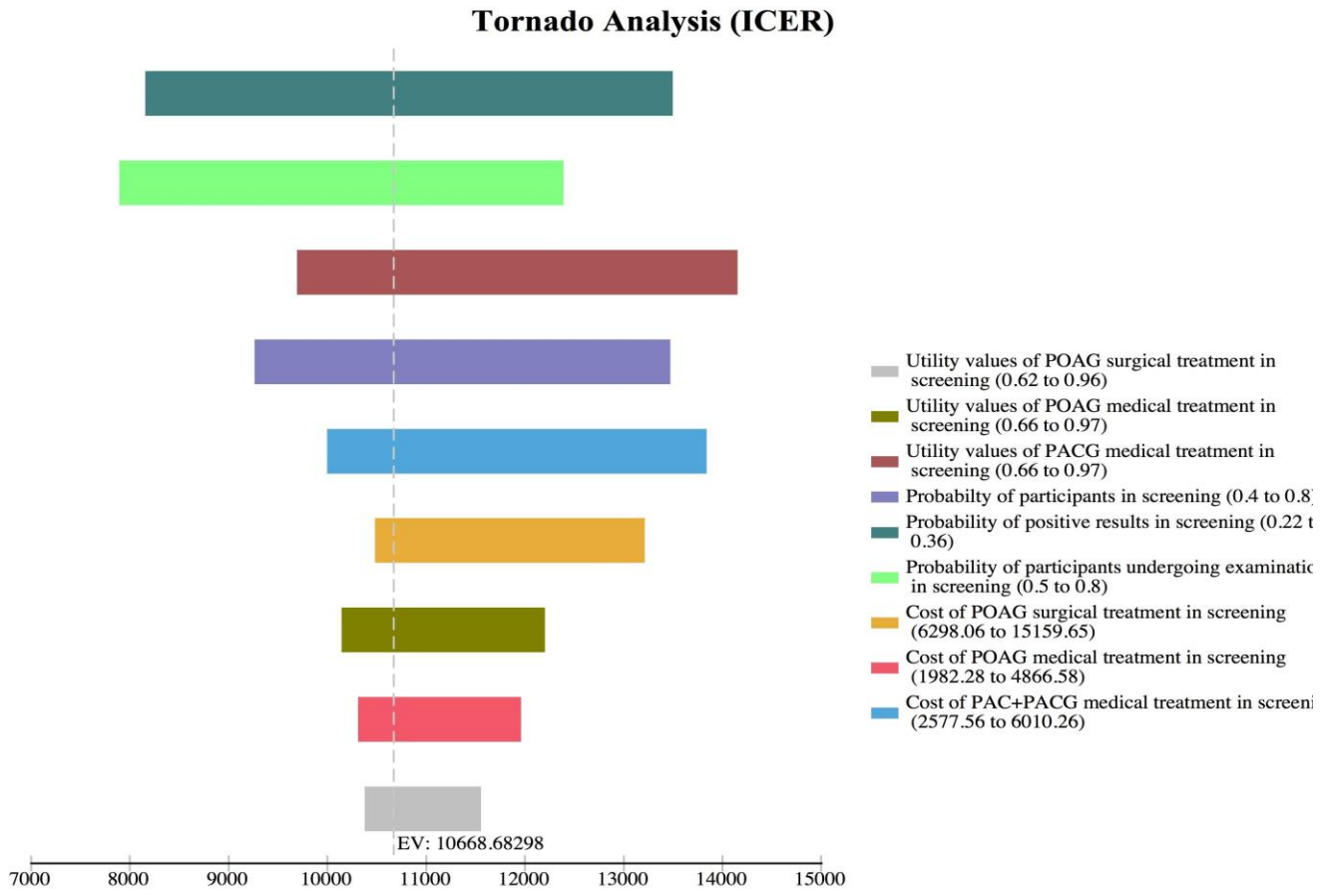
Decision Tree



Parameter	Urban		Rural	
	Without screening*	With screening	Without screening*	With screening
Population eligible	1,000,000	1,000,000	1,000,000	1,000,000
Population undergoing examination	450,000#	600,000	350,000#	800,000
Average cost per person (₹)	309.50	522.91	240.72	443.80
Total cost (₹)	309.50 million	522.91 million	240.72 million	443.80 million
Cases treated	1800	6243	1400	4272
Cost per case treated (₹)	171,944	83,759	171,943	103,886
QALYs	9.3877	9.6444	9.5257	9.8042
ICER^	Reference	8312.71	Reference	7292.30

