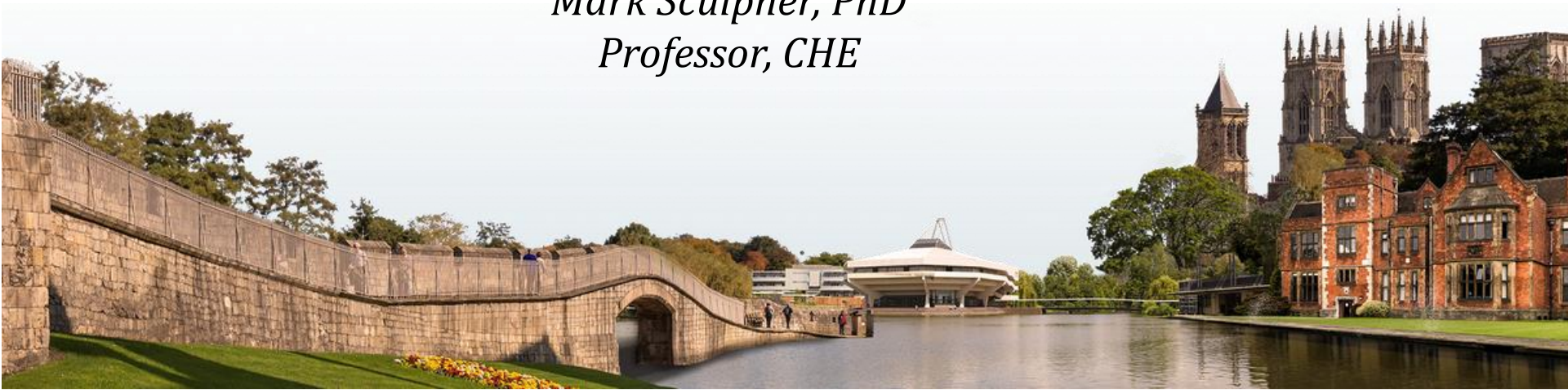
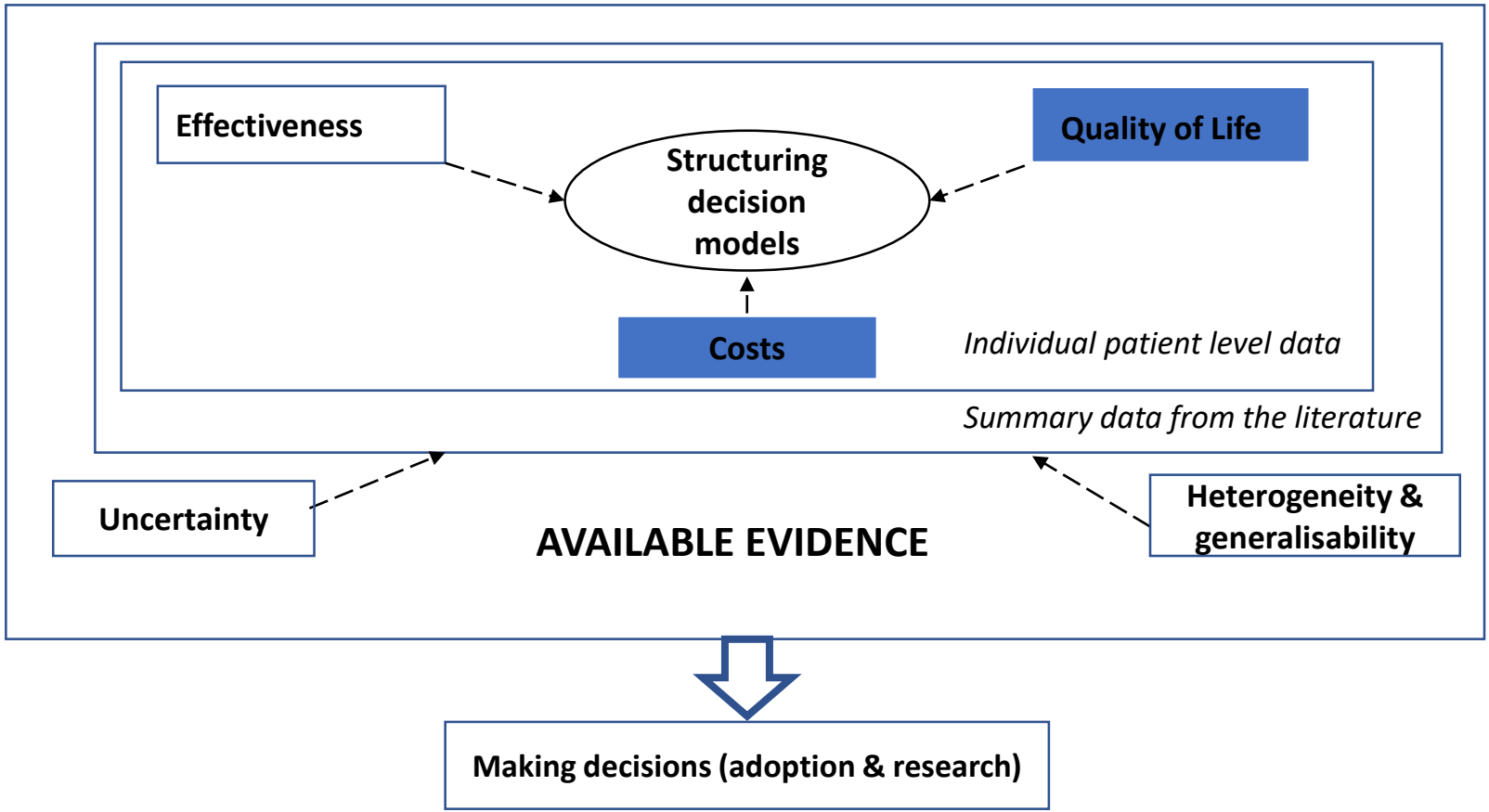
Online Advanced Methods for Cost-Effectiveness Analysis

Presentation 4: Populating Models: Costs and Outcomes
4.1: Overview and objectives

Mark Sculpher, PhD
Professor, CHE



Course structure – where are we up to?



Overview

- Key parameters in any model relate to costs and health-related quality of life outcomes
- Health outcomes central to any economic evaluation
- QALYs widely used in many countries
  - Range of approaches to estimating QALYs
  - Remain a source of controversy
- Key principles of costing
  - Sources of cost data
  - Distinction between costs and charges
  - Costing in specific contexts
- Current controversies in costing
  - Productivity costs
  - Costs in added years of life

Objectives

- Understand the QALY conceptually
- Appreciate different approaches to estimating health-related quality of life for QALYs
- Understand the key principles of costing
- Appreciate the controversies concerning productivity costs and costs in added years of life

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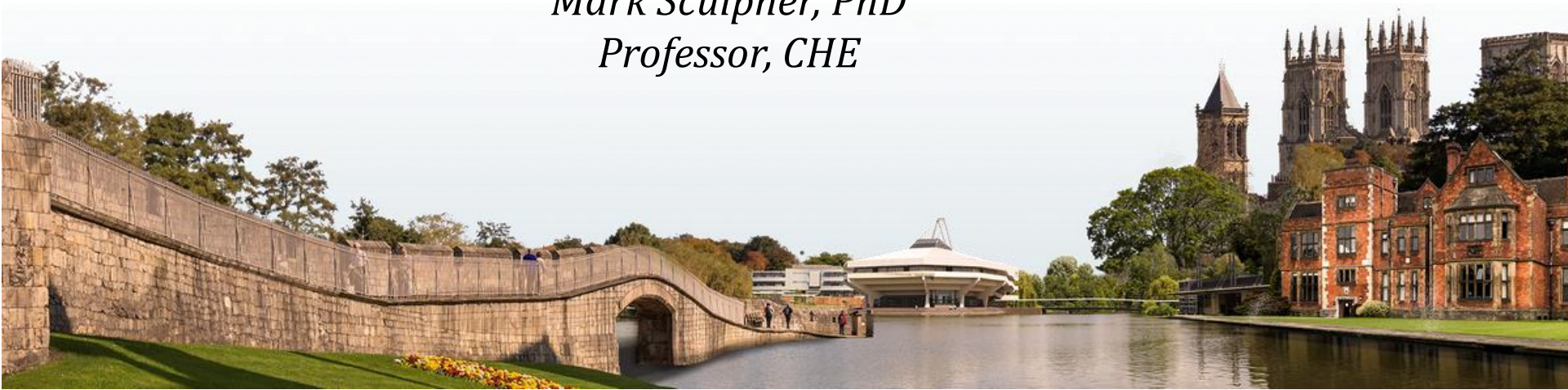
Presentation 4: Populating Models: Costs and Outcomes
4.2: Measuring health

Mark Sculpher, PhD
Professor, CHE



Objectives

- Understand which outcomes for economic evaluation
- Appreciate disease-specific versus generic measures of health
- Consider the importance of outcome valuation for making decisions

Which benefits?

Improving health is central to health sector decisions

Extending from health – equity considerations

Those with rare disease

Those with severe disease

Those with short life-expectancy

Those with disadvantage (e.g. low income)

Broader effects?

Health and care

- Independence
- Social interaction
- Being informed
- …

Other sectors

- Education
- Environment
- Criminal justice
- …

What type of outcome measure should we use?

- Value judgement, no ‘correct’ answer
- What are the health system’s objectives?
- Do effects extend outside the health system?
- Expect inclusion of some measure of health gain

Disease-specific measures of health-related quality of life

St Georges' Respiratory Questionnaire (excerpt)

Questions about how much chest trouble you have had over the past 3 months.

