Cost effectiveness of the B type natriuretic peptide, electrocardiography, and portable echocardiography for the assessment of patients from the community with suspected heart failure

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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
The study examined five strategies for the diagnosis of suspected heart failure (HF).

Strategy 1: All patients undergo portable echocardiography (PE).

Strategy 2: All patients undergo serum N-terminal pro B type natriuretic peptide (NTproBNP) estimation; those with abnormal NTproBNP estimation undergo PE.

Strategy 3: All patients undergo electrocardiography (ECG); those with an abnormal ECG undergo PE.

Strategy 4: All patients undergo ECG; those with an abnormal ECG undergo NTproBNP estimation and those with an abnormal NTproBNP estimation then undergo PE.

Strategy 5: All patients undergo NTproBNP estimation; those with an abnormal NTproBNP estimation undergo ECG and those with an abnormal ECG then undergo PE.

Type of intervention
Diagnosis.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised symptomatic patients with suspected HF.

Setting
The setting was primary care and a hospital. The economic study was carried out in the UK.

Dates to which data relate
The dates when the effectiveness and resource use data were gathered were not reported. The price year was not given.

Link between effectiveness and cost data
The costing was not carried out on the sample of patients included in the effectiveness analysis. The costing was conducted retrospectively.
Study sample
Power calculations, if performed, were not reported. A single group of 137 patients was included in the study. The mean age of the patients was 71 (+/- 13) years and 50% were men. Patient recruitment was based on patients referred to the authors’ community PE service with symptoms of HF. Limited information on the process of sample selection was provided. Further, it was not stated whether some patients refused to participate or were excluded from the study sample for any reasons.

Study design
This was a within-group comparison study that was carried out at a single centre. Each patient underwent all diagnostic strategies. No follow-up was performed. ECG was performed in primary care and was interpreted by a hospital physician blinded to the echocardiography and NTproBNP data. Blood was taken from patients for serum NTproBNP levels prior to echocardiography. Serum NTproBNP levels were analysed in an independent laboratory, blinded to the echocardiography data. PE was used as the reference standard for the detection of cardiac abnormalities, which included left ventricular systolic dysfunction (LVSD), isolated right ventricular dysfunction (RVD), left ventricular diastolic dysfunction (LVDD) and valvular heart disease (VHD).

Analysis of effectiveness
The primary clinical end points were the sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of the alternative diagnostic strategies. Diagnostic accuracy was evaluated for each cardiac abnormality. All of the patients included in the study were accounted for in the analysis.

Effectiveness results
PE was considered to be the ‘gold’ standard, thus its accuracy was 100%. Overall, 33 cardiac abnormalities were found with PE. There were 19 (13.9%) patients with LVSD, 12 (8.8%) with LVDD and 5 with significant VHD or RVD.

The screening characteristics for LVSD were:
for strategy 2, sensitivity 100%, specificity 57%, PPV 27% and NPV 100%;
for strategy 3, sensitivity 95%, specificity 47%, PPV 22% and NPV 98%;
for strategies 4 and 5, sensitivity 95%, specificity 75%, PPV 38% and NPV 99%.

The screening characteristics for isolated LVDD were:
for strategy 2, sensitivity 75%, specificity 69%, PPV 24% and NPV 95%;
for strategy 3, sensitivity 50%, specificity 53%, PPV 13% and NPV 89%;
for strategies 4 and 5, sensitivity 33%, specificity 85%, PPV 24% and NPV 91%.

The screening characteristics for LVSD or isolated LVDD were:
for strategy 2, sensitivity 90%, specificity 60%, PPV 40% and NPV 96%;
for strategy 3, sensitivity 77%, specificity 46%, PPV 30% and NPV 88%;
for strategies 4 and 5, sensitivity 71%, specificity 76%, PPV 46% and NPV 90%.

The screening characteristics for significant VHD or RVD were:
for strategy 2, sensitivity 100%, specificity 51%, PPV 7% and NPV 100%;
for strategy 3, sensitivity 80%, specificity 42%, PPV 5% and NPV 98%;
for strategies 4 and 5, sensitivity 80%, specificity 67%, PPV 8% and NPV 99%.

The screening characteristics for any of the above abnormalities (LVDD, isolated LVDD, significant VHD or RVD) were:
for strategy 2, sensitivity 91%, specificity 62%, PPV 43% and NPV 96%;
for strategy 3, sensitivity 76%, specificity 46%, PPV 31% and NPV 86%;
for strategies 4 and 5, sensitivity 70%, specificity 76%, PPV 48% and NPV 89%.

Clinical conclusions
The effectiveness analysis showed that the NPVs were high for all diagnostic procedures but different levels of
specificity and sensitivity were observed. In general, sensitivity was higher for strategies 2 and 3, while specificity was
higher for strategies 4 and 5.

Measure of benefits used in the economic analysis
The summary benefit measure used was the number of cases detected for each cardiac abnormality. This was based on
the accuracy of the diagnostic strategies, which was derived directly from the effectiveness analysis.

Direct costs
The perspective chosen for the analysis was unclear. Only the costs of the diagnostic procedures were considered.
Details of the calculation of the costs were provided, which were also based on assumptions on machine life. The total
costs of each of the five strategies were calculated from the total number of initial tests plus the total number of follow-
up echocardiograms. The unit costs were presented separately from the quantities of resources used. The estimation of
resource use was based on the hypothesis of one test (or test sequence) for each patient. The costs were derived from
published studies. Discounting was not relevant given the short timeframe of the analysis. The price year was not
reported.

