

Early Cost-Effectiveness Analysis of AI-Enhanced Remote Monitoring Solutions for Timely Detection of Advanced Parkinson's Disease in Finland

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Background

- Deep brain stimulation (DBS) is an established treatment for advanced Parkinson's disease (aPD), but symptom variability and lack of biomarkers can delay aPD diagnosis and DBS initiation.
- Remote monitoring solutions (RMS) and artificial intelligence (AI) can offer potential for more precise aPD detection and timely DBS intervention.
- However, the efficacy and cost-effectiveness of these technologies for early symptom detection and their impact on clinical outcomes for persons with Parkinson's (PwP) remain underexplored.

Aim

- To conduct an early cost-effectiveness analysis (CEA) of an AI-enhanced RMS for aPD detection and timely DBS intervention at Helsinki University Hospital, evaluating its potential to improve clinical outcomes and economic viability, and to inform the early-stage development of this technology.

Technology

- PwP start using the AI-enhanced RMS at a non-advanced stage, eight years post-PD diagnosis, when they are at higher risk of advancing to aPD.
- PwP are monitored through remote devices (e.g., smartwatches) and by recording weekly videos on personal devices (e.g., computers or smartphones) via an app.
- Collected data is analyzed by AI designed to alert physicians if signs of progression towards aPD are detected.

Methods

- Early CEA with a four-state Markov model from the Finnish healthcare perspective, comparing AI-enhanced RMS with conventional care (CC) for aPD detection and timely DBS intervention.
- 3% discount rate to costs and health effects; ICER threshold of 35,000 €/QALY.
- Key assumptions: all PwP will develop aPD, AI-enhanced RMS has 100% diagnostic accuracy, diagnosing aPD one year earlier than CC, allowing 10% to receive timely DBS. Utility improvement: 22% with DBS under CC, hypothesized 24% with timely DBS via AI-enhanced Remote RMS (Figure 1).
- Outcome: Incremental cost-effectiveness ratio (ICER) in €/QALY over a lifetime horizon, exploring various cost and benefit scenarios. Probabilistic sensitivity analysis (PSA) using Monte Carlo simulation.

Figure1. Utility values for PwP receiving conventional pharmacological therapy, those receiving DBS under CC, and PwP receiving timely DBS facilitated by AI-enhanced RMS

