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Economic Evaluations in the Diagnosis and Management of Traumatic Brain Injury: A Systematic Review and Analysis of Quality

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ABSTRACT

Background: Economic evaluations provide a unique opportunity to identify the optimal strategies for the diagnosis and management of traumatic brain injury (TBI), for which uncertainty is common and the economic burden is substantial. **Objective:** The objective of this study was to systematically review and examine the quality of contemporary economic evaluations in the diagnosis and management of TBI. **Methods:** Two reviewers independently searched MEDLINE, EMBASE, Cochrane Central Register of Controlled Trials, NHS Economic Evaluation Database, Health Technology Assessment Database, EconLit, and the Tufts CEA Registry for comparative economic evaluations published from 2000 onward (last updated on August 30, 2013). Data on methods, results, and quality were abstracted in duplicate. The results were summarized quantitatively and qualitatively. **Results:** Of 3539 citations, 24 economic evaluations met our inclusion criteria. Nine were cost-utility, five were cost-effectiveness, three were cost-minimization, and seven were cost-consequences analyses. Only six

studies were of high quality. Current evidence from high-quality studies suggests the economic attractiveness of the following strategies: a low medical threshold for computed tomography (CT) scanning of asymptomatic infants with possible inflicted TBI, selective CT scanning of adults with mild TBI as per the Canadian CT Head Rule, management of severe TBI according to the Brain Trauma Foundation guidelines, management of TBI in dedicated neurocritical care units, and early transfer of patients with TBI with nonsurgical lesions to neuroscience centers. **Conclusions:** Threshold-guided CT scanning, adherence to Brain Trauma Foundation guidelines, and care for patients with TBI, including those with nonsurgical lesions, in specialized settings appear to be economically attractive strategies. **Keywords:** cost-benefit analysis, cost-effectiveness, cost utility, economic evaluation, systematic review, traumatic brain injury.

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Introduction

Traumatic brain injury (TBI) presents a major economic, social, and health challenge worldwide [1]. According to the World Health Organization, TBI will surpass many diseases as the major cause of death and disability by 2020 [2]. In the United States, 53,000 individuals die annually from TBIs, and at least 5.3 million Americans are currently living with long-term disabilities directly attributable to TBI [3,4]. In 2010, the estimated overall burden of TBI on the US economy was approximately \$76.5 billion, with costs for disability and lost productivity outweighing those for

acute medical care and rehabilitation [5,6]. Despite the profound consequences of TBI, there is substantial uncertainty surrounding the costs and benefits of several alternative diagnostic and therapeutic strategies from the societal and health care system perspectives [7,8].

Economic evaluations are tools to weigh the relative costs and benefits of alternative courses of action [9]. They provide means to support decision making in a cost-constrained environment of health care and can be used to explore areas of uncertainty in both costs and benefits. Without considering economic data, the allocation of resources may not lead to optimal value for health

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care spending. Therefore, economic evaluations provide a unique opportunity to identify the optimal strategies for the diagnosis and management of TBI, for which uncertainty is common and the consequential economic burden on patients and health care system is substantial [1,7,10]. Inadequately informed, designed, or poorly executed economic evaluations, however, may inform resource allocation and lead to poor health policy decisions [9].

In this context, we systematically reviewed and evaluated the quality of economic evaluations in the diagnosis and management of TBI.

Methods

Search Methods

We duplicate searched the following databases: MEDLINE, EMBASE, NHS Economic Evaluation Database, Health Technology Assessment Database, EconLit, Tufts CEA Registry, and Cochrane Central Register of Controlled Trials. The search retrieved articles published between January 1, 2000, and August 30, 2013. We followed published guidelines on EMBASE searches for economic studies [11]. We also searched the reference lists of relevant studies, and the Web sites of health technology assessment agencies, including the Canadian Agency for Drugs and Technologies in Health and the National Institute for Health Research Health Technology Assessment program. The search was not restricted by language. We did not consider conference abstracts or unpublished data. The full text of any cited article that was considered potentially relevant was retrieved. The search strategies are described in detail in the [Appendix](#) in Supplementary Materials found at <http://dx.doi.org/10.1016/j.jval.2015.04.012>.