*- With some level of opportunity case finding, #- Examined in opportunity case finding, ^- compared with no screening programme

Tornado diagram



Cost-minimization analysis

Case Study

Cost-minimisation analysis (CMA)

- A cost comparison of two or more interventions with comparable clinical and quality-of-life outcomes
- It is unlikely that the outcomes of two different interventions are equal so CMAs are rarely performed
- Useful for evaluating generically equivalent drugs where the outcomes have been demonstrated to be equivalent
- Useful for evaluating same intervention but given in different settings

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VOLUME 21 NO 2 PP 176–182 FEBRUARY 2016

Cost-optimization in the treatment of multidrug resistant tuberculosis in Nigeria

Baba Maiyaki Musa[1], Denny John[2], Abdulrazaq G. Habib[3] and Andreas Kuznik[4]

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2 *People's Open Access Education Initiative, Manchester, England*
3 *College of Health Sciences, Bayero University, Kano, Nigeria*
4 *Department of Global Pricing and Market Access, Celgene Corporation, Warren, NJ, USA*

Background

- WHO End TB Strategy 2035 targets: No TB-affected families facing catastrophic costs due to TB, and removal of financial barriers to health-care access is vital to achievement of universal health coverage and prevention of catastrophic expenditures
- Recent meta-analysis has shown that ambulatory models of MDR-TB treatment are equally effective and result in similar patient outcomes as facility-based care.
- However, the World Health Organization (WHO) also recommends home based treatment as a viable alternative for MDR-TB treatment

Study objective:

- Cost-minimisation analysis was conducted to assess the potential savings associated with an ambulatory-based MDR TB model from the perspective of the Nigerian national health system

Methods

- Model: Decision Tree
- Time-period: 2 years
- Intervention: Home-based treatment for MDR-TB
- Comparator: Facility-based treatment for MDR-TB
- Outcomes of interest: treatment success, treatment failure, treatment default, and mortality obtained from a systematic review of observational studies (Bassili et. al., 2013)
- Costs: Treatment costs included the cost of: drug therapy, hospital stay, nurse care, physician care, nursing facility and transport
- Cost inputs: Cost of anti-TB medication from published International Drug Price Indicator Guide, other costs based on internal analysis at Aminu Kano Teaching Hospital, Nigeria
- Output: Potential cost savings associated with home based treatment for all patients starting MDR TB treatment in Nigeria

Methods..

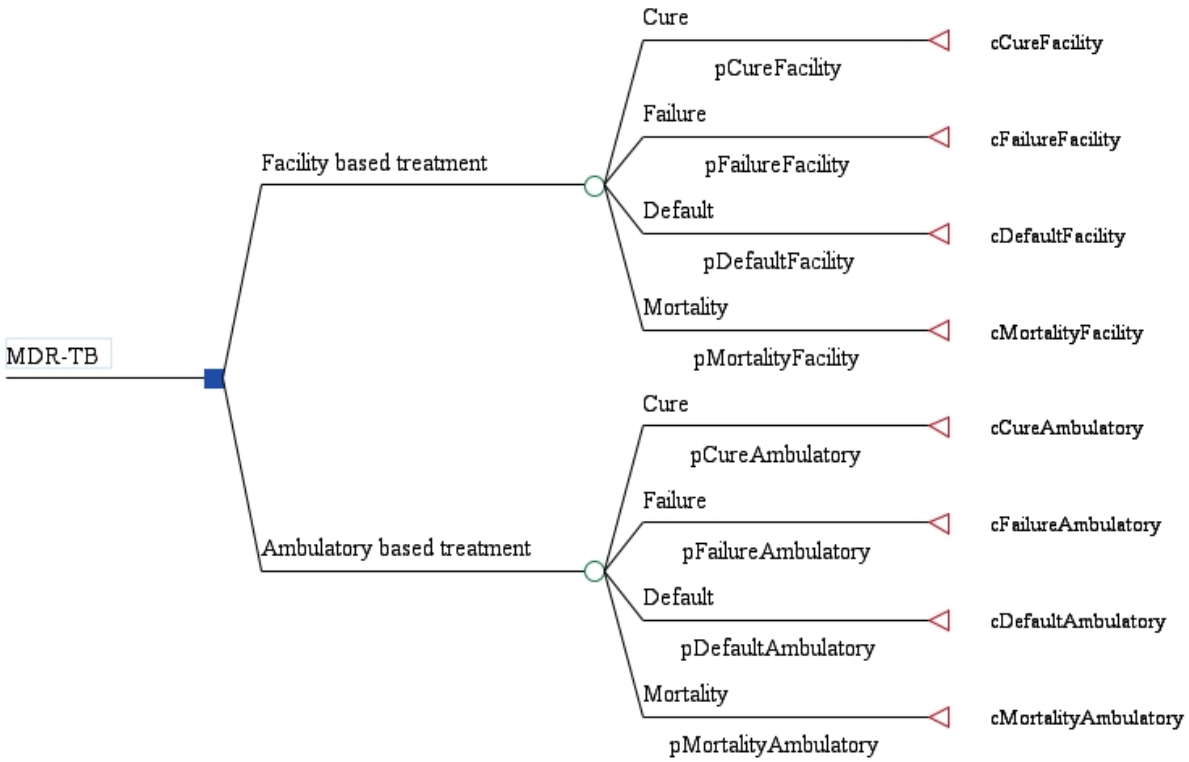
- Treatment efficacy was similar to both arms of the model based on meta-analysis study
- Treatment probabilities

