Cost effectiveness of adding magnetic resonance imaging to the usual management of suspected scaphoid fractures

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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
Magnetic resonance imaging (MRI) of the wrist, performed within 2 to 5 days of presenting to the emergency department (ED) for a suspected scaphoid fracture, was examined.

Type of intervention
Diagnosis.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised patients presenting to the ED with a clinical diagnosis of possible occult scaphoid fracture. The inclusion criteria were older than 18 years of age and presentation with a clinical diagnosis of possible occult scaphoid fracture requiring immobilisation, with normal and/or inconclusive initial wrist radiographs. Patients were excluded if they had any contraindications to MRI (pacemaker, cerebral aneurysm clip, cochlear implant, presence of metal or shrapnel in strategic locations such as the eye, or claustrophobia).

Setting
The setting was a hospital. The economic study was carried out in Australia.

Dates to which data relate
The effectiveness and resource use data were gathered from January 2000 to December 2002. The price year was 2000.

Source of effectiveness data
The effectiveness evidence was derived from a single study.

Link between effectiveness and cost data
The costing was carried out prospectively on the same sample of patients as that included in the clinical study.

Study sample
Power calculations were performed on the basis of the estimated difference in days unnecessarily immobilised. These showed that with a mean duration unnecessarily in plaster of 3 days in the MRI group and 10 days in the control group, and with 5 patients in each group, the study had a power of 80% to detect a significant difference with an a error of 0.05. Of the 37 patients initially identified, six declined to participate, two could not be contacted, and one agreed to participate but moved overseas before any study involvement. Thus, the final study sample included 28 patients, of
which 11 were allocated to the MRI group and 17 to the control group. The median age was 35 years (interquartile range, IQR: 27 - 41) in the MRI group and 29 years (IQR: 24.75 - 50) in the control group. There were 7 men (64%) in the MRI group and 9 men (53%) in the control group.

**Study design**
This was a prospective, randomised controlled trial that was carried out at five major city and suburban hospitals in the state of Victoria, Australia. Randomisation was performed using computer-generated random numbers in a ratio of 1:1. Block randomisation was based on each hospital as a unit of randomisation. A senior radiologist at each site assessed all scans, with copies sent to a central reading site where two readers reviewed the study, reaching a consensus in cases of discrepancy. All patients were contacted by telephone at baseline, and then by telephone or post monthly for 3 months to collect information on clinical outcomes. Only one patient in the MRI group was lost to the follow-up assessment. The outcome assessment was not performed blind.

**Analysis of effectiveness**
The analysis of the clinical study, whether intention to treat or treatment completers only, was not stated. The outcome measures used were:

- the number of scaphoid fractures,
- the number of other fractures,
- the days until diagnosis,
- the days unnecessarily in plaster,
- the days unnecessarily in plaster in patients without a fracture,
- the days off work,
- the activities unable to perform (scale of 1 - 5),
- the recovery of wrist function, and
- pain.

The study groups were comparable at baseline in terms of the clinical and demographic characteristics.

**Effectiveness results**
There were 3 (27.3%) scaphoid fractures in the MRI group and 4 (23.5%) in the control group, (p=0.82).

There were 4 (36.3%) other fractures in the MRI group and 2 (11.8%) in the control group, (p=0.12).

The median days until diagnosis were 3 (IQR: 3 - 3) in the MRI group and 10 (IQR: 10 - 12) in the control group, (p=0.003).

The median days unnecessarily in plaster were 0 (IQR: 0 - 3) in the MRI group and 7 (IQR: 0 - 12) in the control group, (p=0.029).

The median days unnecessarily in plaster in patients without a fracture were 3 (IQR: 3 - 3) in the MRI group and 10 (IQR: 7 - 12) in the control group, (p=0.006).

Days off work, activities unable to perform (scale of 1 - 5), recovery of wrist function and pain were comparable between the groups.
Clinical conclusions
The effectiveness analysis showed that days until diagnosis and days unnecessarily in plaster were significantly shorter for MRI patients than for conventionally managed patients.

Measure of benefits used in the economic analysis
The summary benefit measure was the number of days patients spent unnecessarily in plaster. This was derived directly from the effectiveness analysis.

