The use of hand-carried ultrasound in the hospital setting: a cost-effective analysis

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
The use of hand-carried ultrasound (HCU; OptiGo, Philips, Eindhoven) for the detection of normal echocardiograms in hospital inpatients with suggested cardiac disorders.

Type of intervention
Diagnosis.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised adult inpatients with suspected cardiac disorders.

Setting
The study setting was a district general hospital. The economic study was carried out in Harrow, Middlesex, UK.

Dates to which data relate
The dates to which the effectiveness data, resources used, costs or prices related were not reported.

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

Link between effectiveness and cost data
The costing exercise was conducted prospectively using data obtained from the same sample as that which provided the effectiveness data.

Study sample
No power calculations were reported. The study used a sample of 157 consecutive inpatients from intensive care, coronary care, cardiac and general medical wards, who had been referred to the Northwick Park Hospital to undergo routine SDE. There was no report of any patients who refused to participate, nor was it stated whether anyone was excluded from the initial sample. Ninety-five (61%) of the patients were men, and the mean age was 68 years (Range: 18 to 97). There was no evidence that the study sample was representative of the study population.

Study design
This was a single-centred, prospective, within-group, comparison diagnostic study. All patients underwent HCU and
subsequently SDE. The physician (consultant or specialist registrar, including cardiologists, general physicians, anaesthetists and intensivists) caring for the patient requested the echocardiograms. There was no loss to follow-up. No blinding method was reported.

**Analysis of effectiveness**

All patients that entered the study were accounted for in the analysis. SDE were analysed according to departmental protocol. The definition of what was considered to be a clinically significant abnormal result was reported in the paper. In both series of studies, once completed, the sonographer was asked to report whether the overall study, left ventricular (LV) function and valvular function were normal or abnormal. The outcomes assessed were:

- the number of patients with adequate interpretation of the test;
- the number (and percentage) of patients with completely normal scans and normal LV function with SDE;
- the level of agreement between HCU and SDE in differentiating completely normal from abnormal studies, and normal form abnormal LV function;
- the number (and percentage) of patients assessed for LV function, and the number (and percentage) of them with normal LV function with SDE;
- the sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of HCU in predicting a normal scan (overall and for patients with and without a reason for requesting echocardiography) and in predicting a normal LV function (overall and among patients with specific request for LV assessment); and
- the number of patients with abnormalities that were missed by HCU in comparison with SDE.

**Effectiveness results**

Images adequate for interpretation were obtained in all patients studied by HCU and SDE.

Of the total analysed by SDE, 64 (41%) had completely normal scans and 92 (59%) had normal LV function.

The agreement between HCU and SDE was 83% (k=0.64; 95% Confidence interval, CI: 0.52 to 0.76) in differentiating completely normal from abnormal studies, and 88% (k=0.76; 95% CI: 0.66 to 0.86) in differentiating normal from abnormal LV function.

The sensitivity of HCU in predicting a normal scan, as determined by SDE, was 74%, the specificity 96%, the PPV 94% and the NPV 81%.

The sensitivity of HCU in predicting normal LV function was 84%, the specificity 98%, the PPV 99% and the NPV 78%.

The sensitivity of HCU in predicting normal LV function among patients with a reason for requesting echocardiography was 74%, the specificity 99%, the PPV 98% and the NPV 79%. Among patients without a reason for request, the sensitivity was 33%, the specificity 87%, the PPV 77% and the NPV 87%.

Of all requests, 64% (n=101) were for assessment of LV function, of which 56% (n=57) had normal LV function on SDE.

The sensitivity of HCU in predicting normal LV function in requests specific for assessment of LV function was 81%, the specificity 100%, the PPV 100% and the NPV 77%. Agreement was 87% (k=0.75; 95% CI: 0.62 to 0.87).

Four patients with abnormalities were missed with HCU, as noted by SDE.
Clinical conclusions
HCU turned out to be highly accurate in the detection of normal scan and had higher accuracy to confirm normal LV function.

Measure of benefits used in the economic analysis
The authors did not derive a summary measure of benefit. Therefore, a cost-consequences analysis was performed. However, the authors reported the percentage of patients with normal findings (overall and for those patients with a request for LV function assessment) that would not need further testing after HCU.

