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Cost-utility analysis in orthopaedic trauma; what pays? A systematic review

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ABSTRACT

Background: As healthcare systems come under ever-increasing pressure to provide more care with fewer resources, emphasis is being placed on value-based systems that maximise quality and minimize cost. The aim of this study was to determine which interventions in fracture care have been demonstrated to be cost effective.

Methods: A systemic review of cost-utility studies on the management of fractures from 1976 to 2015 was carried out using a search of the Cost-Effectiveness Analysis Registry, National Health Service Economic Evaluation Database (NHS EED) and MEDLINE.

Results: 20 studies were included with 15 (75%) studies assessing interventions in lower limb trauma and 8 (25%) studies assessing interventions in upper limb trauma. 50% of studies used a decision tree model and 50% used collected data alongside a randomised clinical trial. Interventions which were shown to be cost effective in lower limb trauma were total hip replacement in displaced femoral neck fractures, the SHS in stable (A1 and A2) fractures and IM nailing for unstable (A3) fractures, salvage treatment for grade IIIB and IIIC open tibial fractures and operative treatment of ankle and calcaneal fractures. For systems-based strategies, there is evidence demonstrating cost effectiveness to treating hip fractures in high volume centres and to having resources in place to facilitate fractures being treated within 48 h of injury. In upper limb trauma there was evidence showing operative treatment of displaced proximal humerus fractures to be neither clinically nor cost effective. There was evidence supporting the operative treatment of non-displaced scaphoid fractures. Overall the quality of the studies was poor with only 50% (10) of studies able to make a treatment recommendation. Reasons for this included poor quality primary source data and poor reporting methodological practices.

Conclusion: Certain aspects of fracture management have been shown to be cost effective. However, there is a paucity of evidence in this area and further research is required so that value-based interventions are chosen by healthcare providers engaged in orthopaedic trauma care.

Introduction

The cost of healthcare provision is increasing significantly worldwide and is providing a major challenge for healthcare systems. The main factors driving this increase are an aging population and the emergence of newer treatments and technologies which are often significantly more expensive than current treatments [1]. In the UK, healthcare expenditure has more than doubled over the past 50 years with public spending on the NHS amounting to 8.5% of GDP in 2012 and possibly increasing to 16.6% of GDP by 2061 [1]. There is now an emphasis on value-based healthcare, with clinicians expected to reduce cost by choosing interventions that have been shown to be both clinically effective and cost effective. The most commonly used method of cost effectiveness analysis that estimates the value of an intervention in healthcare is cost utility analysis (CUA) [2].

In CUA, a ratio (cost/benefit) is calculated as the cost of an intervention alongside the benefit it produces (Appendix A) [3]. This benefit is typically expressed in quality-adjusted life-years (QALYS), where each year after an intervention is assigned a utility score from 0 (death) to 1 (perfect health) often calculated from a functional outcome score (e.g. EQ-5D-5L) [3]. Cost per QALY gained

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Table 1
Glossary of terms.

Key terms:
- Utility score = health-related quality of life score associated with a given state of health, typically valued on a 0–1 scale.
- QALY = utility level associated with a given state of health X years lived in that state
- $\text{ICER} = \frac{(C0-C1)}{(E0-E1)}$

C1 = cost of treatment 1
C0 = cost of comparator treatment
E1 = QALY of treatment 1
E0 = QALY of comparator treatment
- ICER = cost per QALY gained for implementing one treatment over another
- Threshold ICER = cost per QALY deemed acceptable for funding
- Reference case = parameters of a typical (or average) patient and their outcome

for different interventions can then be compared in an incremental cost-effectiveness ratio (ICER) (Table 1 and Appendix A). The ICER for an intervention is essentially the cost per QALY gained by implementing one intervention over another. A decision on whether to adapt an intervention can then be made by comparing the ICER with a minimum or threshold ICER known as the "willingness to pay threshold (WTP)". In the United Kingdom (UK), this threshold has been set between £20,000 and £30,000 per QALY gain by the National Institute for Health and Clinical Excellence (NICE) [4]. This method of cost utility analysis is considered the gold standard for reporting the results of economic evaluations in healthcare across all disciplines of medicine [2,4].