Direct costs
Discounting was not relevant since the costs were incurred during a short timeframe. The unit costs were presented separately from the quantities of resources used. The health services included in the cost analysis were ED visits, general practitioner consultation, specialist consultation (initial and follow-up) and diagnostic services (radiographs, skeletal scintigram and MRI). In the economic evaluation, initial ED visits and initial radiographs were not included because the cost-effectiveness analysis focused only on those costs that were expected to vary between the groups. The cost/resource boundary of the health care system was adopted. Resource use was estimated using patient-level data that were derived from the sample of individuals included in the clinical study. The costs came from the Medicare Benefits Schedule. The price year was 2000.

Statistical analysis of costs
Statistical analyses were performed to examine the significance of differences in the costs.

Indirect Costs
The indirect costs were not included in the economic evaluation.

Currency
Australian dollars (Aus$).

Sensitivity analysis
Sensitivity analyses on individual variables were not carried out. However, a bootstrap method using 1,000 simulations was used to generate cost-effectiveness acceptability curves, to show the probability that MRI was cost-effective according to a willingness-to-pay per day saved in plaster. This was calculated by multiplying the productivity losses due to immobilisation (derived from the clinical trial) and the daily earnings (estimated from the average Australian wage).

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

Cost results
The total costs were Aus$594.35 (IQR: 551.05 - 667.23) with MRI and Aus$428.15 (IQR: 124.40 - 702.65) with conventional care, (p=0.187).

Health care use was lower in the MRI group (median 3.0 units, IQR: 2.0 - 4.25) than in the control group (median 5.0 units, IQR: 3.0 - 6.5), (p=0.03).

Synthesis of costs and benefits
An incremental cost-effectiveness ratio was calculated to combine the costs and benefits of the diagnostic strategies.
The incremental cost per day saved from unnecessary immobilisation by the use of MRI over conventional care was Aus$44.37 (95% confidence interval: 4.29 - 101.02).

The acceptability curve showed that, at a 50% productivity loss, the addition of MRI was a cost-effective option in 95.3% of cases. At a very minor productivity loss (10%), the cost-effectiveness was greatly reduced so that MRI was cost-effective in only 11.7% of simulations.

**Authors' conclusions**

The addition of magnetic resonance imaging (MRO) of the wrist to the management of occult scaphoid fracture reduced the number of days the patient was immobilised in a plaster cast and the use of health care units. However, there was a non significant increase in the health care costs incurred.

**CRD COMMENTARY - Selection of comparators**

The selection of the comparators was appropriate as usual care and an alternative diagnostic approach were compared. You should decide whether they are valid comparators in your own setting.

**Validity of estimate of measure of effectiveness**

The effectiveness analysis came from a clinical trial, which was appropriate for the study question. The robust design of the study should have limited the potential impact of confounding factors and selection bias. The internal validity of the study was ensured by the randomisation procedure, the comparability of the patient groups at study entry, the multi-centre design, the satisfactory description of sample selection, and the use of power calculations to determine the sample size. One patient was lost to follow-up and it was unclear whether this patient was included in the analysis of effectiveness. The authors noted that the main limitation of their study was the small sample size.

**Validity of estimate of measure of benefit**

The summary benefit measure was specific to the interventions and is not comparable with the benefits of other health care interventions.

**Validity of estimate of costs**

The cost categories included in the analysis were consistent with the chosen perspective of the study. The unit costs, resource use data and the price year were clearly reported, which will help when replicating and reflating the results of the analysis in other settings and time periods. The source of the data was provided. Some statistical analyses of the costs were performed, but the cost estimates were specific to the study setting. The authors stated that the economic results were also reported in health care units, which aids the interpretation of the study results in other settings.

**Other issues**

The authors compared their findings with those from other studies and noted that similar results were achieved. The issue of the generalisability of the study results to other settings was addressed when the authors stated that the cost data were also reported in health care units. However, other aspects of the analysis were specific to the setting of the study and are not directly transferable to other countries. Sensitivity analyses were not performed to assess the external validity of the analysis. The study referred to patients with suspected scaphoid fractures and this was reflected in the authors' conclusions. The authors stated that the use of a very rigorous definition of scaphoid fracture was used, which represented a strength of the analysis.

**Implications of the study**

The study results suggested that the cost-effectiveness of MRI depended on society's willingness-to-pay for the possibility of days saved from plaster.
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