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Health State Preference Weights for the Glasgow Outcome Scale Following Traumatic Brain Injury: A Systematic Review and Mapping Study

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ABSTRACT

Background: Valid and relevant estimates of health state preference weights (HSPWs) for Glasgow Outcome Scale (GOS) categories are a key input of economic models evaluating treatments for traumatic brain injury (TBI). **Objectives:** To characterize existing HSPW estimates, and model the EuroQol five-dimensional questionnaire (EQ-5D) from the GOS, to inform parameterization of future economic models. **Methods:** A systematic review of HSPWs for GOS categories following TBI was conducted using a highly sensitive search strategy implemented in an extensive range of information sources between 1975 and 2016. A cross-sectional mapping study of GOS health states onto the three-level EQ-5D UK tariff index values was also performed in patients with significant TBI (head region Abbreviated Injury Scale score ≥3) from the Victoria State Trauma Registry. A limited dependent variable mixture model was used to estimate the 12-month EQ-5D UK value set as a function of GOS category, age, and other explanatory variables. **Results:** Six unique HSPWs from five eligible studies were identified. All studies were at high risk of bias with limited applicability. The magnitude of HSPWs differed significantly between studies. Three class mixture models demonstrated excellent goodness of fit to the observed Victoria State Trauma Registry data. GOS category, age at injury, sex, comorbidity, and major extracranial injury all had significant independent effects on mean EQ-5D utility values. **Conclusions:** The few available HSPWs for GOS categories are challenged by potential biases and restricted generalizability. Mixture models are presented to provide HSPWs for GOS categories consistent with the National Institute for Health and Care Excellence reference case.

Keywords: craniocerebral trauma, decision analysis models, economic models, EuroQol-5D, Glasgow Outcome Scale, health status indicators, mapping study, quality-adjusted life-years, quality of life, systematic review.

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Introduction

Increasing health care demands, limited by finite health budgets, have necessitated economic evaluations of new health technologies to ensure efficient use of scarce resources [1]. Cost-effectiveness is commonly assessed by comparing interventions in terms of costs and quality-adjusted life-years, comprising duration of life expectancy weighted by preferences for health-related quality of life (HRQOL) over this period [2].

Incremental costs per quality-adjusted life-year in economic evaluations are often derived using decision analysis modeling to synthesize available evidence and represent hypothetical patients' responses to alternative interventions [3]. Valid and relevant estimates of preference weights for defined outcome states (health state preference weights [HSPWs]) are a key input of such models [4]. Systematic literature searching is the methodological standard to ensure transparent and complete identification of HSPW estimates [5]. In the absence of valid empirical values for HSPWs, "mapping" of non–preference-based measures of health to generic-based measures can be performed [5], with the UK National Institute for Health and Care Excellence (NICE) recommending that HRQOL be measured directly from patients using the EuroQol five-dimensional questionnaire (EQ-5D) and valued by a UK tariff of general population preferences [6]. Background information on the EQ-5D is provided in the Web Appendix in Supplemental Materials found at http://dx.doi.org/10.1016/j.jval.2016.09.2398.

Traumatic brain injury (TBI) is a major public health problem in the United Kingdom, being one of the leading causes of death and disability and costing the economy an estimated £4 billion

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per year [7,8]. Outcome in TBI effectiveness studies is conventionally assessed using the basic or extended Glasgow Outcome Scale (GOS), measuring death and severity of disability using an ordinal scale [9]. Health state valuations corresponding to these outcomes are therefore necessary for health economic models examining new health technologies in TBI, but despite their importance there is a paucity of suitable estimates.

The aim of this study was to provide a comprehensive reference source of HSPWs for GOS health states following adult TBI to inform parameterization of future economic models. Specific objectives were to systematically identify all HSPWs available at present for GOS states following TBI and to validly derive estimates of HSPWs for GOS from the EQ-5D.

Methods

A systematic review and a cross-sectional study mapping GOS health states onto the three-level EQ-5D (EQ-5D-3L) UK tariff index values were conducted.

Systematic Review

Study design and criteria for considering studies

A detailed review protocol stating an a priori analysis plan was developed before data collection. The review inclusion and exclusion criteria are presented in Table 1. All methods of obtaining HSPWs were eligible, with the exception of elicitation using expert opinion, which is limited by high risk of bias and lack of descriptive validity [5].