Please tick (✓) *one box for each question*:

	most days a week	several days a week	a few days a month	only with chest infections	not at all
1. Over the past 3 months, I have coughed:	☐	☐	☐	☐	☐
2. Over the past 3 months, I have brought up phlegm (sputum):	☐	☐	☐	☐	☐
3. Over the past 3 months, I have had shortness of breath:	☐	☐	☐	☐	☐
4. Over the past 3 months, I have had attacks of wheezing:	☐	☐	☐	☐	☐

5. During the past 3 months how many severe or very unpleasant attacks of chest trouble have you had?

Please tick (✓) *one*:

- more than 3 attacks ☐
- 3 attacks ☐
- 2 attacks ☐
- 1 attack ☐
- no attacks ☐

Generic measures of health-related quality of life

SF-36 Measure (excerpt)

SF-36 Survey

Date: / /2014 Patient's Name

Visit: □ **Pre-op** ☐ **6 week** □ **3 month** □ **6 month** □ **1 year**

INSTRUCTIONS: Please answer every question. Some questions may look like others, but each one is different. Please take the time to read and answer each question carefully by circling the number that best represents your response.

1. In general, would you say your health is?

Excellent (1)	Very Good (2)	Good (3)	Fair (4)	Poor (5)

2. Compared to one year ago, how would you rate your health in general now?

Much better now than one year ago (1)	Somewhat better now than one year ago (2)	About the same as one year ago (3)	Somewhat worse now than one year ago (4)	Much worse now than one year ago (5)

Generic versus disease-specific outcomes in resource allocation

- Disease-specific outcomes could be adequate if:
  - A decision maker is focussed only on one disease
  - The effects of a treatment only relate to that disease (no adverse events on other diseases)
  - The opportunity cost of the decisions only fall on patients with that disease
    - ‘ring-fenced’ budgets
    - no adjustment between budgets
- Does such a decision maker exist?

The need for valuation: not just for economics

	Treatment A	Treatment B
Diarrhoea	Moderate	Absent
Hot flushes	Present, mild	Present, mild
Breast swelling	Absent	Present
Physical energy	Lacking energy	No problems
Life expectancy	Option A better by 2 months	

The QALY is as old as the hills

Socio-Econ. Plan. Sci. Vol. 6, pp. 49–68 (1972). Pergamon Press. Printed in Great Britain

ANALYSIS OF A TUBERCULIN TESTING PROGRAM USING A HEALTH STATUS INDEX*

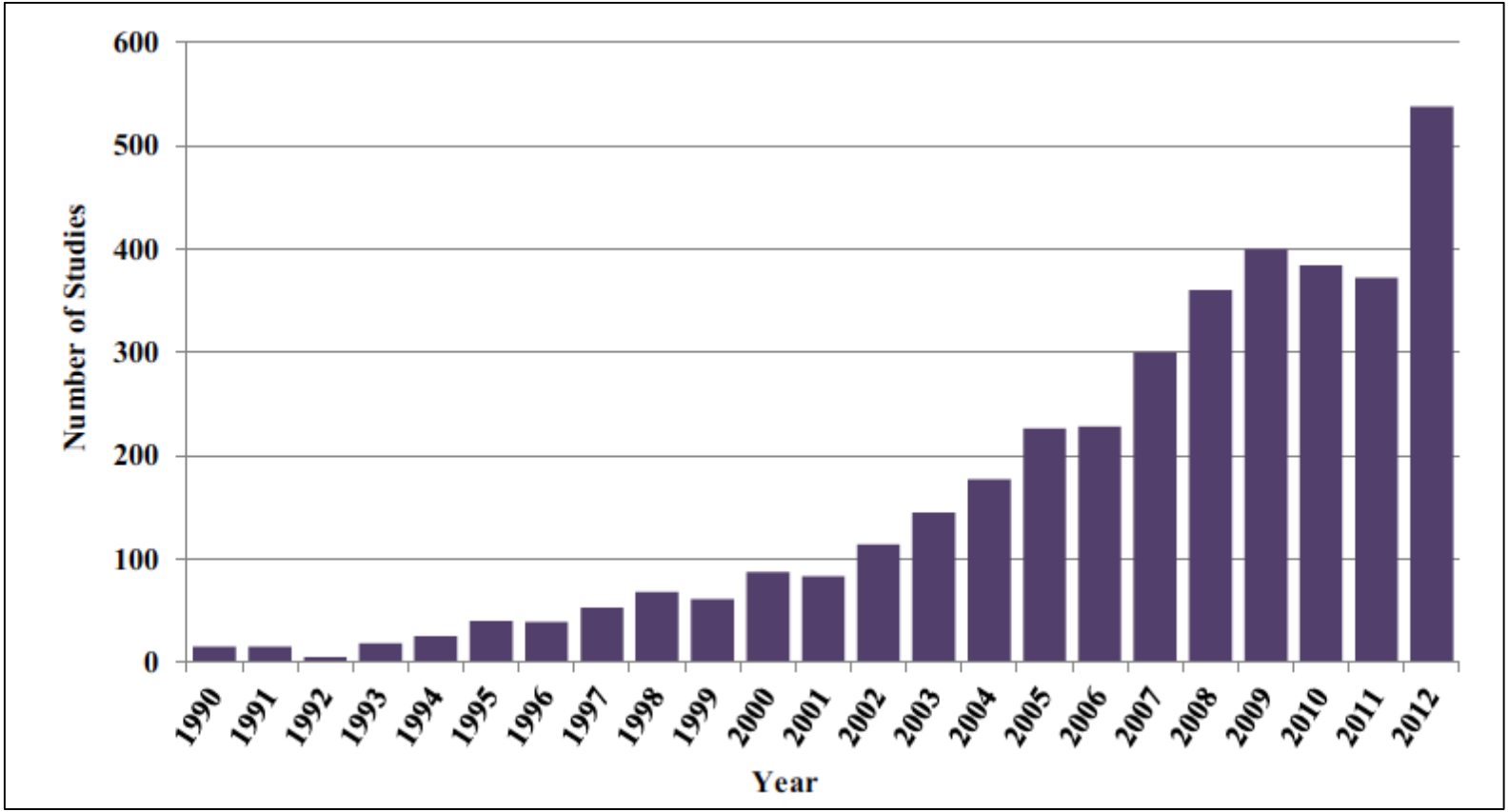
J. W. BUSH,† S. FANSHEL‡ and M. M. CHEN§

Department of Community Medicine, University of California at San Diego, La Jolla, California

(*Received* 21 *June* 1971)

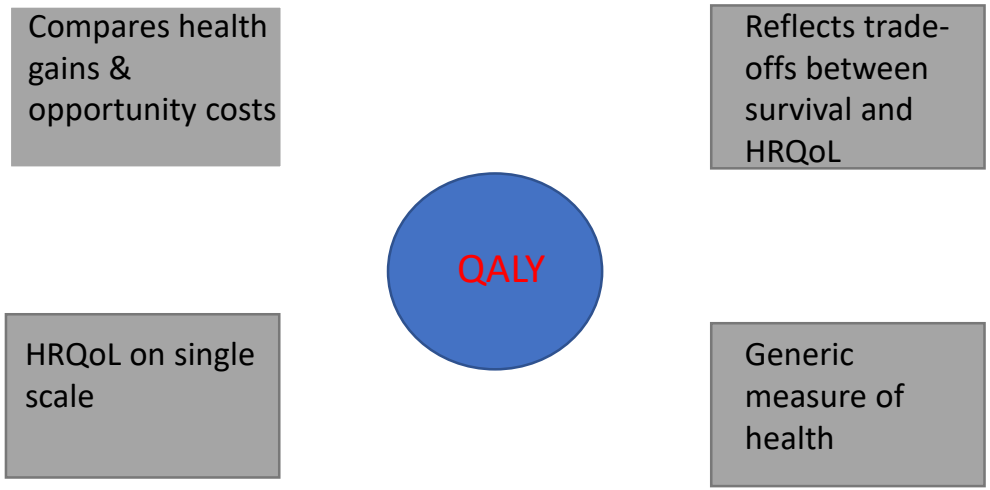
A function status index and a health status index are defined and a county-wide tuberculin testing program is analyzed to illustrate their uses in health planning. Each member of a target population belongs to one of several levels of function, from well-being (S_A), valued 1.0, to through various levels of dysfunction ($S_B, S_C \ldots$), through death (S_K), valued 0.0, and the utility numbers thus assigned between 0 and 1 are called function weights. The distribution of the population cohort among the various levels over time corresponds to a stochastic process where group prognoses make up the transition probability matrices. Using a set of function weights, the function status of a person or population can be computed for each point over time, with and without a program. Output, the expected difference between the two function-histories with or without the program, is measured in function–time units that are independent of disease form, permitting comparisons among health programs for different diseases. The output measure can be used in cost–effectiveness, mathematical programming and other optimization models, as well as in other areas of health services research.