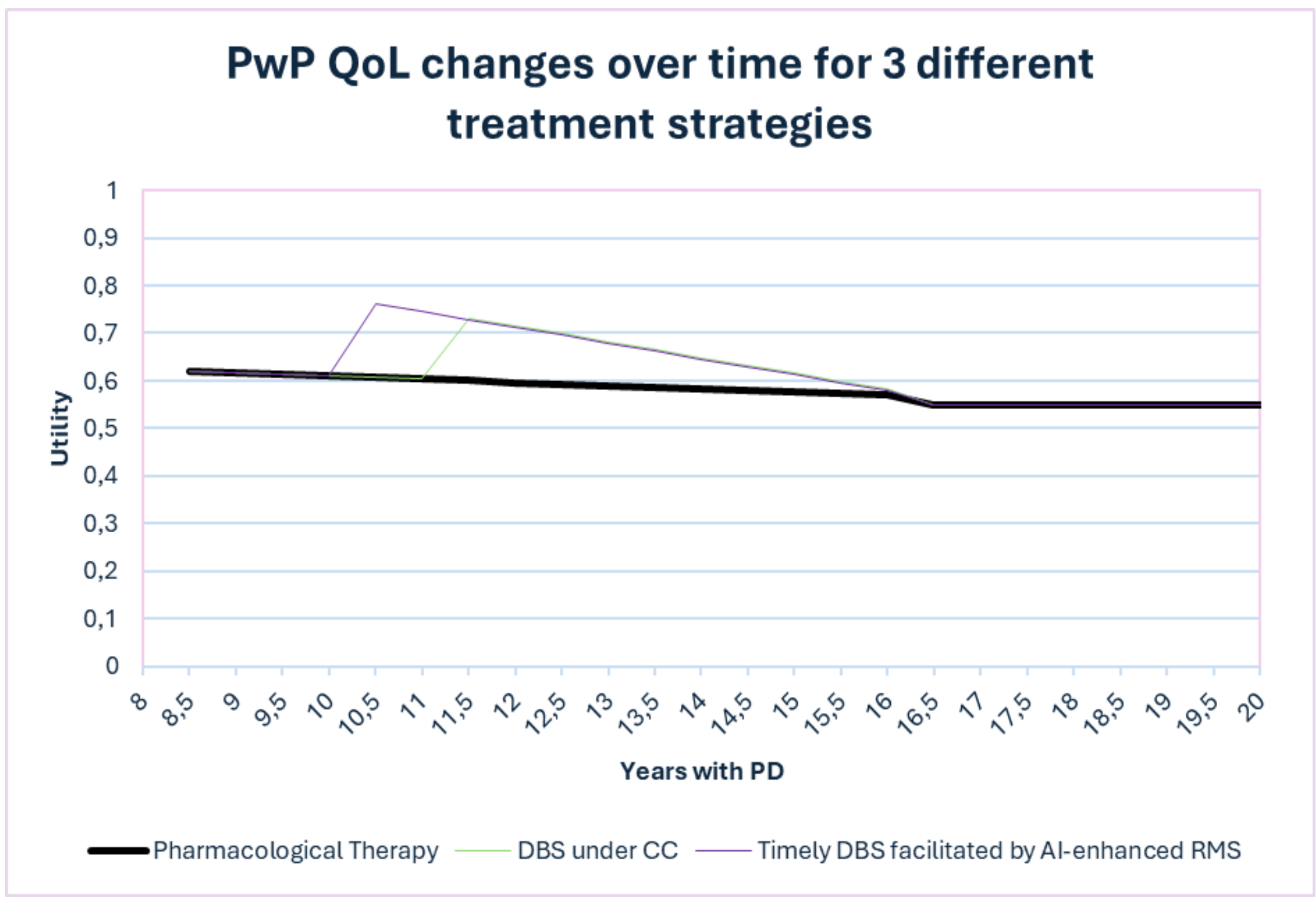
