Should helical CT scanning of the thoracic cavity replace the conventional chest X-ray as a primary assessment tool in pediatric trauma: an efficacy and cost analysis

Renton J, Kincaid S, Ehrlich P F

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
Helical CT (TCT) scanning (General Electric Systems, Light Speed, 4th generation) of the thoracic cavity was compared with conventional chest X-ray (CXR).

Type of intervention
Screening and diagnosis. The authors aimed, in part, to assess whether TCT should be used as a screening or diagnostic tool in selected patients.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised children aged 18 years old and younger who had both a CXR and TCT scan in the initial trauma evaluation.

Setting
The study was set in the Jon Michael Moor Trauma Centre (JMMTC) at a tertiary care medical facility (West Virginia University Hospital, USA).

Dates to which data relate
The effectiveness data were collected between 1996 and 2000. The date for the hospital charges used in the evaluation was not given. The price year was not reported.

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

Link between effectiveness and cost data
The costing was carried out retrospectively on the basis of hospital charges. Therefore, it was not carried out on the same sample of patients as that used in the effectiveness study.

Study sample
The authors did not report that power calculations were carried out. The sample was selected by identifying patients who received a CXR and TCT scan on initial trauma evaluation between 1996 and 2000. Indications for receiving a TCT scan included any sign of thoracic injury on CXR, pathologic findings on physical examination of the chest, and high-impact force to the chest wall. The initial study sample was appropriate for the study question since it included
patients receiving CXR and TCT. However, there was no comparator group that received CXR alone. The authors identified 45 trauma patients (age range: 7 months to 18 years) who met the study criteria. Of these, 25 were male. The authors excluded patients whose films and reports could not be reviewed.

**Study design**
The analysis was a within-group diagnostic study comparing the information gained from CXR and TCT. The authors compared the information on injuries available before and after TCT for a single group of patients who received both CXR and TCT (all patients had previously had CXR). The data were collected concurrently and reviewed retrospectively. The study was conducted at a single centre. The patients were not followed for any length of time, therefore there could be no loss to follow-up.

**Analysis of effectiveness**
The analysis considered patients who received both CXR and TCT. The primary health outcomes observed were disparities between the TCT scan and CXR, and whether a finding on the TCT scan resulted in an immediate change in clinical management. Since there was only a single study group, there was no need for comparisons between groups.

**Effectiveness results**
In 18 of the 45 patients (40.0%), 31 new injuries were detected by TCT that had not been identified by CXR.

In 8 of the 45 patients (17.7%), TCT imaging resulted in a change of clinical management.

The authors calculated that age, gender, trauma score, mechanism, and indication of TCT could not predict differences between TCT and CXR, (p>0.05). However, they did not report the statistical methods used for the calculation.

**Clinical conclusions**
The authors concluded that the clinical information acquired from the TCT scan was rarely significant.

**Measure of benefits used in the economic analysis**
A summary measure of benefits was not used. The study was therefore categorised as a cost-consequences analysis.

**Direct costs**
The authors estimated costs from the perspective of the hospital by estimating the cost of a TCT at their institution. Discounting was not carried out since the authors estimated the immediate cost of the TCT scan. The hospital cost for running the CAT scan (per scan) was estimated. This included standard maintenance and electricity, but excluded the salaries of the staff/technician and the costs of digitalising the films. The authors estimated the costs to the patients on the basis of the patient charge at their institution.

The estimation of quantities was not relevant, as the analysis was only concerned with the cost of a single scan received by the patient. The unit costs were derived from the actual costs at the authors’ institution. A price year was not reported.

**Statistical analysis of costs**
No statistical analysis of the costs was reported.

**Indirect Costs**
The indirect costs to society, such as loss of productivity, were not relevant given the objectives of the authors and the perspective of the study. A price year was not stated.
Currency
US dollars ($).

Sensitivity analysis
No sensitivity analysis was reported.

Estimated benefits used in the economic analysis
See the 'Effectiveness Results' section.

Cost results
The cost of a TCT to the hospital was $200 and the patient charge was $906.

