Institution: University of Sheffield

Unit of Assessment: 18 - Economics and Econometrics

Title of case study: The SF-6D: A new, internationally adopted measure for assessing the cost-effectiveness of health care interventions.

1. Summary of the impact

Given ever increasing demands on scarce health care resources, decisions on whether to fund new health care interventions, particularly pharmaceuticals, are increasingly being informed by evidence on cost-effectiveness in terms of the cost per Quality Adjusted Life year (QALY). The SF-6D health index method is used internationally for calculating QALYs using patient reported health from clinical trials and other sources. The development of the SF-6D contributes to health policy and welfare via a more efficient allocation of scarce health care resources and has significant commercial benefit. The health policy and welfare benefits arise from the use of the SF-6D in the assessment of the cost effectiveness by health services and regulatory agencies around the world (including Australia, Canada, China, Scotland, Netherlands and Norway) thus facilitating decisions on the most efficient use of limited health care resources. The SF-6D is freely available to non-commercial bodies, including researchers and policy makers. Commercial benefits come from the licensing of the measure to pharmaceutical companies and others to assess the cost effectiveness of their products, with 460 licences sold globally since 2008, and a further 521 licences distributed on a non-commercial basis to public sector and charitable status organisations.

2. Underpinning research

The reach and significance of the SF-6D impact emerges both from the original research project and a subsequent body of work. The research team was Jennifer Roberts (Department of Economics, University of Sheffield), John Brazier (School of Health & Related Research [ScHARR] University of Sheffield), and Mark Deverill (ScHARR). Jennifer Roberts' main input was in developing the econometric modelling required to estimate the main valuation algorithm, and subsequent extensions.

The main project was carried out at the University of Sheffield between 1999 and 2001. It involved deriving a health instrument (the SF-6D) from the most commonly used general health measure in clinical studies throughout the world (the SF-36); obtaining population preferences across the dimensions of this new instrument; then estimating values for all SF-6D health states for use in economic evaluation.

The SF-36 itself is not suitable for use in economic evaluation because it simply measures the amount of limitation a patient is experiencing; it does not enable trade-offs between different dimensions of health (e.g. pain vs. physical functioning), or between quality and length of life. Research involved psychometrically reducing the SF-36 to a 6 dimension classification amenable to valuation. Population preferences for the 6 dimensions (physical functioning, role limitation, social functioning, pain, mental health, vitality) were obtained for a sample of health states, via face-to-face interviews with a large representative sample of the UK population using standard gamble (SG), a choice-based method for measuring preferences under uncertainty. Values for all SF-6D health states were then estimated econometrically. The resulting algorithm generates a continuous index for health anchored at 0 (equivalent to being dead), and 1 (full-health); negative values denote health states assumed worse than dead. The algorithm shows how much value people place on different health limitations, and how they will trade-off between them; for example how much vitality they will sacrifice for a reduction in pain.

The main research was published in 2002 (R1) and the SF-6D is now widely used in the economic evaluation of health care around the world (see R4 and R5).

The SF-6D has a number of advantages over the previously used main health valuation measure (the EQ-5D): (i) it is a much richer descriptive system, defining 18,000 states as opposed to only 243 for the EQ-5D, thus it is more sensitive to changes in health; (ii) it was valued using SG, which is theoretically superior to the time-trade off method used for the EQ-5D; (iii) the SF-6D can be derived from the SF-36, which is already included as a health outcome measure in many clinical

trials around the world, thus imposing no additional patient or resource burden. Every SF-36 data set (including those collected prior to the SF-6D) can therefore now be used for economic evaluation.

Four main extensions to the research increase the impact: (i) An algorithm was developed for the SF-12 (a reduced version of the SF-36), increasing the reach to any trial where either SF-36 or SF-12 is administered (R2); (ii) An improved algorithm using non-parametric Bayesian methods was developed (R5), allowing decision makers to take better account of differences across patients; (iii) Valuation algorithms have been developed for the SF-6D in other countries including Australia, Brazil, China (Hong Kong), Japan (R4), Portugal and Spain; as health preferences differ between countries, reach is extended via these local valuations; (iv) Algorithms have been developed for condition-specific measures of health, extending the reach to health problems and trials where generic measures are not appropriate (e.g. R6).

3. References to the research

Main journal paper **[Scopus citations]:**

R1: Brazier J, Roberts J, Deverill M (2002) The Estimation of a Preference-Based Measure of Health from the SF-36 *Journal of Health Economics* 21(2) 271-292. (DOI: 10.1016/S0167-6296(01)00130-8) **[930]** Awarded the 2002 *International Society for Quality of Life* Article of the Year prize for "outstanding contribution to study of health related quality of life". Andrew Oswald (2009), in his Warwick Economics Research Paper (No.887) "World-leading research and its measurement", notes this paper as among the top most cited economics papers in the world.