Identification of evidence

An extensive range of electronic information sources were examined including all major bibliographic databases, specialist health economic and gray literature databases, and relevant Web sites. Additional information sources included forward and backward citation searching, author searching, reference checking, and contact with experts. Search strategies for bibliographic databases were developed iteratively in conjunction with an information services specialist and underwent external peer review. Searches were conducted for original research published between 1975 (corresponding to the introduction of the GOS) and week 33, April 2015. Present awareness searches were conducted in MEDLINE and Embase (week 3, April 2016) immediately before submission. Full details on information sources and search strategies are presented in the Web Appendix in Supplemental Materials.

Selection of evidence and data extraction

All studies identified during searches were assessed in a three-stage process with an initial screening of titles for relevance, followed by further examination of abstracts and full-text articles as required to assess eligibility. Studies were then classified as follows: eligible if inclusion criteria were met; potentially eligible if information was collected that could potentially allow calculation of HSPWs but estimates were not reported (e.g., short form 36 health survey and GOS both measured simultaneously); or ineligible. Relevant information on study characteristics and methodology was then collected for eligible and potentially eligible studies using a prespecified data extraction form. Study selection and data extraction were performed by a single reviewer and checked by a second independent reviewer.

Appraisal of quality, data synthesis, and statistical analyses

Included HSPW studies were assessed for quality using a peer-reviewed critical appraisal checklist based on the NICE Decision Support Unit guidelines [5], the Cochrane risk of bias tool [10], and theoretical considerations (further details are provided in the Web Appendix in Supplemental Materials) [11,12]. The risk of bias in each domain was subsequently rated as high, low, or unclear. A narrative synthesis of identified HSPWs was prespecified in the event that clinically and methodologically homogeneous studies at low risk of bias were not identified. To facilitate comparisons, reported measures of variance for HSPWs were converted to 95% confidence intervals (CIs). Extended GOS category HSPWs were combined using weighted averages to provide results for commensurate basic GOS health states. One-way analyses of variance (ANOVAs) using published summary statistics were used to test for statistically significant differences between HSPW estimates within each basic GOS category. Post hoc Scheffe multiple-comparison hypothesis tests for differences in means were then used to identify which HSPW estimates differed [13].

Table 1 – Review inclusion and exclusion criteria.

Inclusion criteria
• Disease: Mild, moderate, or severe TBI*
• Disease population: Adult patients with TBI > 16 y
• Health states: Consistent with GOS categories
• Population describing health states: Patients, carers, or health professionals
• Method for measuring HRQOL for each health state: Scenarios, generic multiattribute utility instruments, disease-specific multiattribute health instruments, direct measurement
• Method for determining preferences for HRQOL for each health state: Direct preference-based valuation of GOS health states using recognized elicitation method (SG, VAS, or TTO); indirect valuation of GOS health states (following health state measurement with generic or disease-specific multiattribute utility instruments) using recognized elicitation method (SG, VAS, or TTO).
• Population providing preferences for HRQOL of health states: General public, patients, carers, health professionals
• Study types: Original HSPV research study reporting at least one unique HSPV
• Language: English language or available translation
• Dates: 1975 to present
Exclusion criteria
• Disease: Non-TBI conditions (e.g., stroke)
• Disease population: Pediatric patients, aged < 16 y
• Health state measurement: Methods not suitable for mapping to the EQ-5D
• Health state valuation method: Non–preference-based valuation of health states (e.g., expert opinion used to value health states)

AIS, Abbreviated Injury Scale; EQ-5D, EuroQol five-dimensional questionnaire; GCS, Glasgow Coma Scale; GOS, Glasgow Outcome Scale; HRQOL, health-related quality of life; HSPW, Health State Preference Weights; SG, standard gamble; TBI, traumatic brain injury. TTO, time trade-off; VAS, visual analogue scale.

* TBI severity categorized according to GCS score or head region AIS score: mild TBI: GCS 14–15 or AIS 1 or 2; moderate TBI: GCS 9–13 or AIS 3; severe TBI: GCS ≤ 8 or AIS 4–6.

Mapping Study

Study design

A retrospective cohort study was performed by analyzing data from the Victorian State Trauma Registry (VSTR) [14]. A model for predicting mean EQ-5D HSPWs for GOS categories at 12 months postinjury was developed using adjusted limited dependent

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