The cost of a CXR was reported to be $94, although it was unclear whether this was the cost to the hospital, the patient charge, or the sum of the two.

The authors calculated that if a TCT scan were carried out on every child, then 200 would be required to observe one "clinically significant change". The authors reported the cost of this to be $180,000 to the patient and $39,600 to the hospital.

Synthesis of costs and benefits
The costs and benefits were not combined and the study was categorised as a cost-consequences analysis.

Authors' conclusions
The authors concluded "significant clinical information is acquired rarely from the TCT (thoracic computed tomography) scan, and a CXR (chest X-ray) is still a very cost-effective, valuable initial study to obtain".

CRD COMMENTARY - Selection of comparators
The authors compared TCT and CXR of the thoracic cavity. The alternatives were justified with reference to the fact that TCT was a newer method of imaging than conventional X-ray. This may not necessarily be the case in the readers' setting.

Validity of estimate of measure of effectiveness
The analysis used a study of diagnostic techniques, which compared the additional information provided by TCT in a cohort of patients who received both CXR and TCT. This design was appropriate for the objectives stated by the authors. The study sample was representative of the study population. A brief description of the study group, including the causes of their injuries, was provided.

The study group was relatively small and may not have been sufficient to show statistically significant differences in the quantity of injuries observed using each of the techniques. The authors estimated whether age, gender, trauma score, mechanism, and indication of TCT could predict differences between TCT and CXR. However, they did not report their methods for this calculation. This limits the ability of other researchers to fully interpret the results.

Validity of estimate of measure of benefit
The authors did not derive a summary measure of effectiveness. Therefore, the study was categorised as a cost-consequences analysis. The authors' objective was to carry out a cost-benefit analysis. This was not achieved as a summary measure of benefit was not defined and assigned a monetary value. The analysis could, therefore, be more...
accurately described as a cost-effectiveness (cost-consequences) analysis.

Validity of estimate of costs
The authors explicitly stated that they did not include all the relevant categories of cost for the cost perspective adopted. For instance, staff/technician salaries and the costs of digitalising the films were excluded from the analysis. Therefore, the authors may have underestimated the true cost of TCT. The unit costs were reported separately. The perspective adopted by the authors was relatively narrow, and the study may have been improved had a wider perspective, such as that of society, been adopted. Moreover, there was no long-run estimation of the costs, or an estimate of the costs resulting from mismanagement that may have resulted if TCT were not carried out.

Other issues
The authors appropriately made extensive comparisons of their findings with the results from other studies. They pointed out both similarities and differences, and discussed reasons for differences where they existed. However, the issue of generalisability to other settings was not addressed. Given the perspective adopted and the lack of a sensitivity analysis, the study is unlikely to be generalisable beyond the current setting. The authors did not present their results selectively. However, it is not clear that the conclusions drawn accurately reflect the results presented. The authors claimed that "significant clinical information is acquired rarely from the TCT scan" yet their results had reported that clinical management had been altered by TCT in 17.7% of the patients. These results appear to have been inconsistent with the conclusion drawn, although a definition of "significant clinical information" was not provided. The study considered the use of TCT in children and this was reflected in the authors' conclusions. A number of limitations to the study, such as its retrospective nature, were reported.

Implications of the study
The authors explicitly stated that the study "does not allow for conclusions of whether restrictive use of TCT scan is an appropriate policy, nor does it define clear criteria of when a TCT should be used". They highlighted the importance of further work to provide information in this area.

Source of funding
None stated.

Bibliographic details

PubMedID
12720196

DOI
10.1016/j.psu.2003.50169

Indexing Status
Subject indexing assigned by NLM

MeSH
Accidents, Traffic; Adolescent; Child; Child, Preschool; Cost-Benefit Analysis; Female; Hospital Costs; Humans; Infant; Injury Severity Score; Male; Pilot Projects; Radiography, Thoracic /economics /methods; Retrospective Studies; Thoracic Injuries /classification /radiography; Tomography, Spiral Computed /economics

AccessionNumber