EE692

The Cost-Effectiveness of an Artificial Intelligence Software for Stroke Imaging and Treatment Decisions in NHS Hospitals

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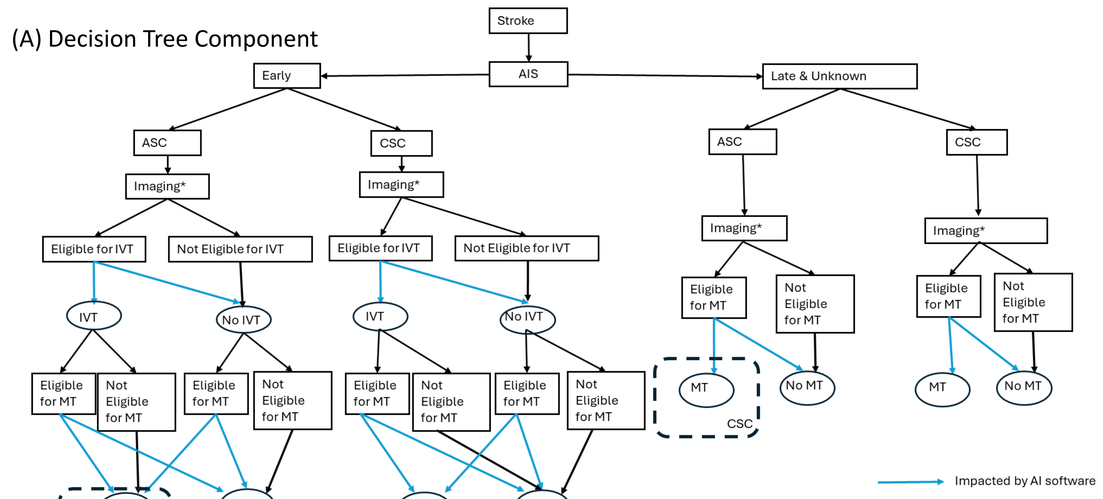
Background

- Ischaemic strokes impose a substantial health and economic burden on the National Health Service (NHS). Rapid diagnosis and treatment with reperfusion therapies (intravenous thrombolysis (IVT) and mechanical thrombectomy (MT)) are critical to improving patient outcomes.
- Artificial intelligence (AI)-based imaging software has been introduced to support clinicians in identifying patients who may benefit from these procedures by automatically interpreting diagnostic imaging results.
- We evaluated the cost-effectiveness of implementing an AI-assisted stroke imaging software (Brainomix 360 Stroke) across NHS hospital networks in England, comparing it to standard practice.

Methods

- A decision-analytic model combining a short-term decision tree and a long-term Markov model was developed to simulate acute stroke management and post-stroke outcomes (Figure 1), parameterised using published inputs (Table 1)
- Costs were assessed from an NHS perspective and health outcomes expressed as quality-adjusted life years (QALYs).
- Net monetary benefit (NMB) was estimated at a willingness-to-pay threshold of £20,000 per QALY gained, with a discount rate of 3.5% applied.
- Probabilistic analysis (sampling 1,000 times), univariate sensitivity analysis and scenario analyses were performed.

Figure 1. Cost-effectiveness model schematic for AI software in stroke patients



For (A): Boxes represent health and treatment states. Arrows represent potential flows of patients. Circular health states are linked to the Markov model in (B). *In the imaging state all patients receive NCCT and CTA, some patients also receive CTP or CTP and MRI.
For (B): Boxes represent health states. Arrows represent potential flows of patients.
Poster Abbreviations: AIS – ischemic stroke, ASC – acute stroke centre, CSC – complex stroke centre, CTA - Computed Tomography Angiography , CTP – CT perfusion IVT – thrombolysis, LVO - large-vessel occlusion, MRP - perfusion magnetic resonance imaging, mRS - Modified Ranking Score. MT – mechanical thrombectomy, NCCT – non-contrast CT scan, QALY – quality-adjusted life year.

Cost-Effectiveness Analysis (CEA) Conclusions:

- AI-assisted stroke imaging was **highly cost-effective**, generating >£40 million in cost savings and >1,000 additional QALYs per year in England.
- **>95% probability** of cost-effectiveness at the £20,000 per QALY threshold, demonstrating **robust efficiency** across uncertainty analyses.
- This efficiency is driven by **improved access to both IVT and MT**.
- Future work: users could **adapt this open-access model** to evaluate different levels of AI integration and other bundled-interventions in stroke care pathways.

Download the model:

Reflections on using AI tools when developing CEA models in R:

- GPT-4o,GTP-5 & GitHub Copilot were useful for initial script **template building**, **code debugging, and annotation**.
- Human review and testing at each stage is still required.
- **Be explicit in prompts** – state **preferred packages** (e.g. *base R* where possible) and preferred **naming conventions.**
- **Clarify input data assumptions** – GPT often defaults to creating automated code; if **inputs/input-types are fixed**, state this to get **simpler, faster-running code**.
- Human-led model building with AI-assistance improved **speed** of the model building process, and **robustness** and **transparency** of the resulting CEA model.