Other key papers arising from the SF-6D body of research **[Scopus citations]:**

R2: Brazier J, Roberts J (2005) Estimation of a preference-based index measure of health for the SF-12 & comparison to the SF-36 preference-based index *Medical Care*, 42(9), 851-859 **[271]**

R3: Brazier J, Roberts J Tsuchiya A, Busschbach J. (2004) A comparison of the EQ-5D and SF-6D across seven patient groups *Health Economics* 13(9) 873-884 **[246]**

R4: Brazier J, Fukuhara S, Roberts J et al (2009) Estimating a preference-based index from the Japanese SF-36, *Journal of Clinical Epidemiology* *62*(12): 1323-1331 doi: 10.1016/j.jclinepi.2009.01.022 **[11]**

R5: Kharroubi SA, Brazier J, Roberts J, O'Hagan A. (2007) Modelling SF-6D health state preference data using a non-parametric Bayesian method. *Journal of Health Economics* 26(3): 597-612 doi: 10.1016/j.jhealeco.2006.09.002 **[31]**

R6: Brazier J, Murray C, Roberts J, Brown M Symonds T, Kelleher C, (2008) Estimation of a preference based index from a condition specific measure: the King's Health Questionnaire *Medical Decision Making* 28(1):113-126 doi: 10.1177/0272989X07301820 **[46]**

4. Details of the impact

The development of the SF-6D contributes to *health and welfare* and has *commercial benefits*. The health and welfare benefits arise from the use of SF-6D data in the assessment of the cost effectiveness of health care interventions by health services and regulatory agencies around the world. Commercial benefits come from the licensing of the measure to pharmaceutical companies and others who need to demonstrate the cost effectiveness of their products. Reach occurs because the SF-6D can be derived from any SF-36 or SF-12 data set and these are the most widely used generic outcome measures in clinical trials around the world.

Achieving impact

Dissemination of the SF-6D was initially via targeted presentations at seminars with the funders (Glaxo Wellcome), other Pharma companies and other key health decision makers such as the Department of Health and the National Institute for Health and Care Excellence (NICE). In addition, presentations were given at the main annual conference of key user organisations including:

International Health Economics Association (IHEA); International Society For Pharmacoeconomics and Outcomes Research (ISPOR); International Society for Quality of Life; American Public Health Association (APHA). The work has also been disseminated via chapters in two major books used by practitioners: the *Elgar Companion to Health Economics* (Jones AM (ed) 2006) and the World Health Organisation volume on *Summary Measures of Population Health* (Murray et al 2001). This has resulted in the SF-6D being widely seen as one of leading measures for calculating QALYs. Alongside the publications of the research to develop the SF-6D, we have produced papers showing how well it performs compared to other measures (in terms of psychometric properties like validity); and how well it performs across different health conditions.

To provide maximum access, the SF-6D is supplied in easy to use software including Excel, SPSS and SAS. These programs can be run on SF-36 (version 1 or 2) and SF-12 datasets and generate the SF-6D index on the zero to one scale for calculating QALYs. Guidance and instructions on how to use the programs are provided at the SF-6D website (www.sheffield.ac.uk/scharr/sections/heds/mvh/sf-6d). Access to the SF-6D is through either a licence for commercial applications from Fusion IP or Quality Metric (US) who supply the software for a charge (see below). Non-commercial applications covering all public sector and charitable organisations are free of charge and copies of the software can be obtained through a named person in ScHARR; 521 non-commercial licences have been distributed since 2008.

Commercial benefits

The main commercial users of the SF-6D have been pharmaceutical companies, and consultancy companies working on their behalf, who wish to examine the cost-effectiveness of new drugs and make submissions to regulatory authorities.

There are two sources for a commercial licence. One is obtained through Fusion IP, a company specialising in marketing IP owned by Universities. The selling of the SF-6D has also been sub-contracted to Quality Metric (www.qualitymetric.com), a US based company specialising in measuring health outcomes, who also distribute other SF products including the SF-36 and SF-12. Since 2008 they have together sold 460 licences (based on royalties paid to the University of Sheffield) to pharmaceutical companies (or consultancy companies) including Novartis, Roche, Pfizer, Novo Nordisk, Astellas, Merck, Sanofi and BMS. Other important commercial users have been health care insurers and providers in the USA.

The companies benefit because an accepted generic health measure administered in their clinical trial (the SF-36 or SF-12) can be directly (and easily) translated into a preference-based measure that can be used in economic evaluation. The SF-6D enables them to estimate the health related quality of life benefits of their technology in terms of QALYs, which is a requirement for a submission to regulatory bodies around the world.

