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Use of artificial intelligence in stress echocardiography in NHS coronary artery disease risk prediction: A cost-effectiveness analysis study

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Introduction

A prospective, multicentre randomised controlled trial was conducted to evaluate and compare the impact of introducing an AI-augmented decision support tool (EchoGo) for stress echocardiography (SE) into the coronary artery disease (CAD) pathway, alongside standard care versus standard care alone in the UK[1]. Alongside this RCT, Health Innovation Oxford & Thames Valley conducted an economic analysis to generate evidence on the cost-effectiveness of AI-based SE, aiming to determine whether AI integration delivers measurable value in terms of both clinical outcomes and healthcare costs, ensuring its sustainability within the NHS.

Aim & Objectives

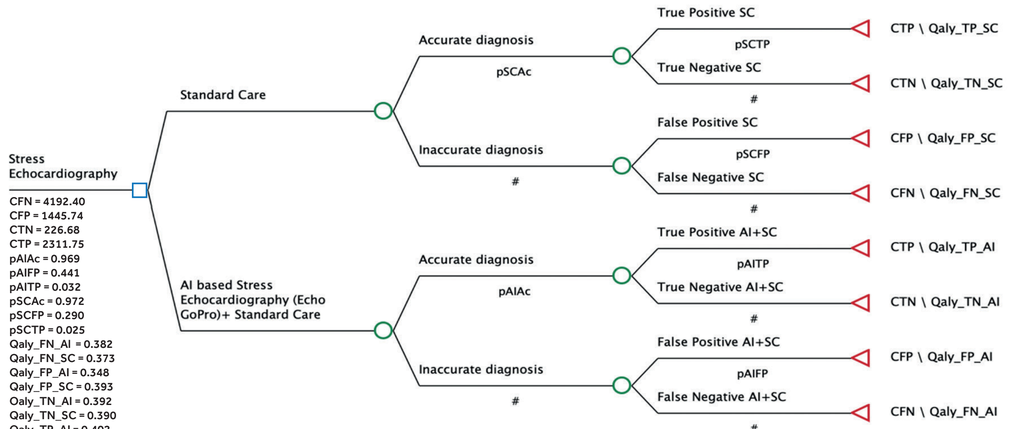
- To assess the diagnostic accuracy of SE reporting using the EchoGo platform in the CAD diagnostic pathway.
- To evaluate the costs, consequences and effectiveness of EchoGo plus standard care compared to standard care alone.
- To analyse the cost consequences and cost-effectiveness of introducing the EchoGo for SE reporting on SE in the CAD pathway.

Methodology

Study design

Participants and randomisation	Data were collected from 2,213 patients across 20 NHS hospitals, who were randomised to receive either: 1. Standard care (control), or 2. Standard care with AI-augmented decision-making (intervention)
Decision Appropriateness	Assessed by confirming severe CAD or related cardiac events
Data Collection Timeframes	Baseline, 3 months, and 6 months
Cost	Obtained from a similar costing study[2]
Consequences	1. Disease-related outcome measures: Seattle Angina Questionnaire (SAQ-7)[3] 2. General Health-Related Quality of Life (HRQoL) measures: EQ-5D-5L[4]
Effectiveness	EQ-5D-5L used to generate a single utility index, which was converted into ALYs (Quality-Adjusted Life
Analysis Type	Years) Cost-Consequence Analysis (CCA) and Cost-Effectiveness Analysis (CEA)
CCA	Within-Group and Between-Group Statistical Tests
CEA	Cost-effectiveness analysis of multiple scenarios, including: - Default case (no AI cost) - Cost input scenarios incorporating varying AI costs - Clinician time-saving costs
Probabilistic Sensitivity Analysis	Monte Carlo simulations were conducted to assess uncertainties in CEA outcomes

Fig 1: Cost-effectiveness decision tree for AI-based stress echocardiography



Results

The **Cost consequence analysis (CCA) and Cost-effectiveness analysis** provided significant insights into the economic viability of AI-based Stress Echocardiography (EchoGo) compared to standard care within the NHS in relation to consequences/effectiveness.