...and widely used

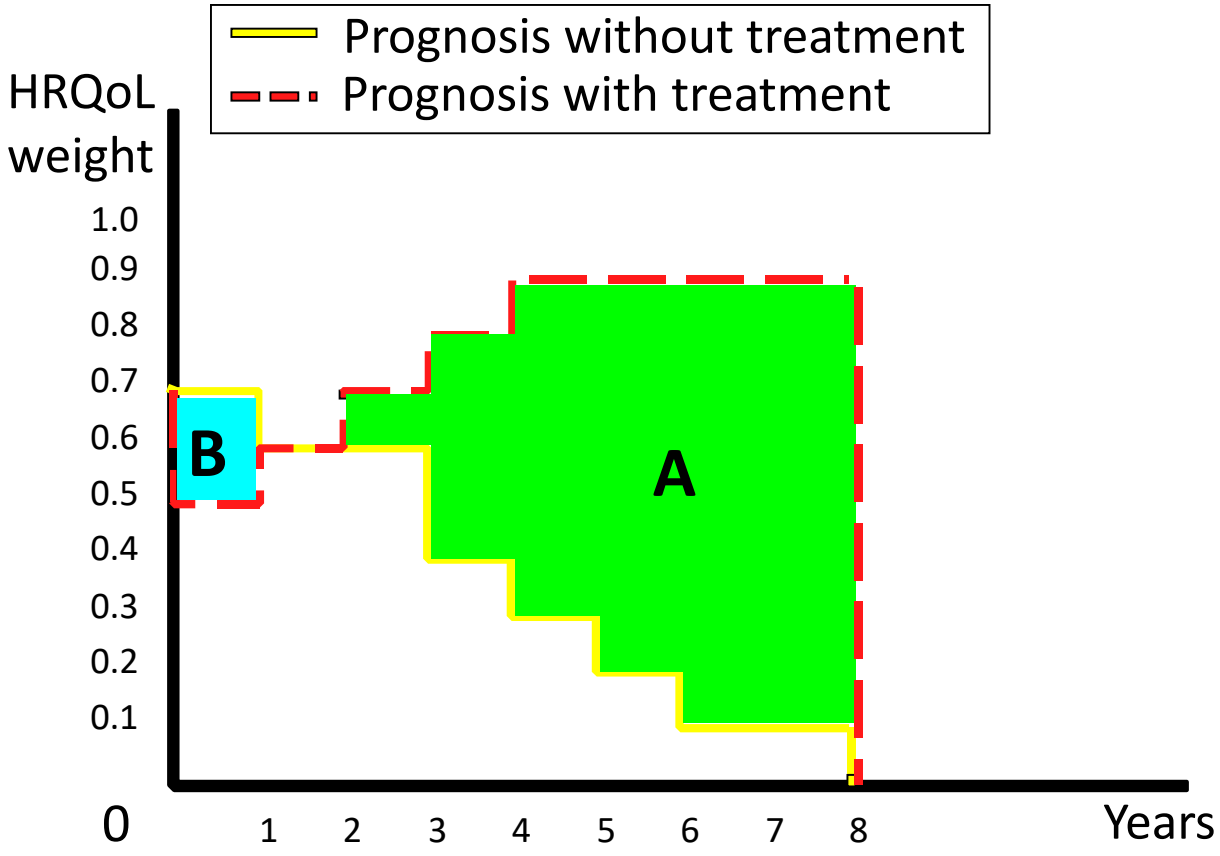


Neumann *et al. Value in Health* 2015; 18:271-77

The QALY and decision-making



The QALY diagrammatically



Weaknesses of the QALY

- Strong assumptions relating to individual preferences
  - Constant proportional trade-off
    - 10 years at 0.5 = 5 years at 1.0
    - 10 months at 0.5 = 5 months at 1.0
- Range of suggested weaknesses
- But QALYs …
  - Provide a consistent method of health valuation
  - Indicator of health outcome: QALY doesn't make decisions
  - Have been routinely measured in numerous studies

Alternatives to the QALY

Healthy-year equivalent
- Theoretical improvement
- Lack of application

Mehrez A, Gafni A. *Medical Decision Making* 1989; 9: 142-149

Saved young life equivalent
- Theoretical improvement
- Lack of application

Nord E. *British Medical Journal* 1992; 305: 875-877

Health years in total
- 'Avoids' QALYs perceived discrimination
- Lack of application

Basu *et al. Value in Health* 2020;23: 96-103

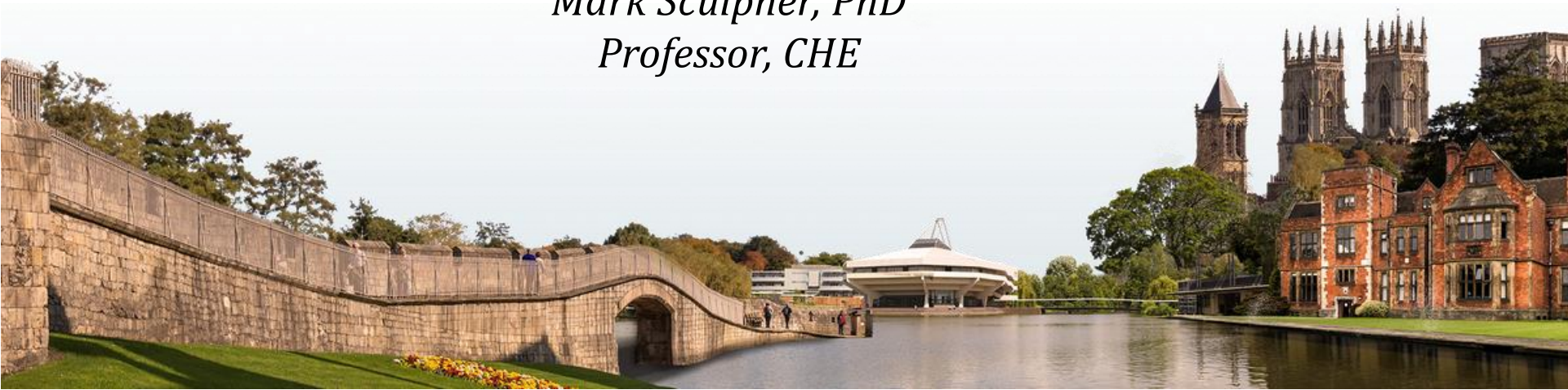
Summary

- Outcome side of economic evaluation highly contested
  - Health gains central
  - Is some people's health gain worth more than others?
  - Are their effects outside health?
- These are value judgements and no social consensus likely
  - Accountable decision makers need to make choices
- Generic measures crucial to support resource allocation decisions
- Quantifying trade-offs (valuation) essential in making decisions
- No perfect measure of health reflecting universal preferences
- QALY a widely understood and used measure of health

Online Advanced Methods for Cost-Effectiveness Analysis

Presentation 4: Populating Models: Costs and Outcomes
4.3: Routes to QALYs

Mark Sculpher, PhD
Professor, CHE



Objectives

- Understand different ways of estimating QALYs
- Further clarify differences between measurement of health and valuation
- Understand generic preference-based measures of HRQoL
  - Example of EQ5D
- Appreciate the importance of mapping approaches

The two stages of QALY estimation

Stage 1

Describing health states

(Measuring (health-related) QOL)

- Generic vs. disease-specific
- Source of measurement?

Stage 2

Valuing health states

(Valuing (health-related) QOL)

- Method of valuation
  - Choice-based
  - Other
- Source of values
  - Patients
  - Public

Alternative valuation methods

- Rating scale
- Standard gamble
- Time trade-off
- Others

See Drummond MF, Sculpher MJ, Claxton K, *et al*. *Methods for the Economic Evaluation of Health Care Programmes.* Fourth Edition. Oxford: Oxford University Press, 2015, Chapter 5

Whose values?

- Patients
  - Ultimate recipient of the change in health
  - Experienced with (some of) the relevant health states
  - (May be) aware of the process of adaptation
- Public
  - Payer
  - Behind the veil of ignorance regarding which health they will experience
  - No experience of the relevant health states
  - Unaware of the process of adaptation in patients

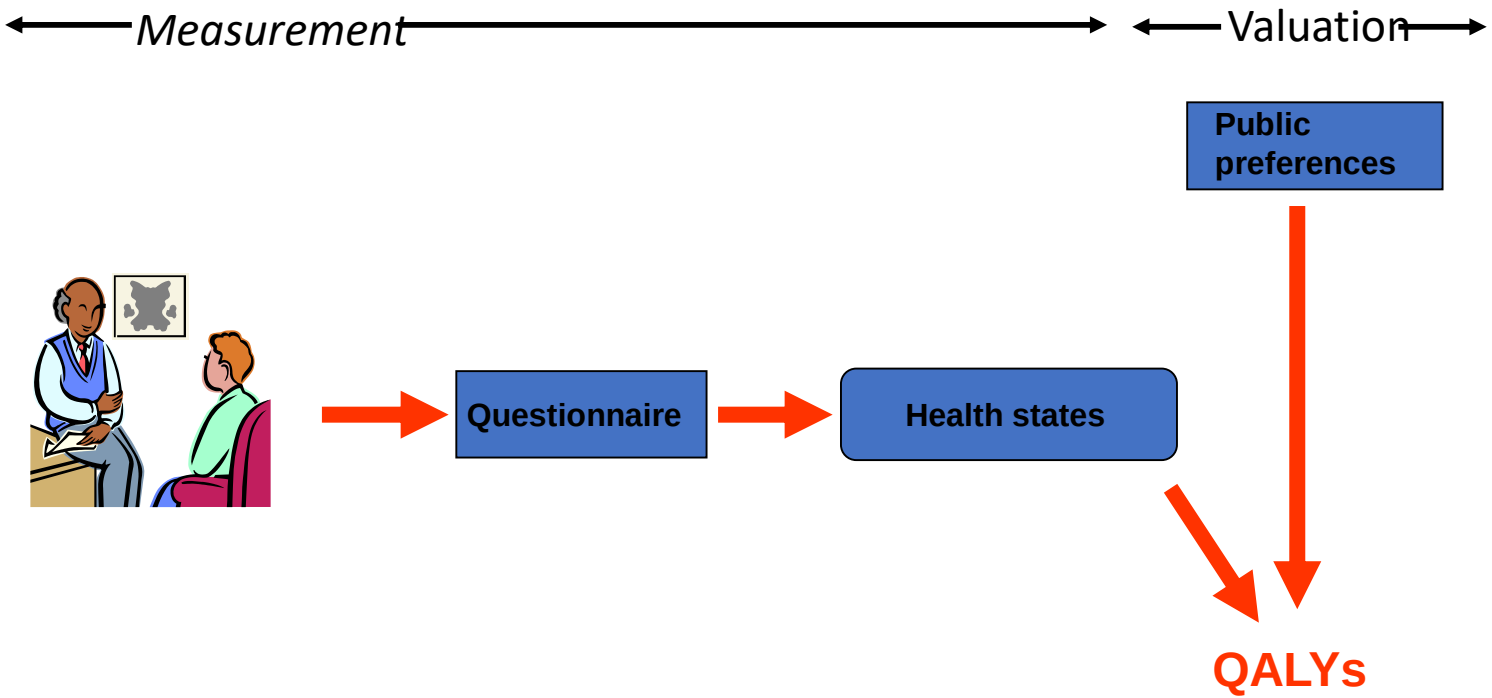
Brazier *et al.* (2005) Should patients have a greater role in valuing health states? *Applied Health Economics and Health Policy*; 4: 201-208