Table 1 Results of MDR TB treatment outcomes in Bassili (2013)

Treatment outcome	Facility based and 95% CI	Adjusted probabilities and 95% CI	Ambulatory based (%, Range)	Adjusted probabilities
Cured	66.7 (61–72)	64.6 (69.3–59.6)	65.5 (55.1–74.6)	66.8% (58.4–74.0)
Failed	9.0 (6.5–12.2)	8.7 (7.4–10.1)	11.4 (6.7–18.8)	11.6 (9.0–14.7)
Defaulted	14.7 (10.2–20.7)	14.2 (11.6 –17.1)	13.3 (7.5–22.6)	13.6 (10.1–17.7)
Died	12.9 (10.3–16)	12.5 (11.7–13.2)	7.8 (5.2–11.7)	8.0 (7–9.2)
Sum	103.3	100	98	100

- One-way sensitivity analysis
- Software: MS-Excel

Decision Tree



RESULTS

- Average expected total treatment cost for a patient in Nigeria treated for MDR TB was estimated at US$ 2095.82 for the facility based model and $1535.06 based on the ambulatory care model, a potential saving of 25%.

- One of the major drivers of this difference is the significantly more intensive, and therefore costlier, nursing care in hospital.

- In the year 2013, an estimated 426 patients with MDR-TB were on treatment, thus, the potential savings associated with implementation of home based care is estimated at US$ 2.2 million for the year 2013

STUDY IMPLICATIONS

- Our study provides evidence of cost savings for MDR-TB patients requiring hospitalization for ambulatory care patients in comparison with facility-based treatment with similar outcomes.

- These cost savings may improve equity, however covering of indirect costs such as travel as part of the current government initiative for covering MDR-TB costs under the state health insurance schemes could mitigate the costs impact on low-income families as well.

- Conclusion: In Nigeria, treatment of MDR TB using home based care is expected to result in similar patient outcomes at markedly reduced public health costs compared with facility based care.

Cost benefit analysis (CBA)

Case study

A Cost-Benefit Analysis of Electronic Medical Records in Primary Care

Samuel J. Wang, MD, PhD, Blackford Middleton, MD, MPH, MSc, Lisa A. Prosser, PhD, Christiana G. Bardon, MD, Cynthia D. Spurr, RN, MBA, Patricia J. Carchidi, RN, MSN, Anne F. Kittler, Robert C. Goldszer, MD, MBA, David G. Fairchild, MD, MPH, Andrew J. Sussman, MD, MBA, Gilad J. Kuperman, MD, PhD, David W. Bates, MD, MSc

Background

- Electronic Medical Record (EMR) systems have the potential to provide substantial benefits to physicians, clinic practices, and health care organizations
- For widespread adoption of EMR a business case using cost-benefit analysis of implementing EMR was conducted

Methods

- Use by primary care physicians in ambulatory-care setting
- Data on costs and benefits from primary data of existing EMR, published studies and expert opinion (using Delphi technique)
- Comparator was traditional paper-based medical record
- Primary outcome measure was net financial costs or benefits per provider during a 5-year period
- Model framed using a healthcare organization perspective