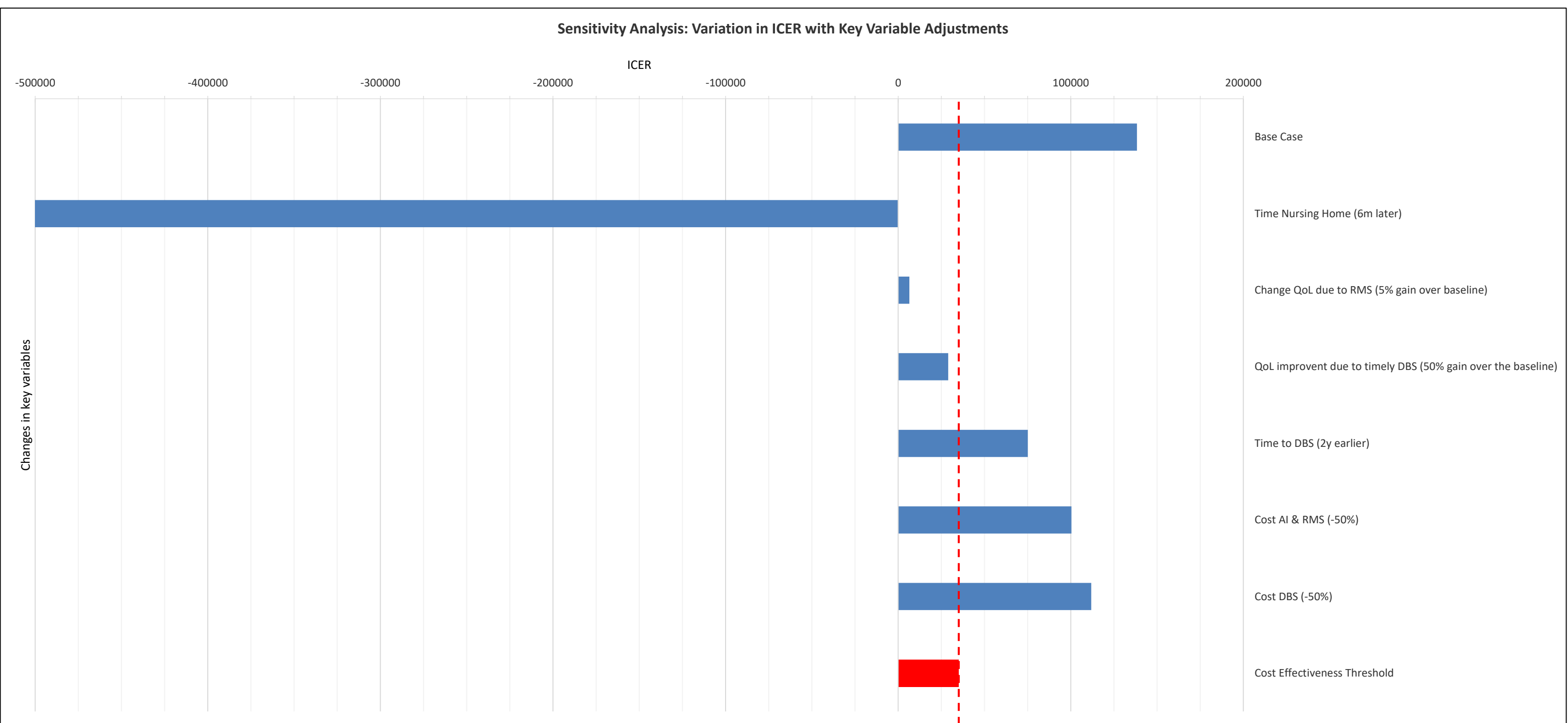