Alternative routes to a QALY

Direct head-to-head standardised data

Measurement	▪ Use of standardised descriptive system ▪ In study comparing interventions of interest ▪ Example: randomised trial; observational study
Valuation	▪ Pre-established set of values with descriptive system

Preference-based systems



EQ-5D 3L descriptive system

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 and dressing myself
I am unable to wash and dress myself

Usual activities (eg. 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

An EQ-5D health state

Mobility	Self care	Usual acts	Pain & dis	Depres'n
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3

See www.euroqol.org

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 ☐

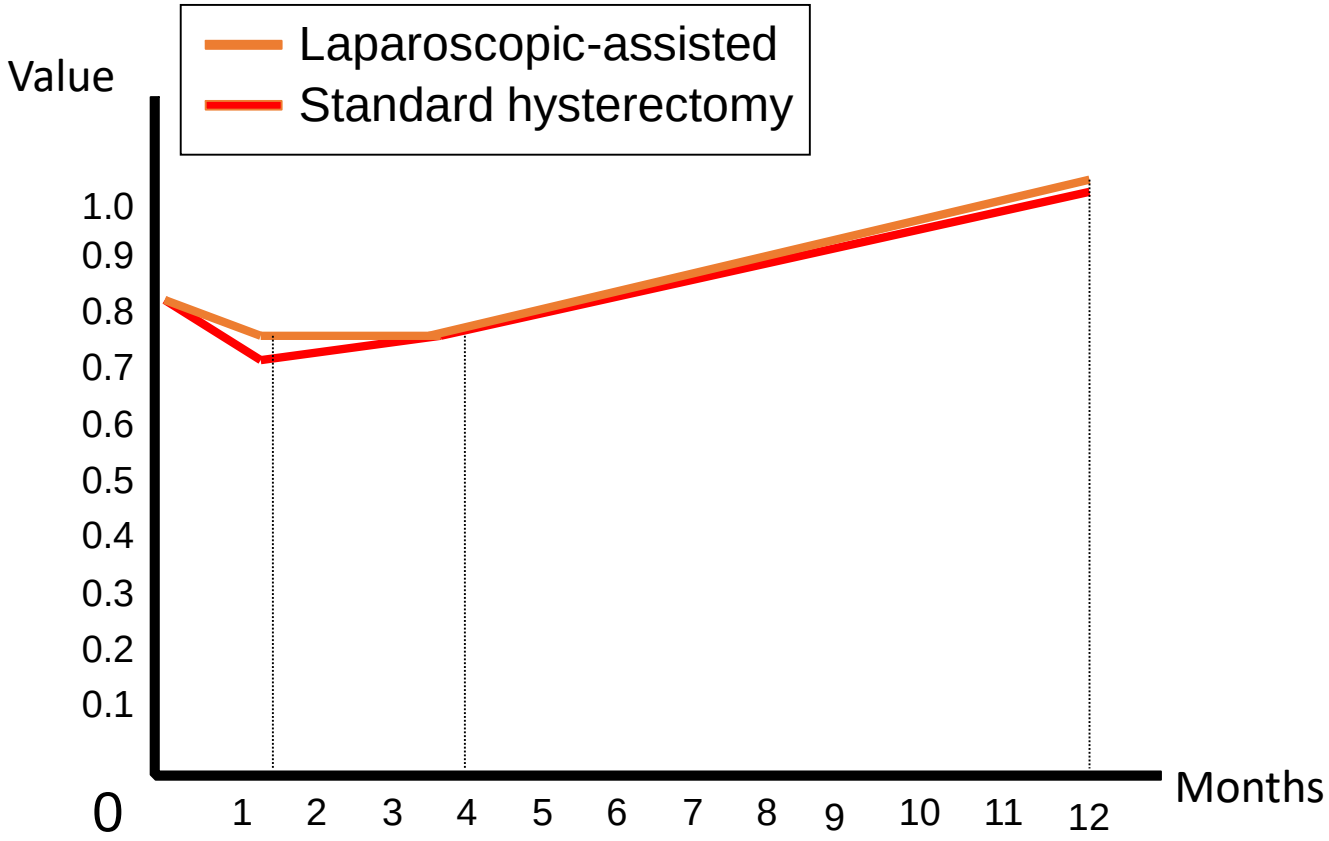
PAIN / DISCOMFORT

- 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 ☐

Example: Laparoscopic hysterectomy



Sculpher *et al. BMJ* 2004; 328: 134

Alternative routes to a QALY

Direct head-to-head disease-specific mapped to a generic system

Measurement	▪ Use of standardised disease-specific descriptive system ▪ Not preference-based ▪ In study comparing interventions of interest ▪ Example: randomised trial; observational study
Valuation	▪ Pre-established set of values with descriptive system

Example: Mapping an asthma-specific measure to the EQ-5D (1)

Sample of 3000 patients in UK general practices

EQ-5D = Fn (Asthma Quality of Life Questionnaire)

Generic descriptions Preferences	32 items (7 levels each) 4 domains (symptoms, activities, emotions, environment)

Tsuchiya *et al.* ScHARR Discussion Paper 02/01, 2002

Guidance on mapping

VALUE IN HEALTH 20 (2017) 18–27

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevier.com/locate/jval

Mapping to Estimate Health-State Utility from Non–Preference-Based Outcome Measures: An ISPOR Good Practices for Outcomes Research Task Force Report

Allan J. Wailoo, MA, PhD[1,], Monica Hernandez-Alava, MSc, PhD[1], Andrea Manca, MSc, PhD[2], Aurelio Mejia, MSc[3], Joshua Ray, MSc[4], Bruce Crawford, MA, MPH[5], Marc Botteman, MS, MA[6], Jan Busschbach, PhD[7]*

[1]*School of Health and Related Research, University of Sheffield, Sheffield, UK;* [2]*Centre for Health Economics, University of York, York, UK;* [3]*Instituto de Evaluación Tecnológica en Salud, Bogota, Colombia;* [4]*F. Hoffmann-La Roche, Basel, Switzerland;* [5]*IMS Health, Tokyo, Japan;* [6]*Pharmerit International, Bethesda, MD, USA;* [7]*Department of Psychiatry, Section Medical Psychology and Psychotherapy, Erasmus Medical Center, Rotterdam, The Netherlands*

Alternative routes to a QALY

Linking a clinical measure to a generic preference-based measure

Measurement	▪ Key clinical measures of effect, severity or events ▪ Mapped to a generic system (e.g. EQ-5D)
Valuation	▪ New sample for valuation

Example from continuous positive airway pressure for the treatment of obstructive sleep apnoea-hypopnoea syndrome

Utility	Coefficient	Standard error	P-value	95% confidence interval	
OLS model for utility based on SF-6D (n=294)					
ESS	-.0095213	.0013849	0.000	-.0122512	-.0067915
Baseline ESS	.0050331	.0011942	0.000	.0026791	.0073871
Baseline utility	.5588972	.0534972	0.000	.4534455	.6643489
Constant	.8067555	.0115013	0.000	.7840845	.8294265
OLS model for utility from EQ-5D (n=94)					
ESS	-.0096984	.003947	0.016	-.0175364	-.0018604
Baseline ESS	.0029526	.0033693	0.383	-.0037382	.0096435
Baseline utility	.6287684	.1346153	0.000	.3614492	.8960877
Constant	.8925207	.0286109	0.000	.8357052	.9493363

Weatherly *et al. International Journal of Technology Assessment in Health Care* 2009; 25: 26-34

Harvesting existing data

Preference-Based EQ-5D Index Scores for Chronic Conditions in the United States

Patrick W. Sullivan, PhD, Vahram Ghushchyan, PhD

Background. *The Panel on Cost-Effectiveness in Health and Medicine has called for an "off-the-shelf" catalogue of nationally representative, community-based preference scores for health states, illnesses, and conditions. A previous review of cost-effectiveness analyses found that 77% did not incorporate community-based preferences, and 33% used arbitrary expert or author judgment. These results highlight the necessity of making a wide array of appropriate, community-based estimates more accessible to cost-effectiveness researchers.* ***Objective***. *To provide nationally representative EQ-5D index scores for chronic ICD-9 codes.* ***Methods***. *The nationally representative Medical Expenditure Panel Survey (MEPS) was pooled (2000–2002) to create a data set of 38,678 adults. Ordinary least squares (OLS), Tobit, and censored least absolute deviations (CLAD) regression methods were used to estimate the marginal disutility of each condition, controlling for age, comorbidity, gender, race, ethnicity, income, and education.* ***Results***. *Most chronic conditions, age, comorbidity, income, and education were highly statistically significant predictors of EQ-5D index scores. Homoskedasticity and normality assumptions were rejected, suggesting only CLAD estimates are theoretically unbiased. The magnitude and statistical significance of coefficients varied by analytic method. OLS and Tobit coefficients were on average 60% and 143% greater than CLAD, respectively. The marginal disutility of 95 chronic ICD-9 codes as well as unadjusted mean, median, and 25th and 75th percentiles are reported.* ***Conclusion***. *This research provides nationally representative, community-based EQ-5D index scores associated with a wide variety of chronic ICD-9 codes that can be used to estimate quality-adjusted life-years in cost-effectiveness analyses.*
Key words: *health-related quality of life; cost-utility analysis; cost-effectiveness analysis; utility; chronic disease; ICD-9; econometric methods.* ***(Med Decis Making 2006; 26:410–420)***