Table 2. Annual Expenditures Per Provider (in 2002 U.S. Dollars) before Electronic Medical Record System Implementation and Expected Savings after Implementation

	Annual Expenditures before Implementation		Expected Savings after Implementation		
	Amount	Reference	Base Case Estimated Savings	Sensitivity Analysis (Range)	Reference
Payer independent					
Chart pulls	$5 (per chart)	*	600 charts	300–1200	*
Transcription	$9600	*	28%	20%–100%	*,32
Capitated patients					
Adverse drug events	$6500	33–36	34%	10%–70%	‡
Drug utilization	$109,000	†	15%	5%–25%	‡
Laboratory utilization	$27,600	†	8.8%	0–13%	37–39
Radiology utilization	$59,100	†	14%	5%–20%	‡
Fee-for-service patients					
Charge capture	$383,100	†	2% (increase)	1.5%–5%	25,40
Billing errors	$9700	†	78%	35%–95%	‡

* Primary data from the Partners HealthCare Electronic Medical Record System, Boston, Massachusetts.
† From the Department of Finance, Brigham and Women's Hospital, Partners HealthCare System.
‡ Expert panel consensus.

Table 3. 5-Year Return on Investment Per Provider for Electronic Medical Record Implementation

	Initial Cost	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Costs							
Software license (annual)	$1600	$1600	$1600	$1600	$1600	$1600	
Implementation	$3400						
Support	$1500	$1500	$1500	$1500	$1500	$1500	
Hardware (refresh every 3 years)	$6600			$6600			
Productivity loss		$11,200					
Annual costs	$13,100	$14,300	$3100	$9700	$3100	$3100	$46,400
Present value of annual costs*	$13,100	$13,619	$2812	$8379	$2550	$2429	$42,900
Benefits							
Chart pull savings		$3000	$3000	$3000	$3000	$3000	
Transcription savings		$2700	$2700	$2700	$2700	$2700	
Prevention of adverse drug events			$2200	$2200	$2200	$2200	
Drug savings			$16,400	$16,400	$16,400	$16,400	
Laboratory savings					$2400	$2400	
Radiology savings					$8300	$8300	
Charge capture improvement					$7700	$7700	
Billing error decrease					$7600	$7600	
Annual benefits		$5700	$24,300	$24,300	$50,300	$50,300	$154,900
Present value of annual benefits*		$5429	$22,041	$20,991	$41,382	$39,411	$129,300
Net benefit (cost)	$(13,100)	$(8600)	$21,200	$14,600	$47,200	$47,200	$108,500
Present value of net benefit (cost)*	$(13,100)	$(8190)	$19,229	$12,612	$38,832	$36,982	$86,400

* Assumes a 5% discount rate.

Results

- The estimated net benefit from using an electronic medical record for a 5-year period was $86,400 per provider.
- Benefits accrue primarily from savings in drug expenditures, improved utilization of radiology tests, better capture of charges, and decreased billing errors.
- In one-way sensitivity analyses, the model was most sensitive to the proportion of patients whose care was capitated
- Net benefit varied from a low of $8400 to a high of $140,100. A five-way sensitivity analysis with the most pessimistic and optimistic assumptions showed results ranging from $2300 net cost to $330,900 net benefit

Consolidated Health Economic Evaluation Reporting Standards (CHEERS)

Denny John, Evidence Synthesis Specialist
Campbell Collaboration

Challenges with reporting of EE studies

- Has been called the "black box"[1]
- Require more space for resource use, valuation procedures and (often) modeling
- Used for decision-making yet,
  - No consensus format or checklist
  - No registries or warehousing of information
  - Evidence of wide variability in reporting

1. John-Baptiste AA, Bell C. A glimpse into the black box of cost-effectiveness analyses. CMAJ. 2011 Apr 5;183(6):E307–308.