There has been a paucity of evidence describing the cost effectiveness of interventions in orthopaedic surgery with a systematic review of studies published between 1966 and 2003 identifying only 37 relevant studies [5]. This is of particular relevance in the area of trauma care as where there has been a trend towards adapting new technologies such as intramedullary nails in intertrochanteric fractures with minimal clinical or economic evidence of superiority over traditional implants [6]. The aim of this study was to systematically review the CUA evidence to date on interventions in orthopaedic trauma care.

Methods

A systematic review was undertaken to identify all published studies relevant to CUA analysis in fracture and trauma care from January 1990 to May 2015 inclusive. Three different search strategies were employed. These were a search of the cost-effectiveness analysis (CEA) registry database, the National Health Service Economic Evaluation Database (NHS EED) and a MEDLINE search. The CEA Registry is an established high quality repository of cost effectiveness analyses (1976 to 2015) in healthcare compiled by the Centre for the Evaluation of Value and Risk in Health at Tufts University [7]. It has been used in multiple previous studies reporting on cost-effectiveness in healthcare [8]. The CEA registry team searches MEDLINE using the keywords "QALYs", "quality-adjusted" and "cost-utility analysis". Articles are then independently reviewed by two registry team members who determine whether they contain appropriate cost utility estimates (QALYs or ICERs). In this study, the following key words were used to search the registry; fracture, trauma, injury. Studies describing the management of osteoporosis were excluded. A subjectively assigned quality rating score (based on a seven point Likert scale) assigned by the registry team for each study based on the six recommendations of the US Panel of Cost-Effectiveness in Health and Medicine was also noted. The second search strategy used in this study was a search of the NHS EED database [9]. This is a database compiled based on searches of MEDLINE, CINAHL, EMBASE and PsychINFO. After articles are identified and screen, they are incorporated into the database by health care economists. The database was searched using the same keywords as for the CEA registry for the period 1990–May 2015. The third search strategy employed was a MEDLINE search for the same search period using the terms cost utility; cost effectiveness; cost with the following qualifiers; "fracture" or "trauma" or "injury".

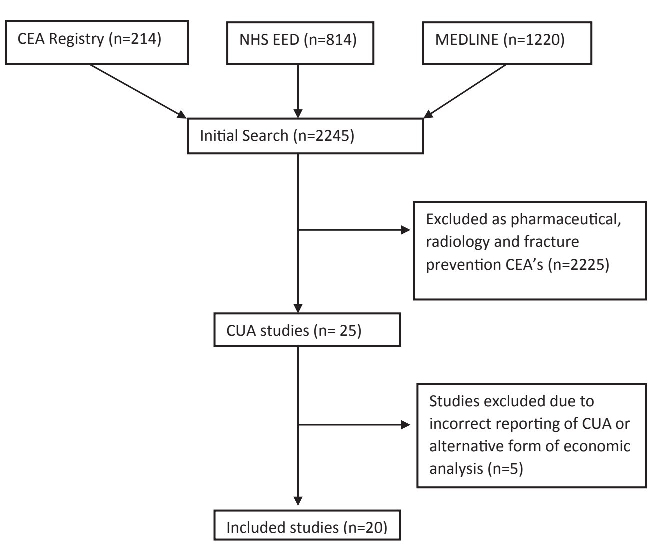

Fig. 1. Search strategy flow chart (1976–2015).

Results

20 studies were identified from the search strategy (Fig. 1). Five studies [10–14] reported on upper limb fractures and 15 studies [15–29] reported on lower limb fractures (Table 2). 55% of studies were published between 2010 and 2015. Table 3 describes the study methodology used in the studies and assessments of study quality. Tables 4 and 5 describe the individual studies in detail in terms of methodology, findings and limitations.

Table 2
Area of analysis.

Area of study	Number of studies
Lower Limb	
Hip	7 [15–21]
Femoral shaft	1 [22]
Tibia	3 [23–25]
Ankle	3 [27–29]
Calcaneus	1 [26]
Upper Limb	
Humerus	2 [10,14]
Wrist	1 [11]
Clavicle	1 [12]
Scaphoid	1 [13]

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