Quality of life weights by ICD 9 codes

ICD-9 Classification	*n*	Mean Age	NCC[b] 25%	NCC[b] 50%	NCC[b] 75%	Unadjusted				Regression Results[a]		
						Mean EQ-5D	EQ-5D 25%	EQ-5D 50%	EQ-5D 75%	Disutility of Condition[a]	Condition[a] Standard Error	Statistical Significance (Condition)
ICD-9 410 Acute Myocardial Infarct	244	62	3	5	7	0.704	0.575	0.778	0.843	–0.0409	0.0002	*
ICD-9 413 Angina Pectoris	228	69	4	6	9	0.695	0.517	0.768	0.827	–0.0412	0.0002	*
ICD-9 414 Oth Chr Ischemic Hrt Dis	183	66	4	6	8	0.738	0.708	0.794	0.827	–0.0336	0.0002	*
ICD-9 424 Oth Endocardial Disease	214	56	2	4	6	0.789	0.708	0.816	1.000	–0.0059	0.0002	*
ICD-9 427 Cardiac Dysrhythmias	649	67	3	5	7	0.774	0.708	0.810	0.843	–0.0190	0.0001	*
ICD-9 428 Heart Failure	284	71	5	6	9	0.636	0.437	0.708	0.810	–0.0635	0.0002	*
ICD-9 429 Ill-Defined Heart Dis	1204	69	3	5	7	0.716	0.619	0.778	0.827	–0.0492	0.0001	*
ICD-9 436 CVA	340	68	3	5	7	0.650	0.463	0.768	0.816	–0.0524	0.0001	*

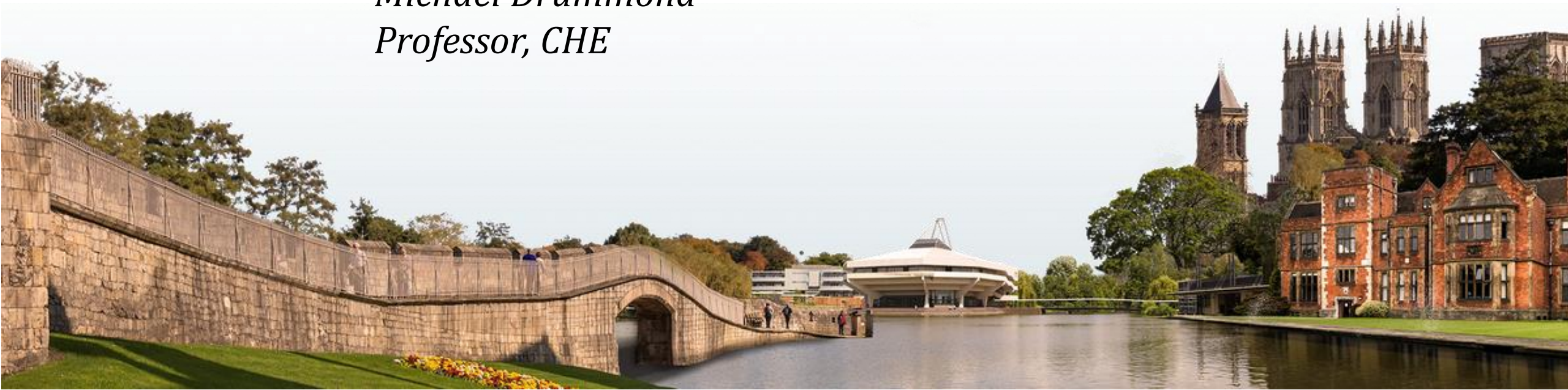
Summary

- Data collection alongside primary studies key source of evidence
  - Direct use of generic preference-based measure
  - Mapping from disease-specific measure
- HRQoL may take place outside effectiveness study
  - Mapped to clinical measures
- Secondary sources of HRQoL weights increasingly available

Online Advanced Methods for Cost-Effectiveness Analysis

Presentation 4: Populating Models: Costs and Outcomes
4.4: Costing Methods: Key Principles

Michael Drummond
Professor, CHE



Objectives

- To understand the key principles of costing, including:
  - The importance of the perspective for analysis
  - The alternative sources of cost data
  - The difference between costs and charges
  - The relevance of considering the context when costing
  - The costing of informal care

Background to costing

- A neglected area in economic evaluation
- Depends on the *perspective* for the evaluation (eg payer, society)
- Requires estimates of the quantities of resources (q) and their prices (p); if possible, report these separately
- Costing methods are often heavily constrained by the financial data available in a given setting
- Observed prices (i.e. charges) may not reflect true costs

Importance of costing assumptions: Cost-effectiveness of Dasatinib and Nilotinib in Imatinib-resistant chronic myeloid leukemia (1)

- Independent analysis performed for NICE in the UK
- No head-to-head trials, but an indirect treatment comparison made
- *Survival estimates*

  Nilotinib 13.0 years Dasatinib 13.4 years
- *Costs of treatment*

  Nilotinib £70,000 Dasatinib £161,000
- Incremental cost-effectiveness ratio was £91,500 per QALY
- In an extensive probabilistic sensitivity analysis, Dasatinib was more costly than Nilotinib 'in virtually all simulations'
- Unambiguous result?

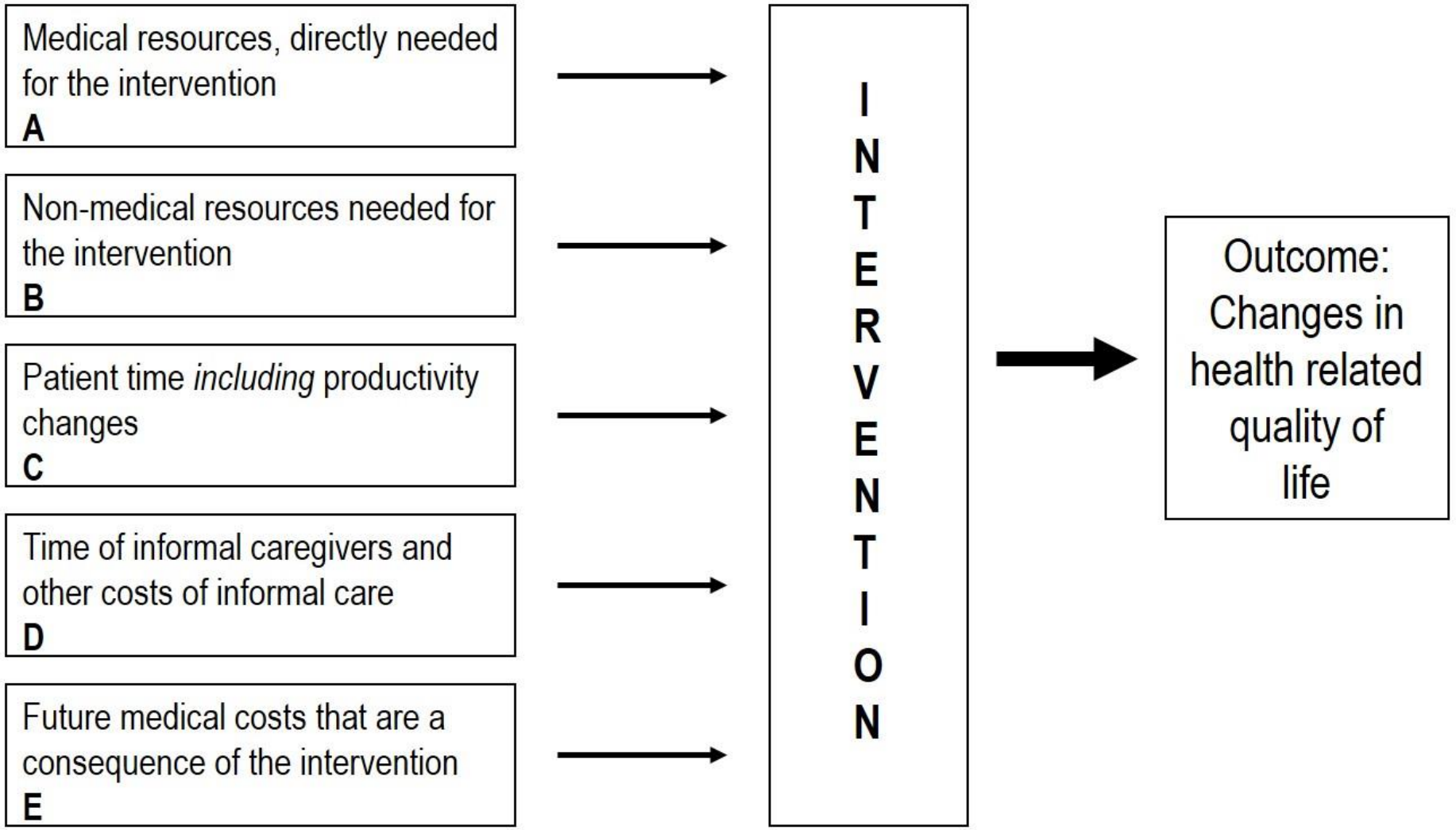
Source: Hoyle *et al. Value in Health* 2011; 14: 1057-1067

Importance of costing assumptions: Cost-effectiveness of Dasatinib and Nilotinib in Imatinib-resistant chronic myeloid leukemia (2)

