What is the most cost-effective strategy to screen for left ventricular systolic dysfunction: natriuretic peptides, the electrocardiogram, hand-held echocardiography, traditional echocardiography, or their combination?

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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 considered eight screening strategies for the identification of left ventricular systolic dysfunction (LVSD).

Strategy 1: all patients undergo traditional echocardiography (TE) (the 'gold' standard strategy).

Strategy 2: all patients have an electrocardiogram (ECG) and those with abnormal results undergo TE.

Strategy 3: all patients have N-terminal pro-brain natriuretic peptide (NTproBNP) serum levels measured and those with raised levels undergo TE.

Strategy 4: all patients have an ECG and NTproBNP levels measured and those with abnormal results for either test undergo TE.

Strategy 5: all patients have an ECG and NTproBNP levels measured and those with abnormal results for both tests undergo TE.

Strategy 6: all patients undergo hand-held echocardiography (HE) and those with possible LVSD undergo TE.

Strategy 7: all patients have an ECG and those with abnormal results undergo HE, followed by TE if visual inspection suggests LVSD.

Strategy 8: all patients have NTproBNP levels measured and those with raised levels undergo HE, followed by TE if LVSD is suggested on visual inspection.

Type of intervention
Screening.

Economic study type
Cost-effectiveness analysis.

Study population
This study considered three populations:

the general public aged 45 years or older;

people with a high risk of LVSD, defined as ischaemic heart disease, diabetes mellitus, peripheral vascular disease, cerebrovascular disease or heavy alcohol use (defined as alcoholism, or more than 40 units per week), aged 45 years or older; and

the low-risk population.
Setting
The setting was primary care. The economic study was carried out in London, UK.

Dates to which data relate
The clinical effectiveness and resource use data were collected between January 2000 and December 2001. No price year was reported.

Link between effectiveness and cost data
The resource use data were collected from the same patient sample that provided the clinical data.

Study sample
A total of 1,392 people were invited to be included in the general population sample and 928 were invited to join the high-risk group. Of these, 734 (53%) of the general population sample and 471 (51%) of the high-risk sample attended the surgery and were included in the study. Attendees were 3 years younger than non-attendees. A total of 444 low-risk individuals were also included in the study. The paper reported that a justification for the sample size was published elsewhere (Galasko et al. 2004, see 'Other Publications of Related Interest' below for bibliographic details).

Study design
This was a multi-centre, diagnostic-yield study covering seven general practices. All patients were subjected to all tests except for HE: it appears that only a sub-group received HE. The health professionals interpreting the NTproBNP serum levels and HE results were not aware of other test results. The tests appear to have been performed concurrently.

Analysis of effectiveness
The primary health outcomes were the sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV). The paper did not report whether the results of any tests were indeterminate.

Effectiveness results
In the general population group, the sensitivity, specificity, PPV and NPV were, respectively:

- 92%, 78%, 14% and 99.6% for strategy 2;
- 80%, 88%, 20% and 99% for strategy 3;
- 96%, 72%, 12% and 99.8% for strategy 4;
- 76%, 94%, 31% and 99% for strategy 5;
- 93%, 97%, 58% and 99.7% for strategy 6;
- 87%, 98%, 65% and 99.3% for strategy 7; and
- 87%, 98%, 72% and 99.3% for strategy 8.

In the high-risk group, the sensitivity, specificity, PPV and NPV were, respectively:

- 90%, 64%, 19% and 99% for strategy 2;
- 76%, 70%, 20% and 97% for strategy 3;
94%, 49%, 15% and 99% for strategy 4;
73%, 85%, 31% and 97% for strategy 5;
97%, 93%, 57% and 99.6% for strategy 6;
83%, 96%, 66% and 98% for strategy 7; and
70%, 97%, 70% and 97% for strategy 8.

Clinical conclusions
The authors did not draw any conclusions on the most clinically effective screening option.

Measure of benefits used in the economic analysis
The measure of health benefit used was the number of cases of LVSD identified.

Direct costs
The direct costs to the NHS of undertaking screening were identified. Only the costs of testing were included. The unit costs were taken from two local hospitals, while the resource data were taken from the clinical study. Although the unit costs were reported in the paper, no breakdown of resource use was provided. No price year was reported.

Statistical analysis of costs
No statistical analysis of the quantities or costs was undertaken.

Indirect Costs
No productivity costs were included in this study.

Currency
UK pounds sterling (€).

Sensitivity analysis
Sensitivity analyses were undertaken to assess the impact of varying the unit costs on the cost-effectiveness of the screening strategies.

Estimated benefits used in the economic analysis
The paper did not clearly identify the number of cases identified by each screening strategy.