Table 1. Key inputs

Parameter	Base Case Value	Distribution (PSA)	Source
Average age at stroke onset	75 years	Fixed	[1]
% of strokes that are acute ischaemic stroke (AIS)	20.9%	Fixed	[2]
% eligible for IVT	25%	Beta (k=20 assumed)	[2]
% eligible for MT (early, ASC)	75%	Beta (k=20 assumed)	[2]
Utility value for mRS 0	0.817	Truncated normal (0.507,0.993)	[3]
Annual cost for mRS 4	£22,692	Gamma (7320, 47411)	[3]
Cost per MT procedure	£9,915.51	Gamma (6077, 14815)	[3]
Cost per IVT procedure	£1,527.72	Uniform (1,528–2,235)	[3]
Cost per AI software license (ASC; CSC)	£16,000; £32,000	Fixed	[4]

Results

Across modelled scenarios, the intervention is cost-effective (see Table 2 & Figure 2). Mortality parameters, long-term impacts, eligibility of IVT and MT, start age and discount rates have a relatively large impact on net monetary benefit.

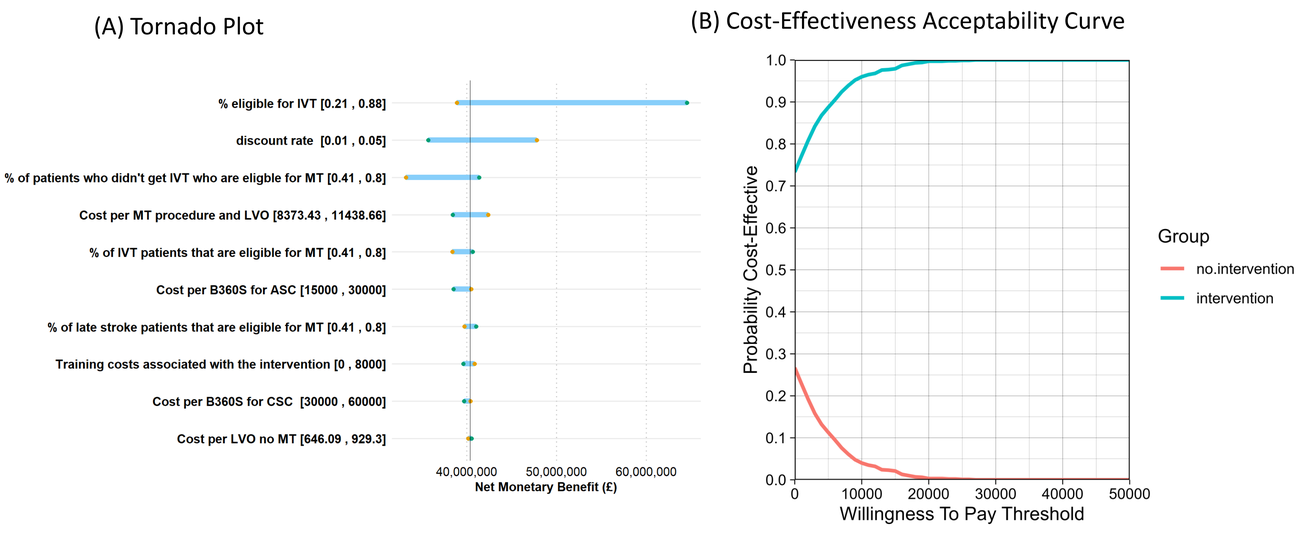
Discussion

- Our results are in line with previous literature. Although previously £3,490 per QALY gained was estimated in the base case, dominance of such AI interventions was present in many of the scenarios tested [4].
- Key potential limitations include that some distributional moments were estimated through assumptions and/or were based on little data, only eligible patients underwent procedures and quality of life impacts were measured only through longer term mRS and death states.

Table 2. Cost effectiveness results for modelled scenarios

SCENARIO	INCREMENTAL COST (£)	INCREMENTAL QALYS	NET MONETARY BENEFIT (£)
BASE CASE	-9,088,665	1,565	40,387,809
SC1: START AGE 66	-25,726,331	2,198	69,682,187
SC2: LONG TERM COST SAVINGS FROM IVT AND MT REMOVED	16,736,324	1,565	14,562,819
SC3: SC2 PLUS MORTALITY SAVINGS FROM IVT AND MT ONLY OCCUR IN YEAR 1	16,736,324	1,508	13,433,432
SC4: ADDITIVE MT AND IVT BENEFITS FOR THOSE WHO HAVE BOTH	-10,377,358	1,745	45,274,028
SC5: DIFFERENT IVT MRS DISTRIBUTION	-3,828,157	1,659	37,012,635

Figure 2. Deterministic and probabilistic sensitivity analyses results



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- ZW, JW and GH are employees and have share options in Brainomix. NN is an employee of OI Pharma Partners which has received funds from Brainomix.

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