Health and welfare policy and practice: use by regulatory authorities and in clinical trials

An important impact of the SF-6D is via its use by regulatory bodies around the world for assessing the cost-effectiveness of health technologies. The SF-6D is recommended for use by Health Technology Assessment (HTA) agencies in Ireland and China (S1, S2); it is explicitly named as an accepted measure in Australia (S3), Belgium, Canada, Norway (S4), South Korea and Thailand; it also meets the specific guideline requirements of HTA agencies in 21 other countries whose guidelines are available via the ISPOR website and thus can be used for health care decision making in those countries.

The SF-6D has been used in health care decision making in the UK by NICE, the Scottish Medicines Consortium and the All Wales Medicines Strategy Group. It has been used as the main health utility measure in important NICE assessments for pharmacological treatments such as for Alzheimer's (TA217) (S5), low platelet count (TA293) (S6), peripheral arterial disease (TA223) (S7), and gout (TA291), and has been used alongside other measures in many other appraisals.

In addition, between them the two main SF-6D studies (R1 & R2) have been cited over 1200 times and the vast majority of these citations report the use of the SF-6D in clinical trials and economic evaluations of health care interventions around the world. This provides clear evidence of its usefulness and popularity as a measure for health care decision making. For example two uses of

the SF-6D have been in a large international clinical trial for nurse led management of heart failure (S9), and to assess the cost effectiveness of diagnostic procedures for HIV in resource limited settings (S10). There are numerous other examples across physical, mental and public health, in both the developed and developing world.

Impact on the general population

The SF-6D aids decision making via economic evaluation and therefore informs the efficient and equitable allocation of health care resources. Hence the general population of these countries are ultimately the main beneficiaries since the health care authorities are able to extract better value for money (i.e. more health outcomes per £/$/€/yuan etc.) from scarce health care resources.

5. Sources to corroborate the impact

S1. Guidelines of the Health Information and Quality Authority in Ireland state :

*"Use of an indirect preference-based measure, such as the EQ-5D or **SF-6D**, is recommended for the reference case as these measures have widespread availability, are easy to use and interpret and because they are based on preferences of the general public."* p31.
www.hiqa.ie/publication/guidelines-economic-evaluation-health-technologies-ireland

S2. The Chinese HTA guidelines states:

*"The recommended measuring instrument of health utility mainly includes Standard Gamble (SG), Time Trade-off (TTO), Visual Analogue Scale (VAS), EuroQol-5 Dimensions (EQ-5D), Short-Form Six-Dimensions (**SF-6D**), Health Utility Index (HUI) and Quality Well Being (QWB)"* p8 (translated from Chinese).
www.pe-cn.org/en/pe_guidelines/index.asp

S3. The Australian HTA guidelines state:

*"Acceptable MAUIs are the Health Utilities Index (HUI2 or HUI3), the EQ5D ('EuroQol'), the **SF-6D** (a subset of the Short Form 36, or SF-36) or the Assessment of Quality of Life (AQoL) instrument." p78*

http://www.pbs.gov.au/industry/listing/elements/pbac-guidelines/PBAC4.3.2.pdf

S4. The Norwegian HTA guidelines state:

*"The main rule is that QALY-outcomes are to be calculated using multi-attribute utility instruments that evaluate both the physical and psychological condition of the patient as well as his/her social functioning. Some examples of such instruments are EQ-5D, **SF-6D** and 15D*". p16

www.ispor.org/PEguidelines/source/Norwegian_guidelines2012.pdf

S5. http://www.nice.org.uk/nicemedia/live/13419/53619/53619.pdf page 30 corroborates use in the NICE assessment for Alzheimers treatment (TA217).

S6. http://www.nice.org.uk/nicemedia/live/14228/64570/64570.pdf pages 23, 33, 35 & 36 corroborate use in the NICE assessment for treatment of low platelet count (TA293).

S7. http://www.nice.org.uk/nicemedia/live/13477/54546/54546.pdf page 19 corroborates use in the NICE assessment for treatment of peripheral arterial disease (TA223).

S8. http://www.nice.org.uk/nicemedia/live/14196/64258/64258.pdf page 15 corroborates use in the NICE assessment for treatment for chronic gout (TA291).

S9. Postmus D et al (2011) A trial-based economic evaluation of 2 nurse-led disease management programs in heart failure. *American Heart Journal* 162 (6): 1096-1104. (doi: 10.1016/j.ahj.2011.09.019) See pages 1099, 1100.

S10: Athan E et al (2010) Cost-effectiveness of routine and low-cost CD4 T-cell count compared with WHO clinical staging of HIV to guide initiation of antiretroviral therapy in resource-limited settings. *AIDS* 24(12): 1887-1895. (doi: 10.1097/QAD.0b013e32833b25ed). See pages 311, 312, 314, 315.