Cost-utility analysis of emergency department thoracotomy for trauma victims
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Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

Health technology
The study examined emergency department thoracotomy (EDT) in comparison with no thoracotomy.

Type of intervention
Treatment.

Economic study type
Cost-utility analysis.

Study population
The study population comprised patients with either penetrating injury or blunt trauma of the thorax.

Setting
The setting was the emergency department (ED). The economic study was carried out in the USA.

Dates to which data relate
The effectiveness data were derived from studies published between 1989 and 2004. Some data on resource use and costs came from sources published between 2002 and 2005. The price year was not reported.

Source of effectiveness data
The clinical and epidemiological data used in the decision model were:

- the probabilities of survival and impaired, or unimpaired, survival in penetrating or blunt trauma;
- the rates of blood exposure, HIV and HCV in healthy providers; and
- the mortality rates in the general population.

Modelling
A decision analytic modelling approach, using published evidence, was applied to a hypothetical cohort of victims and providers of 30 years of age. Two identical decision trees were constructed to model the clinical and economic outcomes for EDT versus no thoracotomy in penetrating or blunt trauma victims. Patients could either survive or die. Those surviving could be intact or disabled. The model also took health care providers and the risk of occupational exposure to infected blood into consideration. The simple structure of the model was represented graphically. Point estimates and probability distributions for each model parameter were reported in full.

Sources searched to identify primary studies
NHS Economic Evaluation Database (NHS EED)
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The authors stated that, for most data, the same sources as those cited by the ACS were used. These sources covered about 7,000 patients undergoing EDT. However, no information on the primary studies was given. Mortality in the general population came from statistics from the general US population. Some assumptions were also made.

Methods used to judge relevance and validity, and for extracting data
The primary studies might have been identified selectively from amongst those available in the literature. There were no details of the methods used to combine the original studies.

Measure of benefits used in the economic analysis
The summary benefit measure used was the quality-adjusted life-years (QALYs). These were estimated using a modelling approach. The utility weights were derived from the literature. Limited information on the sources of these data and the methods used to derive them was given. The QALYs included the utilities of both victims and providers. The authors stated that utility weights for impaired survivors of EDT are difficult to obtain and the data had to be taken from cardiac arrest or stroke survivors. It was assumed that intact survivors have the same quality of life as the general population. The benefits were discounted at an annual rate of 3%.

Direct costs
The perspective adopted in the costs analysis was unclear, although the authors stated that societal costs were considered. The cost categories considered were thoracotomy and other procedures, hospital stay, long-term care, and care associated with provider exposure. The costs used in the model took the status of the patient (intact or neurologically impaired) into account. A detailed breakdown of the cost items was not given and the costs were presented as macro-categories. The unit costs and the quantities of resources used were not presented separately. Most of the costs were derived from the National Inpatient Sample (NIS) from the Health Care Utilization Project database. Hospital charges were adjusted by cost-to-charge ratio. The costs associated with provider exposure were derived from a published economic analysis. Discounting was relevant and was carried out at an annual rate of 3%. The price year was not reported.

Statistical analysis of costs
The costs were treated deterministically in the base-case, but probabilistic distributions were assigned to costs in the sensitivity analysis.

Indirect Costs
Productivity costs were not considered.

Currency
US dollars ($).

Sensitivity analysis
A deterministic sensitivity analysis was carried out on many model inputs to evaluate the robustness of the cost-effectiveness results. Alternative ranges of estimates were taken from published studies. A probabilistic sensitivity analysis was also undertaken using a Monte Carlo simulation. The probabilistic distributions given to the model inputs were presented.

Estimated benefits used in the economic analysis
The expected QALYs were not reported.
Cost results
The total costs were not reported.

Synthesis of costs and benefits
Incremental cost-utility ratios were calculated to combine the costs and benefits of the alternative strategies.

For penetrating trauma, the incremental cost per QALY gained with EDT over no thoracotomy was $16,125 at an average survival probability of 0.10. The probabilistic sensitivity analysis indicated that the probability that the cost per QALY was below the threshold of $50,000 was 93.4%.

For blunt trauma, the incremental cost per QALY gained with EDT over no thoracotomy was $163,136 at an average survival probability of 1.6 per 100. The probabilistic sensitivity analysis showed that the probability that the cost per QALY was below the threshold of $50,000 was 37%.

The deterministic sensitivity analysis showed that, for the penetrating trauma case, the model was sensitive to survival probability. For example, with a survival probability of 2 in 100, the cost per QALY rose to $66,403. The model was insensitive to other inputs. For blunt trauma patients, as the probability of survival after EDT approached zero, the strategy was dominated, meaning that no thoracotomy was more effective and less expensive. With a survival gain as high as 5 in 100, the incremental cost per QALY gained with EDT was $84,137. The impact of occupational exposure did not affect the conclusions of the analysis.

Authors' conclusions
Emergency department thoracotomy (EDT) was cost-effective for penetrating trauma, but was not recommended for blunt trauma because of the low rate of survival and the high rate of impairment.

CRD COMMENTARY - Selection of comparators
The rationale for the choice of the comparators was clear. EDT was compared with no EDT, which represented the only feasible alternative for the patient population considered in the study. You should decide whether they are valid comparators in your own setting.

Validity of estimate of measure of effectiveness
The clinical data were derived from the literature but no systematic search for data was reported. The parameters for the model were mainly derived from sources cited by the ACS. Since no information on the designs and other characteristics of the primary studies was given, it is not possible to judge the validity of the data given the information reported in this paper. Also, no details of the methods used to combine the original estimates were given. However, the authors pointed out that the ACS summarised the best available data. Key clinical parameters were extensively varied in the deterministic and probabilistic sensitivity analyses.

Validity of estimate of measure of benefit
The estimation of health benefits (QALYs) was modelled using a decision analytic model. The methods used to estimate the utility weights were not described as they were taken from published papers. Discounting was performed, as recommended by international guidelines. The QALYs included quality changes from the perspective of both the patient and the provider.

Validity of estimate of costs
The perspective adopted in the study was not clear. However, only costs relevant to the health care system appear to have been included. The costs were not broken down and were presented as macro-categories. This might limit the possibility of replicating the analysis in other settings. Since hospital charges were used to derive the costs, the use of a cost-to-charge ratio was appropriate. The sources of the costs were reported for most items. However, since some costs were derived from previous studies, the information on the estimation of these categories of costs was limited.
price year was not given, which will hinder reflation exercises in other time periods. Statistical analyses of the costs were carried out since probabilistic distributions were assigned to the economic inputs.

Other issues
The current results were not compared explicitly with those from other studies. The authors stated that the validity of their analysis relied on the robustness of the model assumptions, and was enhanced by the extensive use of probabilistic sensitivity analysis. The authors did not explicitly address the issue of the generalisability of the study results to other settings, but the sensitivity analyses on key cost parameters improved the external validity of the study.

Implications of the study
The study results suggest that EDT should be performed in patients with penetrating trauma. The use of EDT in patients with blunt trauma does not appear to be cost-effective. The authors stated that, ideally, a multi-centred prospective study should be carried out to evaluate the cost-effectiveness of EDT. However, the low survival rate of EDT appears to preclude any feasible study with sufficient power.

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Indexing Status
Subject indexing assigned by NLM

MeSH
Blood-Borne Pathogens; Cost-Benefit Analysis; Decision Support Techniques; Emergency Service, Hospital /economics; Health Personnel; Humans; Occupational Exposure; Survival Rate; Thoracotomy /adverse effects /economics; Treatment Outcome; Wounds, Nonpenetrating /mortality /surgery; Wounds, Penetrating /mortality /surgery

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