CHEERS-History

- Several existing guidelines that require updating/consolidation (BMJ/Drummond, Annals/LDI, Gold/CEA Task Force)
- BMJ considering updating their guidelines
- Task Force approved in November 2009
- Work began in 2010-change in scope/structure/leadership in 2011

Purpose of CHEERS

- A paper that meets all the requirements in the checklist will:
  - Clearly state the study question and its importance to decision makers
  - Allow a reviewer and a reader to assess the appropriateness of the methods, assumptions, and data used in the study
  - Allow a reviewer and reader to assess the credibility of the results and the sensitivity of the results to alternative data choices
  - Have conclusions that are supported by the study results
  - Potentially allow a researcher to replicate the model

Recommendations

- The recommendations are subdivided into the five sections generally found in a paper presenting an economic evaluation
  - Title and Abstract
  - Introduction
  - Methods
  - Results
  - Discussion

CHEERS Checklist – Items to include when reporting economic evaluations of health interventions (1)

Section/Item	Item No	Recommendation
Title and abstract		
Title	1	Identify the study as an economic evaluation, or use more specific terms such as ``cost-effectiveness analysis``, and describe the interventions compared.
Abstract	2	Provide a structured summary of objectives, perspective, setting, methods (including study design and inputs), results (including base case and uncertainty analyses), and conclusions.
Introduction		
Background and objectives	3	Provide an explicit statement of the broader context for the study.
		Present the study question and its relevance for health policy or practice decisions.
Methods		
Target Population and Subgroups	4	Describe characteristics of the base case population and subgroups analyzed including why they were chosen.
Setting and Location	5	State relevant aspects of the system(s) in which the decision(s) need(s) to be made.
Study Perspective	6	Describe the perspective of the study and relate this to the costs being evaluated.
Comparators	7	Describe the interventions or strategies being compared and state why they were chosen.
Time Horizon	8	State the time horizon(s) over which costs and consequences are being evaluated and say why appropriate.

CHEERS Checklist – Items to include when reporting economic evaluations of health interventions (2)

Section/Item	Item No	Recommendation
Discount Rate	9	Report the choice of discount rate(s) used for costs and outcomes and say why appropriate.
Choice of Health Outcomes	10	Describe what outcomes were used as the measure(s) of benefit in the evaluation and their relevance for the type of analysis performed.
Measurement of Effectiveness	11a	*Single Study-Based Estimates*: Describe fully the design features of the single effectiveness study and why the single study was a sufficient source of clinical effectiveness data.
	11b	*Synthesis-based Estimates*: Describe fully the methods used for identification of included studies and synthesis of clinical effectiveness data.
Measurement and Valuation of Preference-Based Outcomes	12	If applicable, describe the population and methods used to elicit preferences for outcomes.
Estimating Resources and Costs	13a	*Single Study-based Economic evaluation*: 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.
	13b	*Model-based Economic Evaluation*: 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.

CHEERS Checklist – Items to include when reporting economic evaluations of health interventions (3)

Section/Item	Item No	Recommendation
Currency, Price Date and Conversion	14	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.
Choice of model	15	Describe and give reasons for the specific type of decision-analytic model used. Providing a figure to show model structure is strongly recommended.
Assumptions	16	Describe all structural or other assumptions underpinning the decision-analytic model.
Analytic Methods	17	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.
Results		
Study parameters	18	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.
Incremental costs and outcomes	19	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.

CHEERS Checklist – Items to include when reporting economic evaluations of health interventions (4)

Section/Item	Item No	Recommendation
Characterizing Uncertainty	20a	*Single study-based economic evaluation*: 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).
	20b	*Model-based economic evaluation*: Describe the effects on the results of uncertainty for all input parameters, and uncertainty related to the structure of the model and assumptions.
Characterizing Heterogeneity	21	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.
Discussion		
Study Findings, Limitations, Generalizability, and Current Knowledge	22	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.
Other		
Source of Funding	23	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.
Conflicts of Interest	24	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

Campbell & Cochrane Economic Methods Group (CCEMG)

Webpage

- https://methods.cochrane.org/economics/
  - Further training materials

Cochrane Handbook

- Chapter 20, Economic Evidence, *Cochrane Handbook for Systematic Reviews of Interventions*. London: Cochrane. Shemilt I, Aluko P, Graybill E, Craig D, Henderson C, Drummond M, Wilson E, Wilson S, Vale L on behalf of the Campbell and Cochrane Economics Methods Group. Chapter 20: Economics evidence. Draft version (15 September 2018) in: Higgins JPT, Thomas J, Chandler J, Cumpston MS, Li T, Page MJ, Welch V (editors). *Cochrane Handbook for Systematic Reviews of Interventions*. London: Cochrane.

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