Table1: Overview of the base case results and scenario analysis

	Costs		ΔC	QALYs		ΔQ	ICER
	AI-RMS	CC		AI-RMS	CC		
Base case	€131,631	€129,595	€2,036	3.858	3.844	0.015	€ 138,351
6m delay nursing home admission	€117,225	€129,595	€-12,370	3.861	3.844	0.017	Dominant
RMS alone QoL enhancement by 5%	€131,631	€129,595	€2,036	4.011	3.844	0.168	€12,140
50% QoL gain over baseline due timely DBS	€131,631	€129,595	€2,036	3.913	3.844	0.069	€29,455
2y early aPD detection	€131,358	€129,595	€1,763	3.865	3.844	0.021	€83,872

ICER=Incremental Cost-Effectiveness Ratio, QALYs= Quality Adjusted Life-Years, ΔC = Incremental Costs, ΔQ = Incremental QALYs, CC = Current Care

Figure2: ICER of AI-Enhanced RMS compared to CC in different scenarios

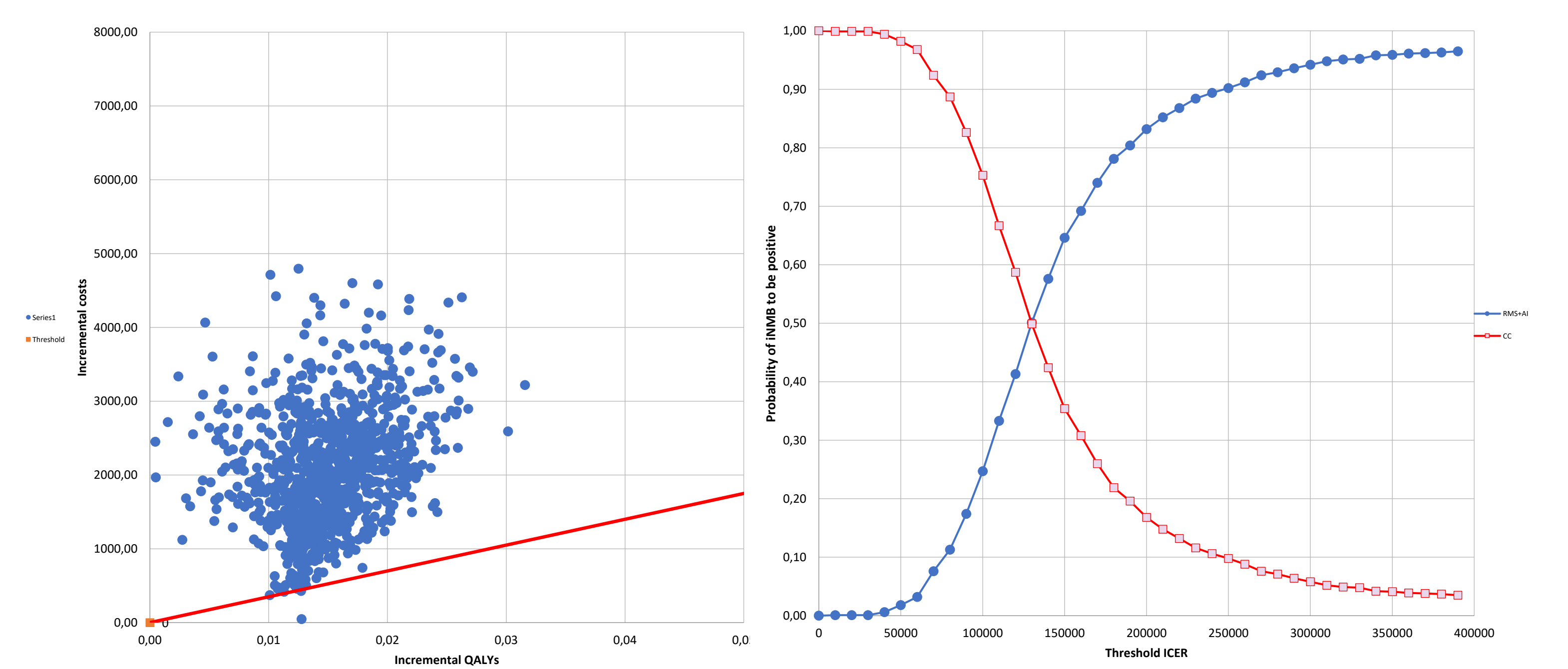


Results

- Diagnosing aPD one year earlier with timely DBS intervention through AI-enhanced RMS improves QALYs (3.858 vs. 3.844) but incurs higher total costs (€131,631 vs. €129,595) compared to CC. The ICER is €138,351 per QALY, exceeding Finland's cost-effectiveness threshold of €35,000/QALY, indicating that the AI-enhanced RMS is not cost-effective (Table 1, Figure 2).
- Probability of Cost-Effectiveness: AI-enhanced RMS has a 1% probability of being cost-effective under the base case scenario (Figure 3). The cost-effectiveness acceptability curve (CEAC) shows a probability of over 50% only when willingness to pay (WTP) exceeds €130,000 per QALY (Figure 4).
- Scenario Analyses: Additional scenario analyses suggest more favorable outcomes under certain conditions (Figure 2).

Figure3. Cost-effectiveness plane of AI-Enhanced RMS Compared to CC

Figure4. Cost-effectiveness acceptability curve (CEAC) of AI-Enhanced RMS Compared to CC



Key Take-Aways



- AI-enhanced RMS for early detection of aPD shows potential in improving QoL for PwP.
- However, its costs and the current lack of robust clinical evidence on its effectiveness limit its cost-effectiveness.
- This study highlights important areas for further investigation and potential strategies to enhance the economic sustainability of AI-enhanced RMS for aPD detection and timely DBS intervention