- Progression-free survival was 0.63 for nilotinib (at 18 months) and 0.77 for dasatinib (at 20 months)
- Monthly drug cost was £1217 for nilotinib and £1169 for dasatinib, so treatment cost difference can only be due to the amount of therapy
- Direct information on treatment duration was not available, but duration of therapy was assumed to be just 2.4 years for nilotinib, but 6.5 years for dasatinib
- The estimate of drug utilisation was an assumption, based on time to progression, which was longer for dasatinib.
- NICE's clinical advisers felt that, in their experience, the duration of therapy was fairly similar for the two drugs

Source: Reed SD. *Value in Health* 2011; 14: 1055-6

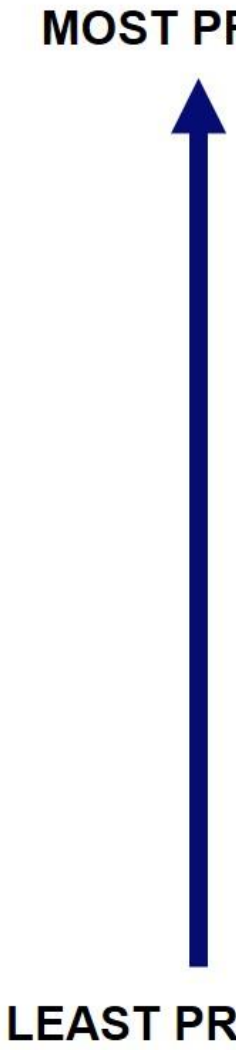
Categories of cost in economic evaluation



Important things to know about cost estimates

- Is it a cost or a charge?
- What elements does it include (e.g. capital costs)?
- Is it average or marginal?
- Is it relevant to the setting of my study?

General approaches to costing (e.g. hospital costs)



Micro-costing
Each component of resource use (e.g. laboratory tests, days of stay by ward, drugs) is estimated and a unit cost derived for each.

Case-mix group
Gives the cost for each category of 'case' or hospital patient. Takes account of length of stay. Precision depends on the level of detail in specifying the types of cases.

Disease-specific per diem (or daily cost)
Gives the average daily cost for treatments in each disease category. These may still be quite broad (e.g. orthopaedic surgery).

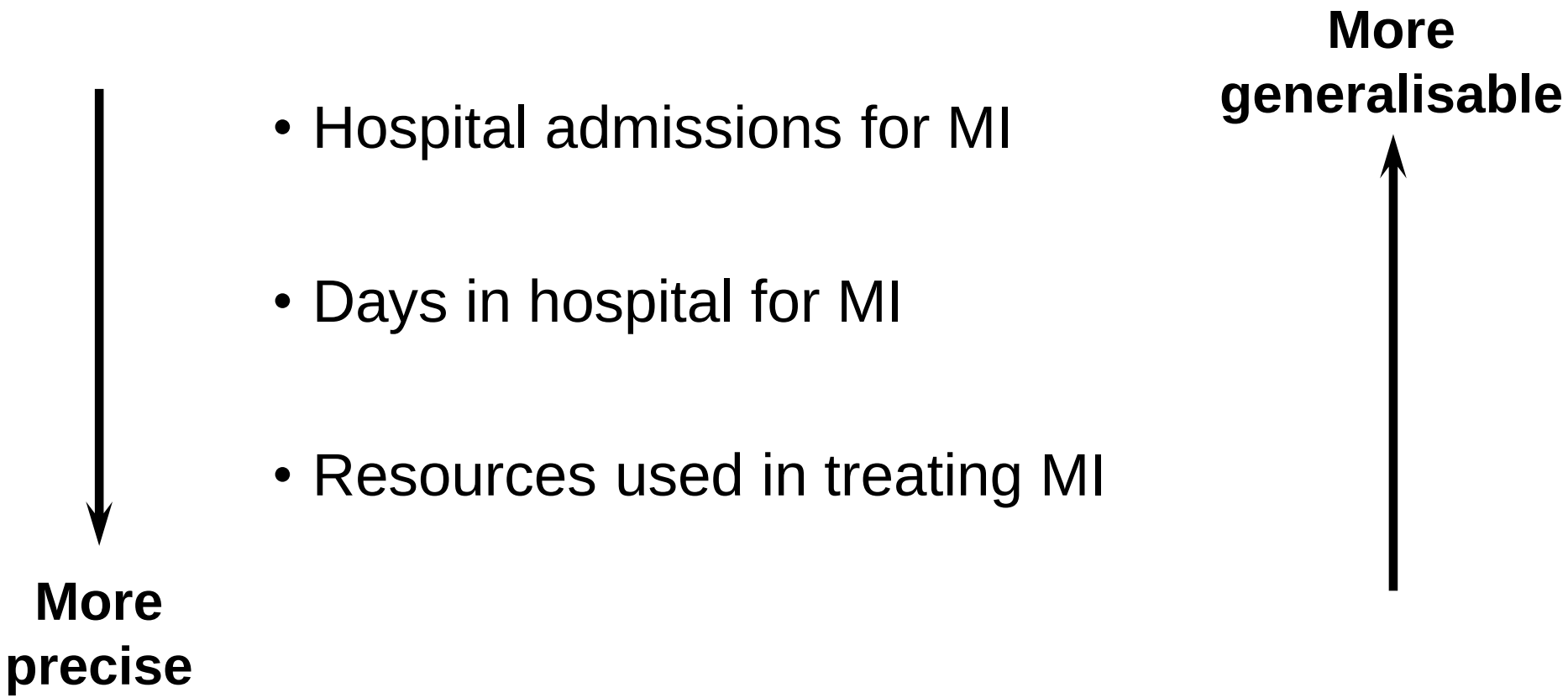
Average per diem (or daily cost)
Averages the per diem over all categories of patient. Available in most health care systems.

Source: Drummond *et al*, 2015

Typical sources of cost data

- Clinical trials with concurrent economic evaluation (e.g. resource use and/or billings)
- Free-standing study (e.g. database study, patient chart review)
- Existing literature
- Routinely available sources

Levels of detail in resource data capture alongside clinical trials



Examples of adjusting charges to costs

- Most experience is from the USA, where hospital bills (i.e. charges) are readily obtainable
- Nigrovic and Chiang. *Arch. Pediatric Adolesc. Med.* 2000; 154: 817-21:
  - costs calculated from charges using a standard cost-to-charge ratio of 0.65
- Zupancic *et al. Paediatrics* 2003; 111: 146-152:
  - itemised billing records converted to costs using Medicare cost-to-charge ratios

Does the method of adjustment matter?

- Taira *et al* (*Am. Heart. J.* 2003; 145: 452-8) compared four methods of estimating costs:
  (i) hospital charges
  (ii) hospital charges converted to costs by use of hospital-level cost-to-charge ratios
  (iii) hospital charges converted to costs by use of departmental cost-to-charge ratios
  (iv) itemised laboratory costs with nonprocedural hospital costs generated from departmental level cost-to-charge ratios

Treatment group level comparison of analytic methods for the Vegas II clinical trial

	Treatment				
	Urokinase (n = 169)		Angiojet (n = 163)		
Analytic model	**Mean**	**Median**	**Mean**	**Median**	**Difference in means**
Hospital charges	$80,753	$50,953	$59,442	$75,617	$21,311
Hospital level cost-to-charge ratios	$37,705	$24,954	$27,571	$35,074	$10,134
Department level cost-to-charge ratios	$19,154	$12,276	$13,950	$18,305	$5204
Itemised procedure costs and department cost-to-charge ratios	$22,529	$15,234	$17,075	$21,261	$5454

Adapted from Taira *et al* (2003)

Does the method of adjustment matter?

- In the study by Taira et al the method used to approximate costs did not affect the main results of the cost comparisons (eg Urokinase always more costly than Angiojet)
- Charges were approximately twice as high as hospital cost estimates
- The magnitude of the cost differences between groups varied considerably by method
- Department-level cost-to-charge ratios represent a reasonable compromise between accuracy and ease of implementation
- However, depending on the perspective of the study, we may be mostly interested in the amount actually paid or received

Cost, Context, and Decisions in Health Economics and Health Technology Assessment

- A really good conceptual paper on the nature of costs, why costs are always associated with a decision and why costs always vary according to the context of that decision
- Considers the distinctions between short and long run costs and between fixed and variable inputs
- Discusses why 'harms' and negative consequences are not, in general, costs and how the consideration of 'clinically unrelated' future costs and benefits depends on context

Culyer AJ. *Int. J of Tech Assess in Health Care* 2018; 34:1-8

Other issues

- Costing in specific contexts
- Learning curves
- Costing informal care

Costing in specific contexts

- For reimbursement submissions national, average, costs may be appropriate
- At the local level, decision-makers may be sceptical about costs (e.g. will the ‘savings’ from the use of a new drug really be achieved?)

