Cost-effectiveness of immediate MR imaging versus traditional follow-up for revealing radiographically occult 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
Patients with suspected scaphoid fractures, but without radiographic evidence of fracture, underwent modified magnetic resonance imaging (MRI) using a 1.5-T magnet (General Electric Medical Systems; Milwaukee). The fracture is identified as a linear area of low signal intensity on T1- and T2-weighted images. The comparator treatment was to cast the wrist, have a follow-up orthopaedic appointment 7 to 10 days later, have several X-rays, and often fluoroscopy and sometimes MRI.

Type of intervention
Diagnosis and treatment.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised patients with suspected scaphoid fractures at one hospital who had negative radiographic findings at the initial consultation, and who had been examined in the MRI department.

Setting
The setting was secondary care. The economic study was carried out in the USA.

Dates to which data relate
The effectiveness and resource use evidence came from between 1995 and 2000. The price year was unclear.

Source of effectiveness data
The effectiveness data were derived from a review or synthesis of published studies.

Outcomes assessed in the review
The input parameters used in the decision analytic model was the positive predictive value (PPV) of the clinical examination for scaphoid fracture, and the negative predictive value (NPV) of initial radiographic findings in the setting of strong clinical suspicion.

Study designs and other criteria for inclusion in the review
Not reported.
Sources searched to identify primary studies
The sources searched for primary studies were not reported. The authors reported that, during the 6-year period between 1995 and 2000, 334 wrist studies were published. Of these, 5% were performed to rule out scaphoid fracture.

Criteria used to ensure the validity of primary studies
Not reported.

Methods used to judge relevance and validity, and for extracting data
Not reported.

Number of primary studies included
Overall, 6 primary studies provided the effectiveness data.

Methods of combining primary studies
The primary studies were combined in a meta-analysis using weighted average estimates of PPV and NPV. The weighted average PPV represented the total positive clinical examinations divided by the total true-positive scaphoid fractures. The weighted average NPV represented the total positive clinical examinations, negative radiography divided by total true-negative scaphoid fractures.

Investigation of differences between primary studies
No differences between the primary studies were investigated.

Results of the review
The PPV ranged from 13 to 69%, with a weighted average of 21%. These figures suggested that 4 out of 5 patients would not have a scaphoid fracture.

The NPV ranged from 50 to 87%, with a weighted average of 74%. These figures suggested that 3 of every 4 patients with positive results at clinical examination and negative findings on initial radiographs would be likely to undergo needless immobilisation and monitoring.

Measure of benefits used in the economic analysis
No summary measure of benefits was produced. Therefore, the authors carried out a cost-consequences analysis.

Direct costs
Discounting was not carried out as the costs were incurred during less than 2 years. The cost of the following resources was given: an emergency department splint, wrist radiographs (3 views), a scaphoid radiographic series, emergency department consultation, outpatient office visit, wrist fluoroscopy in office, first follow-up appointment, second follow-up appointment, nuclear bone scanning, routine MRI of the wrist imaging, and screening MRI of the wrist. The estimated quantity of resources used in the two treatments was given, and was illustrated by four case scenarios drawn from the authors' setting during the 6 years from 1995 to 2000. Charges were used to proxy costs. No price year was given.

Statistical analysis of costs
No statistical analysis of the costs was carried out.
Indirect Costs
No indirect costs were estimated.

Currency
US dollars ($).

Sensitivity analysis
The authors described three case scenarios in which patients with positive clinical indications, and who had negative radiographic results, turned out eventually to have scaphoid fractures. This meant that they sometimes had to wait more than 2 weeks to receive appropriate treatment for their fracture. The authors described one case scenario of suspected scaphoid fracture in which the patient was given modified MRI immediately after the negative radiographic results and it was discovered that there was no scaphoid fracture.

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

Cost results
The cost of screening MRI of the wrist was $770, while the cost of standard wrist MRI was $1,256.

The total costs with the traditional protocol were $677 or more, depending on whether a diagnosis was made at that time.

For example, in the case of scenario 1, 24 days were required to arrive at the diagnosis of scaphoid fracture and additional charges of $578 (including emergency department splint, a short arm thumb spica bandage and radiographs) were incurred before a definitive diagnosis was made. An additional expense of $486 was incurred by using routine MRI of the wrist ($1,256) rather than a screening protocol ($770).

The costs were calculated until a definitive diagnosis was made.

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

Authors' conclusions
Immediate magnetic resonance imaging (MRI) produced a definite diagnosis much earlier than the traditional protocol, which delays any MRI until much later and involves more orthopaedic visits, radiography and office fluoroscopy. Immediate MRI would sometimes be slightly more expensive than the traditional protocol, but it would usually turn out to be less expensive. When the indirect costs of the traditional protocol were also taken into consideration, then the likely cost-advantage of immediate MRI was likely to be even greater.

CRD COMMENTARY - Selection of comparators
The choice of the comparator was justified by it representing current practice in many settings. You should decide if the comparator represents current practice in your own setting.

Validity of estimate of measure of effectiveness
Although the authors stated that they conducted a review of the literature, they did not provide details of the methodology used to select and review the literature. The authors used data from the primary studies selectively. They did not consider the impact of differences between the studies identified when estimating effectiveness. A meta-
analysis was carried out to synthesise the data. The appropriateness of this was unclear, given that there was no reported investigation of differences between the studies in this update study. In addition, the weighted estimates derived from the literature were not tested in a sensitivity analysis.

**Validity of estimate of measure of benefit**

The authors did not derive a measure of health benefit and the analysis was one of cost-consequences. The reader is referred to the comments in the 'Validity of estimate of measure of effectiveness' field (above).

**Validity of estimate of costs**

Although the perspective from which the costing was carried out was not specified, it appears to have been that of the hospital. Based on this perspective, all the relevant categories of costs seem to have been included in the analysis. The authors realised that the indirect costs would be very important to the patients but made no attempt to quantify them. The cost data were presented in an unclear manner. Some costs were reported separately from the quantities, thus enhancing the reproducibility of the study in other settings. However, the total costs incurred by the patients were not given. Charges, rather than costs, were reported. This practice is methodologically inferior to reporting costs since charges do not reflect opportunity costs, and this limits the generalisability of the study findings. The resource use quantities were taken from a single setting, while the prices were taken from the authors' setting. No other sources were used for the resource quantities or prices. No statistical, sensitivity or any other kind of analysis of the quantities or prices was conducted. The price year was not given, hence impeding any future reflation exercises. Discounting was not necessary as the costs were incurred during less than 2 years.

**Other issues**

The authors compared their effectiveness findings, but not their cost results, with those from other studies. The issue of generalisability to other settings was not addressed. There was no way of knowing how representative the illustrative case scenarios were of all the case histories. Since their data source was the MRI department, the authors did not have any patients whose condition improved without further investigation. The authors’ conclusions do not reflect the scope of the analysis. The study should have dealt with all kinds of patients who are suspected of having a scaphoid fracture but for which there is no radiographic evidence. The authors did not report any limitations of their study.

**Implications of the study**

The authors concluded that screening MRI of the wrist in their own setting is becoming accepted in a manner similar to screening MRI of the hip. Research in which patients were randomly allocated to the two kinds of protocol studied in this paper would be useful.

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