Cost results
The total costs of the screening strategies were not reported in the paper.

Synthesis of costs and benefits
In the general population, the costs per case identified were:

for strategy 1, 4,236 (95% confidence interval, 95% CI: 2,862 to 6,619);
for strategy 2, 1,614 (95% CI: 1,049 to 2,490);
for strategy 3, 1,501 (95% CI: 1,092 to 2,364);
for strategy 4, 2,412 (95% CI: 1,715 to 3,827);
for strategy 5, 1,912 (95% CI: 1,343 to 2,911);
for strategy 6, 1,101 (95% CI: 1,007 to 2,138);
for strategy 7, 884 (95% CI: 3,755 to 1,508); and
for strategy 8, 913 (95% CI: 890 to 1,818).

In the high-risk group, the costs per case identified were:
for strategy 1, 1,757 (95% CI: 1,384 to 2,259);
for strategy 2, 1,006 (95% CI: 813 to 1,272);
for strategy 3, 1,096 (95% CI: 909 to 1,430);
for strategy 4, 1,485 (95% CI: 1,203 to 1,920);
for strategy 5, 1,104 (95% CI: 897 to 1,386);
for strategy 6, 683 (95% CI: 596 to 884);
for strategy 7, 649 (95% CI: 526 to 771); and
for strategy 8, 712 (95% CI: 631 to 923).

In the low-risk group, the costs per case identified were:
for strategy 1, 64,050 (95% CI: 12,810 to infinity);
for strategy 2, 22,846 (95% CI: 4,714 to infinity);
for strategy 3, 21,656 (95% CI: 4,464 to infinity);
for strategy 4, 35,869 (95% CI: 7,307 to infinity);
for strategy 5, 27,217 (95% CI: 5,519 to infinity);
for strategy 6, 19,588 (95% CI: 4,013 to infinity);
for strategy 7, 12,960 (95% CI: 2,737 to infinity); and
for strategy 8, 15,940 (95% CI: 3,621 to infinity)

The sensitivity analysis showed that the results did not change much in response to the variation in cost estimates for the tests.

**Authors' conclusions**

Screening in the community using hand-held echocardiography (HE) is cost-effective, with HE following N-terminal pro-brain natriuretic peptide (NTproBNP) measurement being the most cost-effective screening strategy for both the general population and high-risk groups.
CRD COMMENTARY - Selection of comparators
The study compared seven strategies for screening for LVSD with TE. No explicit rationale for this choice of gold standard was provided in the paper, but it appears to have represented usual practice in the authors' setting. The authors stated that a few feasible strategies were not assessed. You should consider how all seven strategies compare with usual practice in your own setting prior to applying the results of this study.

Validity of estimate of measure of effectiveness
The measure of clinical effectiveness was taken from a diagnostic yield study. This was an appropriate study design for the research question. The authors indicated that the rationale for the sample size was reported elsewhere, so it is not possible to comment on whether the study was appropriate powered. They acknowledged that there was a statistically significant difference between the age of the general population sample invited to attend screening and those who attended, which may have led to selection bias. The authors also stated that not all patients underwent HE, and this may also have introduced selection bias.

Validity of estimate of measure of benefit
The measure of health benefit used in the study was taken directly from the clinical study.

Validity of estimate of costs
The economic perspective of the study was that of the NHS and all appropriate costs appear to have been identified. Although the study provided a breakdown of the unit costs, resource use was not clearly identified. In particular, where strategies included two tests, it was not clear how many patients required the second screening test. Further, the total costs of each strategy were not reported. The authors also referred to strategies that were better value for money as "cost-saving", which is a misleading statement. Sensitivity analyses were performed to assess the impact of varying the unit costs and this enhances the generalisability of the study findings. However, uncertainty around resource use and clinical results was not investigated. No price year was reported, which will prevent any future reflation exercises.

Other issues
The authors do not appear to have presented the results selectively and their conclusions reflected the scope of the analysis. They compared their findings with those from other relevant studies. The authors acknowledged that their study did not consider the costs of treating patients with LSVD once they had been diagnosed, but commented that there were several cost-effective treatment options. They also noted that 3% of patients with LSVD would not be identified by TE (the 'gold' standard in this study) and would require contrast echocardiography for diagnosis.

Implications of the study
The authors did not make any recommendations for further research or changes to practice.

Source of funding
None stated.

Bibliographic details
Galasko G I, Barnes S C, Collinson P, Lahiri A, Senior R. What is the most cost-effective strategy to screen for left ventricular systolic dysfunction: natriuretic peptides, the electrocardiogram, hand-held echocardiography, traditional echocardiography, or their combination? European Heart Journal 2006; 27(2): 193-200

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Other publications of related interest
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