Direct costs
The direct costs considered in the analysis appear to have been those of the hospital. For SDE, these included the sonographer's fee, transportation by hospital porter, and depreciation of the device. For HCU, these included professional time for the scan (including writing the report), and yearly depreciation of the device. The cost calculations were based on the authors’ department performing 2,000 inpatient echocardiograms per annum. The unit costs were presented separately, and the authors mentioned which resources were included in average unit cost calculations. The unit costs appear to have been obtained from the authors’ setting. Discounting was not carried out, but it was not relevant given the short time horizon considered. The price year was not reported. The authors reported the average unit costs, as well as the total cost per intervention and cost-differences (savings) between the interventions.

Statistical analysis of costs
The costs were treated deterministically.

Indirect Costs
No indirect costs were reported.

Currency
UK pounds sterling (£).

Sensitivity analysis
No sensitivity analysis was reported.

Estimated benefits used in the economic analysis
The percentage of patients with normal findings that would not need further testing after HCU would be 29 overall, and 22 for those patients with a request for LV function assessment.

Cost results
The annual cost for 2,000 inpatients undergoing complete SDE was 132,300.

The annual cost of HCU, if this was used initially by the physician at the bedside in all of the patients, would be 8,000.

Alternatively, if patients with requests for assessment of LV function (64% of all requests) were to initially undergo an HCU study, this would cost 5,120 per annum.

The annual cost-saving derived from those patients with normal findings that did not require further assessment would be 30,367 overall, and 23,986 among those patients with a request for LV function assessment.
Synthesis of costs and benefits
The costs and benefits were not combined since a cost-consequences analysis was undertaken.

Authors' conclusions
Hand-carried ultrasound (HCU) is an accurate method for identifying patients with normal hearts, as determined by standard departmental echocardiograms (SDE). Its routine use is cost-effective and can significantly reduce the number of SDE that need be performed.

CRD COMMENTARY - Selection of comparators
The authors stated that the diagnostic technology used as the comparator represented standard practice. You should decide if this technology represents current practice in your own setting.

Validity of estimate of measure of effectiveness
The analysis was based on a single-centred, prospective, within-group, comparison, diagnostic study. Given the study question, this design appears to have been appropriate, although it is associated with some limitations. The sample was taken from consecutive patients entering the authors' department, and thus might be subject to selection bias and/or might not be representative of the study population. Moreover, confounding may also be present. The assessments of the different tests were independent, but the authors did not state whether any methods were used to blind the second test to the results of the previous test. Again, bias might be likely. No power calculations were reported, thus it was not possible to ascertain whether the results obtained were due to the intervention or to chance.

Validity of estimate of measure of benefit
No summary measure of benefits was derived. The reader is referred to the comments in the 'Validity of estimate of measure of effectiveness' field (above).

Validity of estimate of costs
Although not explicitly stated, the analysis of the costs appears to have been performed from the perspective of the hospital. It was unclear whether all the relevant costs were included in the analysis, as the costs of further testing for those patients with abnormal HCU results did not seem to have been included in the study. The unit costs were reported, although the quantities were not reported separately. However, the authors reported all the categories considered in the calculation of the unit average costs. No statistical analysis of the resources used or costs were performed and the costs were treated deterministically, which introduces uncertainty into the cost estimation. Moreover, the price year for the costs was not stated, meaning that caution should be exercised when comparing the results of this study with those of other studies and/or when performing any future reflation exercises.

Other issues
The authors made appropriate comparison of their diagnostic results with those of other studies, finding them generally to be in agreement. The authors did not address the issue of generalisability and this is likely to be important, as this was a single-centred study with a relatively small sample size. However, the authors mentioned that if HCU was used for groups of patients who were more ill than those studied, physicians might be more likely to perform HCU for patients with normal hearts. This would underestimate cost-savings as there might be more false-positive HCU results for those undergoing SDE. The authors do not appear to have presented their results selectively and their conclusions seem to reflect the scope of the analysis.

Implications of the study
The authors stated that the implications of the study findings suggest that HCU could be considered as an efficient tool in the detection of a normal scan.
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Other publications of related interest


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