Economic evaluation of Propofol/Fentanyl compared with Midazolam/Fentanyl on recovery in the ICU following cardiac surgery

- Propofol shortened times to extubation and discharge from the ICU
- Patient level data reanalysed in terms of nursing shifts
- Savings calculated based on reduction in nurse staffing requirements

Source: Sherry *et al. Anaesthesia* 1996; 51: 312-317

Sugammadex in the reversal of Neuromuscular Blockade (NMB)

- Immediate reversal of NMB can save time in the operating room or recovery room
- The value of the time saved depends greatly on:
  - where it is saved
  - whether the time saved can be put to alternative uses

    (e.g. in caring for other patients or improving workflow)

Source: Chambers *et al. Health Technology Assessment* 2010; 14: 1-211

Learning curves

- Important when studying the cost impact of newly introduced technologies
- Cost data gathered alongside clinical trials may require adjustments
- Examples include:
  - drug dosage and wastage
  - time for surgical techniques
  - monitoring for side effects
- Routinely available costs generally reflect the effects of ‘learning’
- Important issue in the evaluation of medical devices

Cost-effectiveness of spinal cord stimulation versus percutaneous myocardial laser revascularisation in patients with angina

- Outcomes in survival and quality of life for SCS improved over the time of the trial, 'which could be indicative of a learning curve effect'
- 'The ICER was estimated at £230,000 per QALY in 2000/1, whereas for 2002/3 is was £18,000'

Source: Dyer MT *et al. Trials* 2008; 9: 40-51

Costing informal care

- Most important in areas such as care of the elderly, mental illness and end-stage disease
- Very little guidance in the literature
- Estimates of the *quantities* of time should distinguish between actual tasks and general surveillance
- The *valuation* of time should depend on what time is being sacrificed (e.g. paid work, unpaid work, leisure time)
- It may also be relevant to consider the impact on caregivers' wellbeing or quality of life

Useful papers on costing informal care

- Weatherly *et al*: review a number of methods for estimating caregiver burden, in terms of the opportunity cost of time, loss of wellbeing and impact of quality of life

  In: A J Culyer (ed) *Elsevier Online Encyclopaedia of Health Economics* 2014
- Van den Berg *et al*: estimate the value by assessing the compensating valuation necessary to maintain the same level of well-being after providing informal care

  Health Economics 2007; 16: 1227-44
- Koopmanschap *et al*: review several methods, assessing which can be used alongside estimates of health effects in a CEA or CUA

  PharmacoEconomics 2008; 26: 269-80
- Themed issue on measuring family spillover effects of illness

  PharmacoEconomics 2019; 37(4)

Summary

- Costing is a neglected area of economic evaluation
- Whilst theoretical principles exist, the methods used are highly dependent on the data available
- The main estimation issues include adjusting charges to costs, learning curves and costing in context

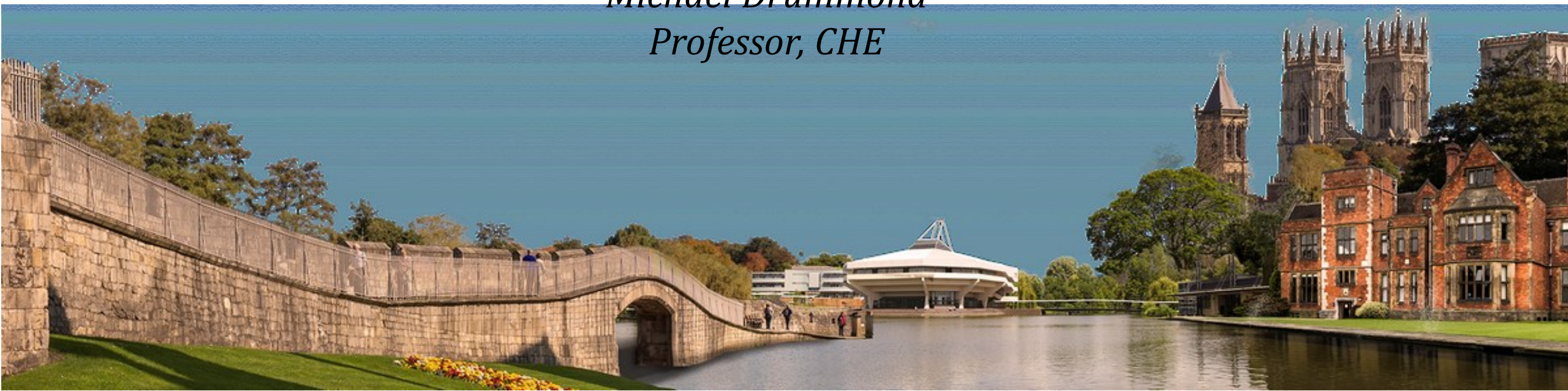
Further reading

- Drummond MF et al. *Methods for the economic evaluation of health care programmes.* Oxford University Press, 2015, Chapter 7.
- Culyer, AJ Cost, Context, and Decisions in Health Economics and Health Technology Assessment. . *Int. J of Tech Assess in Health Care* 2018; 34:1-8

Online Advanced Methods for Cost-Effectiveness Analysis

Presentation 4: Populating Models: Costs and Outcomes
4.5: Costing Methods: Two Controversies

Michael Drummond
Professor, CHE



Objectives

- To discuss the role, relevance and measurement of productivity costs in economic evaluation
- To understand the arguments for and against including, for future years:
  - Related health care costs
  - Unrelated health care costs
- To determine how analysts should proceed, given these controversies

Methodological controversies in costing

- Two major controversies addressed here:
  - productivity costs
  - costs in added years of life
- Controversies relate both to *relevance* (i.e. should they be included in the evaluation) and to *measurement* (i.e. estimation of quantities and valuation)

Productivity costs

These arise from:

- short-term absence from work*
- long-term absence from work
- loss of productivity whilst at work
- premature death (during working age)

* We normally think of paid work, but in principle unpaid work could be considered also

Controversies with productivity costs (1)

- The extra-welfarist approach to economic evaluation predominates in healthcare
- Under this approach health outcomes are main focus, rather than broader effects on the economy
- However, changes in productivity can effect expenditure on health care, and therefore maybe relevant to the extra-welfarist approach
- Olsen and Richardson (*Social Science and Medicine* 1999) argue that part of the value of productivity effects may be included to the extent that it results in increased resources available for health care

Controversies with productivity costs (2)

- Valuing changes in productivity is generally based on individuals' wage rates
- This may result in services which benefit the more highly paid being favoured
- Considering productivity gains *net* of consumption raises ethical issues (i.e. it would imply that priority be given to services for those who produce more than they consume!)
- However, one person's consumption is another person's job!

Policy relevance of productivity changes: Summary

- As a result of treatment, the patient or a member of their family may be able to return to work, or be more productive at work
- If the person is in paid work, a proportion (*x*) of their earned income will be used to finance their own consumption activities. (The impact of this may or may not be captured in the QALYs gained.)
- In addition, the remainder (1-*x*) will benefit other individuals in society, through taxation and redistribution
- If a health programme delivering more productivity benefits costs more than the alternative, the impacts on health and productivity of the displaced treatments would also need to be considered
- Whether or not we consider productivity changes to be relevant depends on whether we feel healthcare expenditure is to maximise health gain, or welfare more generally

Systematic approaches to measurement

- Measurement typically *ad hoc:*

  e.g. how many days have you taken away from paid work in the last six weeks?

- Often part of questionnaires relying on patient recall

- Standardised questionnaires are now available*:
  - Work Productivity and Activity Impairment (Reilly *et al*, 1994)
  - Health and Labour Questionnaire (van Roijen *et al*, 1996)

- Issue of whether lost time is compensated for, by colleagues or when the individual returns to work

* The EU Horizon 2020 project PECUNIA, has undertaken a systematic review and classification of the available questionnaires, and produced a costing template.

Hakkaart-van Roijen L, Hubens K, Sajjad, A on behalf of the PECUNIA Group (2019): Standardised costing template for selected costing approaches: production loss of paid and unpaid work. Deliverable D3.4: PECUNIA project. Erasmus University Rotterdam, Netherlands. DOI: 10.5281/zenodo.4455444

Productivity losses due to presenteeism

- Most of the current measurement approaches do not address the potential productivity losses due to presenteeism
- The sick worker may be at work, but not able to perform their duties at the normal level
- Potentially, the performance of *other* workers could be affected
- An even tougher sell with payers than losses due to absenteeism!
- Useful references:

  - Pauly MV *et al. Health Economics* 2008; 17: 469-85
  - Schultz AB *et al. PharmacoEconomics* 2009; 27: 365-78
  - Despiégel N *et al. Value in Health* 2012; 15(8): 1148-61

Alternative valuation methods for productivity costs

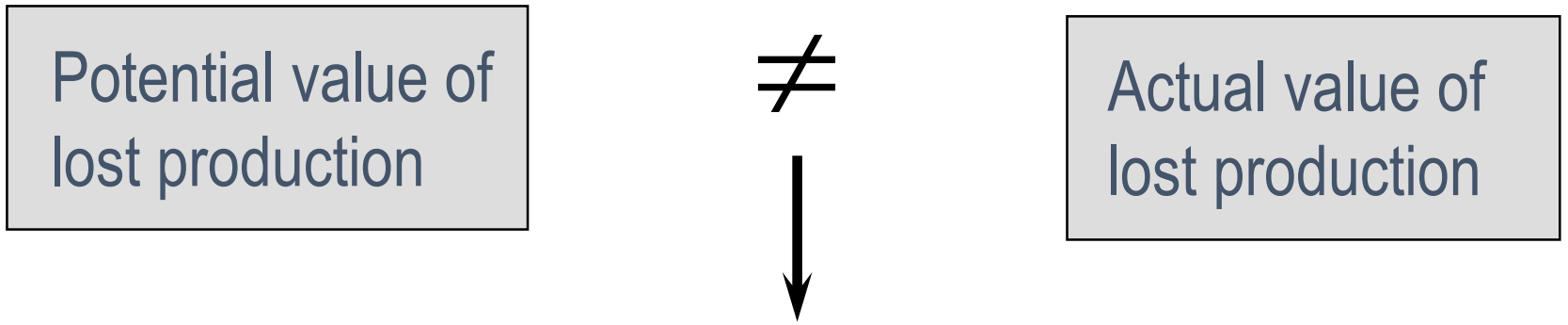
- Human capital
- Friction cost
- US Panel approach

Human capital method

- Valuation is based on gross wages
- Assumes all the worker's productivity is lost when they are absent
- Double counting issues:
  - if using to value life years lost through premature death, these are already reflected in the life-years or QALYs
  - lost leisure time may be reflected in the QALY
  - the valuation of lost working time may be reflected in the QALY

Friction-cost approach

(Koopmanschap *et al*, *Journal of Health Economics* 1995)