In the CCA:

The SAQ-7 domains - physical limitation, angina frequency and quality of life - showed statistically significant improvements in both groups from baseline to six months (all p<.001), with no statistically significant differences in change patterns between the groups (p=0.99, 0.324, 0.181).

For the EQ-5D dimensions - mobility, usual activities, pain, discomfort and anxiety/depression - no significant differences were observed over time (p>.05), except for self-care (p=.017 and p=.032 for the control and intervention groups respectively). There were no statistically significant differences between the groups in any EQ-5D dimension (all p>.05).

The CEA reveals significant insights across various scenarios.

- In the default case, which considers only cost savings based on treatment and management of different patient categories and involves no additional AI cost inputs, the AI-based intervention had a slightly higher cost but remained cost-effective, with an ICER of £6,938.90 per QALY, indicating economic value well within the NICE WTP threshold of £30,000 per QALY (Table 1 and Fig 2).
- When considering AI cost inputs for installation, maintenance, and training, ranging from £25 to £100, the intervention remained cost-effective at lower inputs (Table 2). Specifically, at £25 and £30 per case, the ICERs were £23,247.15 and £26,508.80 per QALY respectively, both within the NICE WTP threshold of £30,000, with breakeven occurring at around £35 per case.
- Incorporating clinician time savings (estimated at £10.58 per case) further improved economic viability, shifting the breakeven point from around £35 to £45. This indicates that AI cost inputs up to £45 per case can remain cost-effective under the NICE WTP threshold.
- Probabilistic sensitivity analysis and cost-effectiveness acceptability curves supported these findings, demonstrating that AI-based stress echocardiography becomes competitive at higher WTP thresholds but remains within the WTP threshold at lower cost inputs.

Table 1: Incremental Cost effectiveness ratio - ICER

Groups	Costs (£)	Incremental Cost (IC) (£)	Effectiveness (Qalys)	Incremental Effectiveness (IE) (Qalys)	ICER (IC/IE)	NMB (£)	C/E
Standard care (control)	366.08		0.390			11333.99	938.67
EchoGo Pro + Standard care (Intervention)	376.72	10.637	0.392	0.002	6938.901	11369.34	962.17

Figure 2: Cost-effectiveness acceptability curve (CEAC) – default case

Table 2: Incremental cost-effectiveness ratio - ICER

Cost input – AI based SC	Total Cost	Incr. Cost	Effectiveness	Incr. Effectiveness	ICER	NMB	C/E
0	376.7215817	10.6370999	0.391535266	0.00153297	6938.90138	1369.3364	962.165134
25	401.7215817	35.6370999	0.391535266	0.00153297	23247.1561	1344.3364	1026.01634
30	406.7215817	40.6370999	0.391535266	0.00153297	26508.807	1339.3364	1038.78658
35.3518801	**412.0734618**	**45.98898**	**0.391535266**	**0.00153297**	**30000**	**1333.9845**	**1052.45555**
40	416.7215817	50.6370999	0.391535266	0.00153297	33032.1089	1329.3364	1064.32707
50	426.7215817	60.6370999	0.391535266	0.00153297	39555.4108	1319.3364	1089.86755
60	436.7215817	70.6370999	0.391535266	0.00153297	46078.7127	1309.3364	1115.40804
75	451.7215817	85.6370999	0.391535266	0.00153297	55863.6655	1294.3364	1153.71876
100	476.7215817	110.6371	0.391535266	0.00153297	72171.9203	1269.3364	1217.56997

Breakeven wrt NICE WTP threshold £30000 | Cost-effective | Not Cost-effective

Conclusion

AI-based stress echocardiography proved to be a more optimal strategy than standard care, offering slightly higher effectiveness but increased costs while remaining within NICE-recommended willingness-to-pay thresholds in specific scenarios where the implementation costs are kept within a manageable range. Overall, whether AI-based stress echocardiography remains within NICE-recommended willingness-to-pay thresholds at observed accuracy and effectiveness will depend on actual implementation costs and potential savings in clinician time, inter alia.

References

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