Study Selection

Type of studies

We included published comparative economic evaluations. The search was limited to the literature published from 2000 onward, to focus on contemporary studies that are potentially relevant to the current economic environment. Furthermore, older studies are likely to derive their input values from outdated clinical effectiveness and cost-estimation data. We included both single study-based (i.e., clinical data were derived from a single study) and model-based (i.e., incorporating clinical data from various sources) economic evaluations.

Type of patients

Economic evaluations related to patients of any age who had mild, moderate, and/or severe TBI were included. Studies that included general trauma patients or those with acquired brain injury were included only if a subgroup analysis on patients with TBI was reported.

Type of comparators

We included economic evaluations of any diagnostic modality, medical, or surgical intervention aimed at the diagnosis and/or management of patients with TBI.

We scanned the abstracts of every record retrieved to determine which studies should be further assessed. If it was clear from the abstract that the article was irrelevant, we rejected the record. The full texts of the remaining articles were evaluated. Two reviewers (A.A. and K.B.) independently assessed and determined the eligibility of each study. Disagreements were resolved by discussion and consensus.

Data Extraction

Data abstraction forms were created to collect the relevant data from the included studies (see [Appendix](#) in Supplemental Material). Two review authors (A.A. and K.B.) independently extracted the data on target population, comparators, methods, outcomes, and results using a data extraction form (see [Appendix](#) in Supplemental Material). Any discrepancy in data extraction was resolved by discussion and consensus. We divided the economic evaluations into five groups as defined by Drummond et al. [9]: cost-utility analyses, cost-effectiveness analyses, cost-benefit analyses, cost-minimization analyses, and cost-consequences analyses. To facilitate comparison, costs were converted, if price date and currency were specified, to 2012 international dollars (Geary-Khamis dollars) using the World Bank's purchasing power parity conversion factors, after adjusting for temporal changes in country-specific gross domestic product [12,13]. The international dollar (Int.\$) is a hypothetical unit of currency that has the same purchasing power parity (i.e., same ability to buy the same amount of goods and services) that US dollar had in the United States at a given point in time [14].

Assessment of Methodological Quality

Two review authors (A.A. and K.B.) independently assessed the quality of each included study using the 24-item Consolidated Health Economic Evaluation Reporting Standards checklist [15,16]. Quality scores were assigned on the basis of this checklist (range 0–24 points). Any disagreement was resolved by discussion and consensus.

The results of all economic evaluations that met our eligibility criteria were summarized qualitatively and quantitatively ([Tables 1–3](#)). Studies of high quality (quality score > 20/24 [$>80\%$]) were discussed in more detail.

Results

Results of the Search

Our search strategy yielded a total of 4079 potentially relevant citations; 540 duplicates were excluded, and 3465 were excluded after scanning the abstracts because they did not meet our inclusion criteria ([Fig. 1](#)). A total of 74 citations were retrieved for detailed evaluation of full-text articles. Fifty of these articles were excluded because they did not meet our inclusion criteria (further details are available in the [Appendix](#) in Supplemental Material). Common reasons for exclusion were lack of comparator, combining data from patients with TBI and other causes of acquired brain injury (e.g., stroke) in the analysis, and reporting hospital charges (rather than costs) only.

Description of Included Studies

Twenty-four economic evaluations met the inclusion criteria. Nine studies were cost-utility analyses [17–25], five were cost-effectiveness analyses [26–30], three were cost-minimization analyses [31–33], and seven were cost-consequences analyses [34–40]. There were no cost-benefit analyses that met our inclusion criteria.

[Tables 1, 2, and 3](#) summarize the characteristics and findings of economic evaluations of diagnostic approaches, management strategies, and alternative structures of care, respectively, for patients with TBI. Further details are provided in the [Appendix](#) in Supplemental Material. Seven studies examined diagnostic strategies for mild TBI in children and/or adults [20–22,26,31,33,40], two compared different screening strategies for suspected blunt cerebrovascular injury [24,27], two evaluated management strategies for patients with mild TBI [20,23], and four studies

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