Ultrasound as a first-line test in the diagnosis of carpal tunnel syndrome: a cost-effectiveness analysis
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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.

CRD summary
This study evaluated the cost-effectiveness of ultrasound, as an initial diagnostic test, before surgery, for carpal tunnel syndrome. The authors found that it was cost-effective when patients were referred by a specialist, but more expensive when referred by a general practitioner. The analysis was clearly reported, and used appropriate methods, but the conclusions may not be reliable due to the use of an intermediate outcome, rather patient health, and a limited costing.

Type of economic evaluation
Cost-effectiveness analysis

Study objective
This study evaluated the cost-effectiveness of ultrasound, as an initial diagnostic test, for patients who were being considered for surgery, for carpal tunnel syndrome.

Interventions
Three interventions were considered: ultrasound as a first diagnostic test, followed by electrodiagnostic testing, if the ultrasound results were negative; electrodiagnostic testing alone; and ultrasound alone. If any result was positive, standard care was provided.

Two scenarios were considered: general practitioners (GPs) conducting the tests; and specialists conducting the tests.

Location/setting
USA/out-patient care.

Methods
Analytical approach:
The study was based on an individual patient, Monte Carlo simulation, which allowed hypothetical patients to be assigned test outcomes, based on the range of plausible sensitivity and specificity values for each test, to model the variation seen in clinical practice. The study perspective was not stated.

Effectiveness data:
The fictional sample of 38,000 patients was based on data from the US Healthcare Cost and Utilization Project (HCUP) on patients with presumed carpal tunnel syndrome who were referred for confirmatory testing. The key effectiveness outcomes were the sensitivities and specificities of each test protocol. Each likelihood of true-positive, true-negative, false-positive, and false-negative results was determined by the prevalence of carpal tunnel syndrome in patients referred by GPs or by specialists, and the sensitivity and specificity of the test regimens. The prevalence of carpal tunnel syndrome in GP referrals was from a 2003 UK published study. The prevalence in specialist referrals was from two studies (published in 1999 and 1983). The sensitivities and specificities were from a published meta-analysis (see Other Publications of Related Interest) and a published study.

Monetary benefit and utility valuations:
Not relevant.

Measure of benefit:
No summary measure of benefit was derived; the outcomes were presented separately.

Cost data:
The cost categories included the diagnostic tests, and missed work for the patient. Diagnostic test costs were from Medicare charges, from one hospital. The costs of missed work were from the US Social Security Administration, National Wage Index for 2010. The costs varied by diagnostic method, diagnosis, and assumed days of missed work. The number of days missed after a true-positive result was assumed to be 10, on average (from a range of one to 80 days, in the simulation), based on a published 2012 study. The number of days after a false-negative diagnosis was assumed to be 10 (from a range of one to 50). All costs were reported in US $.

Analysis of uncertainty:
Uncertainty was assessed by the probabilistic generation of 38,000 patients. It was further assessed by sampling from this population, using Monte Carlo simulation, with 100 patients in each sample, to produce means and 95% confidence intervals. Two scenarios were assessed for referral by a GP, or by a specialist.

Results
For GP referrals, the false-positive rates were 8.5% (95% CI one to 17) for ultrasound, 1.4% (95% CI zero to seven) for electrodiagnostic testing, and 9.6% (95% CI two to 20) for ultrasound then electrodiagnosis. The false-negative rates were 11.9% (95% CI two to 21) for ultrasound, 18.9% (95% CI eight to 31) for electrodiagnosis, and 3.7% (95% CI zero to 11) for ultrasound then electrodiagnosis.

The mean charges were $476.30 (95% CI 256 to 1,275) for ultrasound, $400.30 (95% CI 289.20 to 920.90) for electrodiagnostic testing, and $562.90 (95% CI 323.50 to 1,372) for ultrasound then electrodiagnosis.

For specialist referrals, the false-positive rates were 2.5% (95% CI zero to 10) for ultrasound, 0.3% (95% CI zero to three) for electrodiagnosis, and 2.7% (95% CI zero to 10) for ultrasound then electrodiagnosis. The false-negative rates were 17.5% (95% CI six to 30) for ultrasound, 27.7% (95% CI 14 to 41) for electrodiagnosis, and 5.5% (95% CI zero to 14) for ultrasound then electrodiagnosis.

The mean charges were $367.80 (95% CI 230.20 to 726.90) for ultrasound, $428.30 (95% CI 311.00 to 838.80) for electrodiagnosis, and $369.50 (95% CI 249.20 to 845.80) for ultrasound then electrodiagnosis.

Authors' conclusions
The authors found that initial diagnostic ultrasound, to confirm carpal tunnel syndrome, was cost-effective when patients were referred by a specialist, but it was more expensive when they were referred by a GP.

CRD commentary
Interventions:
The interventions were well described and appear to have been appropriate.

Effectiveness/benefits:
The methods of finding and selecting the effectiveness data were not described, but the sources appear to have been appropriate. The primary effectiveness data – test sensitivity and specificity – were from a meta-analysis, which was an appropriate way to synthesise data from various sources, but the methods were not reported, so they cannot be assessed. The prevalences, for GP and specialist referred patients with suspected carpal tunnel syndrome, were from sources that were 14 to 30 years old; this might affect their current validity. The authors acknowledged that these prevalences might not reflect clinical practice. They reported that the sensitivity and specificity were compared with a reference standard, not with the other diagnostic test, which may affect the results. The health benefit to the patient was not assessed.

Costs:
Productivity costs were included, so it seems that a societal perspective was adopted. Clear rationales were provided for the costing, but not all assumptions were justified. The authors acknowledged that the false-positive charge for missed work was designed to penalise false-positive results. Both true- and false-positive patients underwent surgery, so both should have the same charge for missed work, which was not the case. The cost of the surgery was not included and as false-positive rates varied between regimens and practitioners, this could affect the overall costs. The cost assumptions...
seemed arbitrary and in some instances lacked face validity. The use of charges limits the generalisability to other settings.

Analysis and results:
The results, methods, and assumptions of the analyses were clearly reported. Conducting different analyses for GPs and specialists was appropriate, and increases the likelihood that the data will be useful to practitioners. While the authors were thorough in discussing the study's limitations, no comparisons were made with other studies on the topic. The lack of consideration of the health benefits was a limitation. Overall, the reporting was good, but the external validity may be limited.

Concluding remarks:
The analysis was clearly reported, and used appropriate methods. Only the diagnostic outcomes were considered, which may not truly reflect the health gain or loss to patients. The conclusions may not be reliable due to the use of an intermediate outcome and limited costing.

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Other publications of related interest

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