Impact of a dedicated trauma service on the quality and cost of care provided to injured patients at an urban teaching hospital

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
A dedicated trauma response and care centre, provided for injured patients, was compared with the situation before the centre was provided. Specifically, the trauma centre would provide committed private attending surgeons, improved intensive care unit (ICU) support, improved availability of the trauma work force, and improved follow-up of trauma patients by a dedicated trauma "rounder".

Type of intervention
Trauma response service.

Economic study type
Cost-effectiveness analysis.

Study population
The study population included all trauma patients. These were admissions of at least one day with at least one assigned International Classification of Diseases, Ninth Revision (ICD-9) diagnostic code between 800.0 and 959.9. Patients with only burns, insect bites, foreign bodies or late effects of injury, were included.

Setting
The setting was a trauma centre within a hospital. The economic study was carried out in Detroit, USA.

Dates to which data relate
The effectiveness data for the pre-trauma service (PRE) were taken from patients entering the hospital between 1 January 1995 and 31 December 1995. The data for the post-trauma service (POST) were taken from patients entering the centre between 1 July 1996 and 30 June 1997. All the costs were reported in 1997 US dollars ($).

Source of effectiveness data
The effectiveness data were derived from a single study.

Link between effectiveness and cost data
The costing was undertaken on the same patient sample as that used in the effectiveness analysis, although accurate cost information only became available in 1996. As such, the same charge-to-cost ratio was used for both periods.

Study sample
There were 1,025 trauma patients admitted during the PRE period and 1,065 admitted during the POST period. There were 39 repeat admissions, 20 of which were for the same injury. These were included, as the characteristics of these
patients did not differ from the population. No power calculations to determine the sample size were reported.

Study design
This was a single-centre, retrospective before-and-after study using two patient cohorts. No details of the follow-up period were provided, although all patients were considered for their entire length of stay. Any patients who died whilst in the trauma centre were accounted for in the results.

Analysis of effectiveness
The patients were assigned at least one ICD-9 code. These codes were then used to calculate the expected survival probabilities using techniques modified a published study. The population was then divided into two groups, the 'severely injured' (survival probability less than 0.5) and 'less severely injured' (survival probability greater than 0.5). The health outcomes included the admission rate, survival probability, mortality, and the number of lives saved. The length of stay for patients and an Injury Severity Score were also recorded. The analysis was performed on an "intention to treat" basis.

Effectiveness results
In the PRE period, 1,025 trauma admissions accounted for 4.6% of all the admissions. This increased to 1,065 (5.3% of all the admissions) for the POST period.

The severity of injury increased for the POST period. The mean Injury Severity Score was 8.9 (standard deviation, SD=7.01) in the POST period, compared with 8.1 (SD=6.06) in the PRE period.

The mean probability of survival decreased significantly from 0.84 (SD=0.19) to 0.79 (SD=0.24).

There was no significant change in the actual number of deaths. There were 37 deaths in the PRE period and 43 in the POST period.

The mean length of stay did not change significantly, 7.35 days (SD=8.19) days for the PRE period versus 7.13 (SD=9.05) for the POST period.

The reduction in the length of stay was significant for less severely injured patients, 6.26 (SD=5.9) days PRE versus 5.52 (SD=5.9) days POST.

It was also reported that an addition 51 lives were saved as a direct result of the trauma service.

Clinical conclusions
The introduction of a dedicated trauma centre was associated with an increase in the number of patients, and an increase in the mean severity of patient injury. This resulted in a decrease in the probability of survival, a reduction in the length of stay for less severely injured patients, and an increase in the number of lives saved.

Measure of benefits used in the economic analysis
No summary measure of benefit was reported, and as such, a cost-consequence approach was used. See the 'Effectiveness Results' section.

Direct costs
No discounting was performed on the direct costs. This was appropriate given the short period of analysis (less than 2 years). The costs were taken from the hospital's activity-based costing system and were reported as the mean cost per patient in sub-groups of patient type, using charge-to-cost ratios. The figures were adjusted for inflation using the Hospital Producer Price Index for the price year 1997. The costs and the quantities were not reported separately.
Statistical analysis of costs
A chi-squared analysis was used to determine any significant differences in the costs between the two periods. Statistical significance was reported at p=0.05.

Indirect Costs
No indirect costs were considered.

Currency
US dollars ($).

Sensitivity analysis
No sensitivity analysis was performed.

Estimated benefits used in the economic analysis
No summary measure of benefit was reported. See the 'Effectiveness Results' section.

Cost results
The mean costs of care increased significantly from $10,748 to $12,530, (p=0.02), following the introduction of the trauma centre. In particular, the significant increases in cost were for those patients who received blunt injuries, (p=0.05), and for those who were struck, either deliberately or accidentally, (p=0.02).

Synthesis of costs and benefits
The costs and the benefits were not synthesised as there was no summary benefit measure. It was stated that the hospital cost per life saved was $224,621 during the PRE period, and that this decreased to $134,316 for the POST period.

Authors’ conclusions
The introduction of a dedicated trauma service had a positive impact upon the quality of care, but was accompanied by an increase in the cost.

CRD COMMENTARY - Selection of comparators
The retrospective before-and-after approach undertaken, which used two different cohorts, meant that there were a number of factors that could not be controlled. It was apparent from the results that the patients included in each group differed significantly, particularly in terms of the injury severity. This may have been because any patients with particular injuries would be directed towards the dedicated trauma centre, rather than another hospital. Indeed, the authors suggested that the increase in number of patients injured in motor vehicle crashes was far greater than could have occurred by chance. It is therefore difficult to single out the effect of the trauma team and the change in health outcomes. The confounding variables and potential bias indicate that these results should be treated with caution.

Validity of estimate of measure of effectiveness
As reported already, the measures of injury severity may have been open to significant bias by other factors. Thus, injury severity does not appear to have been an appropriate measure of effectiveness. This would also be the case for other measures such as length of stay and mortality rates.

Validity of estimate of measure of benefit
The benefits of the intervention are associated with the clinical outcomes. These were left disaggregated in the cost-consequences approach adopted by the authors, which was appropriate.

**Validity of estimate of costs**
In the reporting of the costs, it was unclear which of the costs were a result of the trauma centre being established (staff, building etc), and which were directly associated with the treatment of trauma patients. It would have helped if a clear cost for factors such as building the centre, staff, equipment, medicine, and so on, had been reported. This factor means that the costs saved due to specialist treatment would have been underestimated in this study.

**Other issues**
The authors made several comparisons of their finding with other studies, and discussed comprehensively the limitations of their study. The issue of generalisability, however, was not addressed. The study was performed from the perspective of the hospital, which ignores the fact that patients who may now be taken to this specific trauma centre would have been taken to another hospital had the centre not existed. From a societal perspective, therefore, the severity of injury upon arrival is irrelevant, as this should not be affected by the presence of a trauma centre. What is important is the reduction in treatment costs resulting from an improved, dedicated service. This can only be effectively measured through comparing two otherwise comparable groups within a prospective, preferably randomised, study. However, this may not be feasible or ethical within this particular clinical setting.

**Implications of the study**
The authors suggest that the introduction of a dedicated trauma centre has resulted in improved service, and that similar establishments would be recommended. However, due to the uncontrolled nature of the study, it is recommended that the conclusions drawn from this study be viewed with some caution.

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