Statistical analysis of costs
Statistical analyses of the costs were not performed.

Indirect Costs
Productivity costs were not considered.

Currency
Euros (EUR).

Sensitivity analysis
A sensitivity analysis was carried out to assess the robustness of the cost-effectiveness ratios to variations in the cost of
the diagnostic procedures, especially serum NTproBNP. Cost-reductions appear to have been based on authors’
opinions.

Estimated benefits used in the economic analysis
The number of detected cases was not reported. See the 'Effectiveness Results' section for accuracy rates.
Cost results
The unit costs for the individual diagnostic tests were reported: EUR 16.50 for ECG, EUR 22.50 for serum NTproBNP and EUR 41 for PE.

The total costs of each diagnostic strategy were not reported.

Synthesis of costs and benefits
The costs and benefits of the alternative strategies were combined by calculating average cost-effectiveness ratios.

Overall, strategy 1 was the most efficient, followed by strategy 2.

The average cost per LVSD detected was EUR 296 with strategy 1, EUR 313 with strategy 2, EUR 310 with strategy 3, EUR 336 with strategy 4, and EUR 345 with strategy 5.

The average cost per isolated LVDD detected was EUR 468 with strategy 1, EUR 661 with strategy 2, EUR 930 with strategy 3, EUR 1,513 with strategy 4, and EUR 1,551 with strategy 5.

The average cost per LVSD or isolated LVDD detected was EUR 181 with strategy 1, EUR 213 with strategy 2, EUR 275 with strategy 4, and EUR 282 with strategy 5.

The average cost per significant VHD or RVD detected was EUR 1,123 with strategy 1, EUR 1,191 with strategy 2, EUR 1,395 with strategy 3, EUR 1,513 with strategy 4, and EUR 1,552 with strategy 5.

The average cost per any of the above cardiac abnormalities detected was EUR 170 with strategy 1, EUR 198 with strategy 2, EUR 223 with strategy 3, EUR 263 with strategy 4, and EUR 270 with strategy 5.

The sensitivity analysis showed that strategy 1 was the most cost-effective strategy. Serum NTproBNP was more efficient only with a cost-reduction (to the same unit cost of ECG) and for a detected case of LVSD, significant VHD or isolated RVD.

Authors’ conclusions
Portable echocardiography was the most cost-effective strategy for assessing patients from the community with suspected heart failure (HF).

CRD COMMENTARY - Selection of comparators
The selection of the comparators was appropriate given the objective of the study. All the diagnostic strategies reflected the available patterns of care for patients with suspected HF. Details of each diagnostic technique were given. The authors stated that tissue Doppler imaging is a new modality for the assessment of LV diastolic function, but the reasons for the exclusion of this approach from the analysis were not discussed. You should decide whether they are valid comparators in your own setting.

Validity of estimate of measure of effectiveness
The effectiveness data came from a within-group comparison study, which has the advantage of applying all the comparators to a single sample of patients. A control group was therefore not required, thereby reducing the potential impact of selection bias and confounding factors. A strength of the analysis was the fact that blinding was performed, thus ruling out the possibility that analysts could be aware of the results of other diagnostic tests. The accuracy of the interventions was evaluated simultaneously, limiting the potential impact of time-dependent confounding variables. However, some drawbacks of the analysis should to be noted. First, the evidence came from a single institution and it was unclear whether the study sample was representative of the patient population. Second, no justification for the size of the sample was provided and, owing to the small number of patients included in the analysis, it was unclear whether the results obtained were due to the intervention or to chance. Third, limited information on the sample selection process was provided. These issues tend to limit the internal validity of the study.
Validity of estimate of measure of benefit
The summary benefit measure was specific to the disease considered in the study. The number of cases detected is not easily comparable with the benefits of other health care interventions. However, it is a typical end point for diagnostic procedures.

Validity of estimate of costs
The authors did not explicitly state the perspective chosen for the analysis. Only the costs of the diagnostic procedures were included. Other costs associated with an incorrect diagnosis were not included. Details of unit costs were presented, which will help when replicating the analysis in other settings. Further, the use of alternative cost estimates was investigated in the sensitivity analysis. The costs were derived from a published study, thus few details were provided. The price year was not reported, which will hinder reflation exercises in other time periods.

Other issues
The authors did not make extensive comparisons of their findings with those from other studies. They stated that this was the first study comparing the cost-effectiveness of all these diagnostic strategies for suspected HF. The issue of the generalisability of the study results to other settings was not explicitly addressed and sensitivity analyses were restricted to a limited number of cost items. Therefore, the external validity of the analysis was limited. The authors stated that their cost analysis is only valid in the UK or in countries where the salary of the personnel who performed the ECG examination is the same as that mentioned in their study. The results of the analysis were presented in detail. The authors' conclusions appear to be consistent with the scope of the analysis.

Implications of the study
The study results support the use of PE for the diagnosis of suspected HF. The authors noted that performing and interpreting echocardiography requires considerable skill and training, which may limit the availability of this diagnostic procedure. However, caution will be required when interpreting the results of the analysis because of the small number of patients involved in the study.

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Other publications of related interest
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Galasko GI, Barnes SC, Collinson P, et al. What is the most cost-effective strategy to screen for left ventricular systolic dysfunction: natriuretic peptides, the electrocardiogram, hand-held echocardiography, traditional echocardiography, or


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