- Pool of involuntary unemployment
- Replacement of sick person
- Production losses during friction (replacement) period only
- Costs of recruitment and re-training

Human capital versus friction costs: The Netherlands (1988, billions of gilders)

Cost category	Human capital	Friction costs
Absence from work	23.8	9.2
Disability	49.1	0.15
Mortality	8.0	0.15
Total	89.0	9.5
% of net national income	18%	2.1%

Source: Koopmanschap *et al*. *Journal of Health Economics* 1995; 14: 171-89

Systematic review of friction cost estimates

- 46 studies located, from 12 countries
- 28 studies were from the Netherlands, which suggests this approach in its national guidelines
- 35 studies reported the length of the friction period used
- The friction cost methods used to estimate productivity costs varied in quality

Source: Kigozi J *et al. Eur. J Health Economics* 2016, 17: 31-44

(First) US panel approach

- Valuing mortality in monetary terms is double-counting if using life-years or QALYs
- The effect of morbidity on production could and should be valued in the QALY

Source: Gold *et al. Cost-Effectiveness Analysis in Health and Medicine*. New York: OUP, 1996

Income losses and quality of life measurement

- In general, the empirical evidence is very poor
- Tilling *et al (Value in Health* 2010; 13: 298-305) argue that avoiding mentioning income effects in health state valuations may induce a minority of respondents to include them, but the impact on results is minor
- Brouwer *et al (PharmacoEconomics* 2005; 23: 209-18) argue that worse health states may be associated with lower productivity

Do productivity costs matter?

- Krol *et al* (*PharmacoEconomics* 2011; 29: 601-19) reviewed 81 unique studies of treatments for adults with depressive disorders
- Approximately 69% ignored productivity costs, often to comply with national guidelines
- In those studies including productivity costs, these reflected an average of 60% of total costs per treatment arm
- Inclusion or exclusion of productivity costs had a substantial impact on incremental costs

Productivity costs in economic evaluations of expensive drugs

- Systematic review identified 249 economic evaluations of 33 drugs on the Dutch Expensive Hospital Drug List
- Only 22 studies included productivity costs related to paid work
- One study included unpaid productivity
- Exclusion of productivity costs could not be explained by study population age or health status
- National guidelines appeared to be influential

Source: Krol *et al. Eur J Health Economics* 2016; 17: 391-402

(Second) US panel on cost-effectiveness in health and medicine

- Acknowledged that there is little evidence that productivity gains are included in individuals' assessments of quality of life
- Recommended that these should be included the estimate of costs in the numerator, recognising that this might lead to some double-counting

Source: Sanders GD *et al. JAMA* 2016; 316(10): 1093-1103

So what should we do?

- Take into account any local methods guidelines for conducting economic evaluations
- Present productivity costs separately, in either the main analysis or a sensitivity analysis
- Use QALY estimates that are purged of income effects, or at least acknowledge the possibility of double-counting
- Be cautious about valuations using the human capital approach – consider using the friction cost approach or an average value for earnings

Costs in added years of life

- Meltzer (1997) developed a theoretical argument in favour of including costs in added years of life
- He considered all costs (including the difference between consumption and production)
- In health care the debate often focuses on *health care* costs in added years of life

Source: Meltzer D. *J. Health Econ*. 1997; 16: 33-64

Costs in added years of life

- Including *health care* costs in added years of life is bad news for prevention
- Including the difference between consumption and production improves the cost-effectiveness of life-saving programmes among younger individuals (Johannesson *et al*, *Medical Decision Making* 1997).

Categories of costs in added years of life

- Related healthcare costs (i.e. linked to the disease of interest or its treatment)
- Unrelated healthcare costs (i.e. costs of other diseases the person might have in the added years)
- Related non-healthcare costs (i.e. impacts on other production and consumption)
- Unrelated non-healthcare costs

Related healthcare costs

- Widespread agreement that these should be included
- The time horizon for the evaluation should be long enough to capture all relevant costs and cost-offsets
- But……!

Cellulose versus synthetic dialysers

- Synthetic dialysers were associated with a small additional cost and led to a gain in QALYs, mainly through extending survival ($5036 per QALY gained)
- However, including the additional dialysis during the extra survival increased the ICER to $83,501
- This is because the decision to provide dialysis in the first place was possibly marginally cost-effective
- Therefore, unless one were prepared to re-visit the earlier decision to provide dialysis it makes sense to implement a cost-effective improvement in therapy

Source: Manns *et al. Health Economics* 2003; 12: 949-58

Unrelated healthcare costs

- A majority of health economists feel these should be included in evaluations having a generic outcome measure (e.g. life-years gained, QALYs)
- The notion is that if evaluations assess the long term benefits, which include the effects of subsequent interventions, for balance they should also include the costs of those interventions
- Some argue against:
  - in principle (these costs relate to other decisions, which the current decision-maker cannot commit society to)
  - in practice (it could be hard to separate these costs out from related costs in routinely available data)

For a good discussion of the issues see Morton A *et al, Health Economics* 2016; 25: 933-938

Related and unrelated non-healthcare costs

- Arguments for and against inclusion mirror those for productivity costs (especially the equity arguments)
- In particular, the Olsen and Richardsen (1999) argument is relevant (i.e. be concerned about society's ability to pay for future healthcare)

Does inclusion of future costs make a difference?

- Kruse *et al* (*Eur. J. Health Economics* 2012; 13: 63-70) assessed the impact on the ICER of including the impact on production and consumption following a health care intervention that improves survival
- Net consumption varies greatly by age
- Omitting future costs may bias the ranking of interventions in favour of those aimed at older age groups

Second US panel on cost-effectiveness in health and medicine

- Health costs and benefits in the future should be included, regardless of whether they are related to the intervention of interest or not
- Proposed an ‘impact inventory’ which analysts should use to show which components of cost and benefit are included in their study

Source: Sanders GD *et al. JAMA* 2016; 316(10): 1093-1103

So what should we do?

- Take into account any local methods guidelines for conducting economic evaluations
- Include related health care costs
- Estimate unrelated healthcare costs in a sensitivity analysis
- Be cautious about the inclusion of non-healthcare costs, especially impacts on production and consumption

Summary

- In general, follow the local methodological guidelines in the setting where you are conducting your costing study

- Perform sensitivity analyses to deal with the controversial items

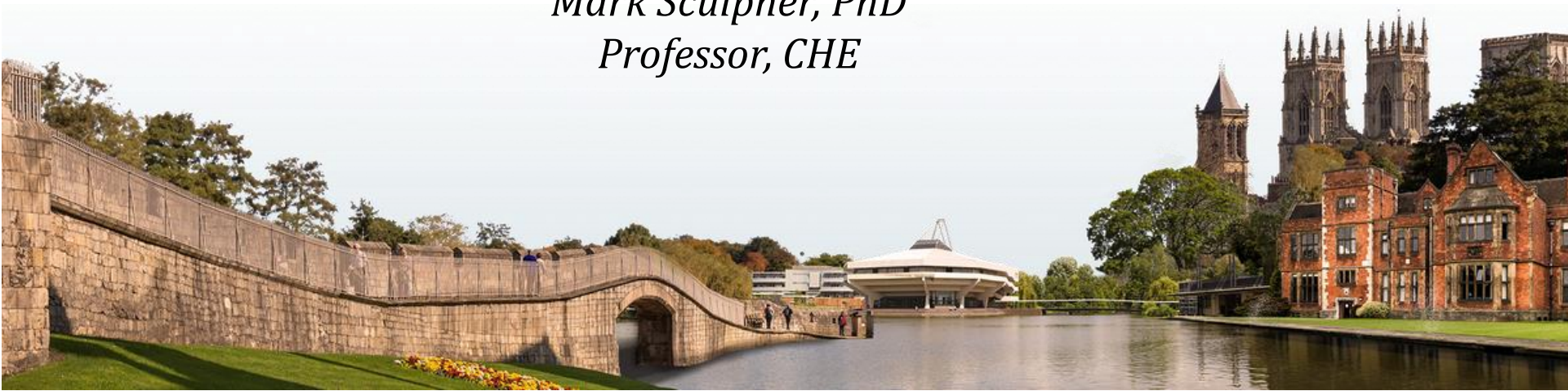
Further reading

- Neumann P et al. Cost-effectiveness in health and medicine. Oxford University Press, 2016
  - Chapter 3 Recommendations on perspective for the reference case
  - Chapter 8 Estimating costs and valuations of non-health benefits in cost-effectiveness analysis

Online Advanced Methods for Cost-Effectiveness Analysis

Presentation 4: Populating Models: Costs and Outcomes
4.6: Conclusions

Mark Sculpher, PhD
Professor, CHE



Conclusions

- Health related outcomes central to economic evaluation
  - Issues associated with the social value of health varying for different groups
- Generic health measure essential for resource allocation
- QALY imperfect but long history
- Preference-based measures of health-related quality of life widenly used
- Various routes to QALY calculation
- Costing methods highly dependent on the data available
- Many costs issues (e.g. adjusting charges to costs, learning curves)
- Local costing methods important
- Key role for sensitivity analysis

Further reading

Health valuation methods

- Drummond MF *et al. Methods for the Economic Evaluation of Health Care Programmes*, 4th edition, Oxford: OUP, 2015, Chapter 5.
- Brazier J *et al. Measuring and Valuing Health Benefits in Economic Evaluat*ion, 2nd edition, Oxford: OUP, 2016, Chapters 4, 7-9.

Costing

- Drummond MF *et al. Methods for the Economic Evaluation of Health Care Programmes*, 4th edition, Oxford: OUP, 2015, Chapter 7.
- Kim DD *et al.* Perspective and costing in cost-effectiveness Analysis, 1974–2018. *Pharmacoeconomics* 2020. doi.org/10.1007/s40273-020-00942-2.