Identification of undiagnosed atrial fibrillation using a machine learning risk prediction algorithm and diagnostic testing (PULsE-AI) in primary care: health economic impact assessment of a UK randomised controlled trial

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Introduction

- Atrial fibrillation (AF) is prevalent in approximately 3% of the general population [1], and is associated with a five-fold increase in stroke and stroke severity [2,3]
- Detection can be challenging due to the often paroxysmal and asymptomatic nature of the condition
- Screening for AF can be opportunistic (e.g. screening of patients attending their general practitioner for another reason), targeted (e.g. screening of higher-risk patients), or systematic (e.g. screening of all patients >65 years); however, these screening approaches for AF are not effective or cost-effective [4]. There is currently no national screening programme for AF in the UK.
- The PULsE-AI trial sought to determine the effectiveness of a detection strategy that included an AF risk prediction algorithm (developed using machine learning techniques) in conjunction with diagnostic testing for the identification of undiagnosed AF in primary care [5]
- In the trial, intervention arm participants at high risk of AF, were invited to receive a 12-lead electrocardiogram (ECG) and undertake 2-weeks of home-based ECG monitoring with a KardiaMobile device; the primary endpoint was diagnosis of AF or related arrhythmias

Objective

- The purpose of this analysis was to evaluate the health economic impact of the diagnostic pathway implemented in the PULsE-AI trial

Methods

- Assessment of the health economic impact of the screening intervention for the PULsE-AI trial considered:
  - Costs associated with implementation of the intervention (administrative, clinical contact, and device costs; Table 1), and
  - Lifetime treatment and event (stroke, major bleed, myocardial infarction, intracranial haemorrhage) costs in patients diagnosed with AF compared with the lifetime cost of events in undiagnosed patients who did not receive the screening intervention
- Estimated treatment and event costs, and quality-adjusted life years (QALYs) were based on either warfarin therapy or the mean of all direct oral anticoagulant (DOAC) therapies
- Incremental net monetary benefit (NMB) was calculated based on a willingness-to-pay threshold of £30,000

Table 1. Summary of costs associated with the PULsE-AI trial intervention

		Cost per participant	N	Cost for activity	Overall	
Trial administration	Invitation letter	£1.48	779	£1,152.92	**Total cost of the intervention**	**£16,744.91**
	Reminder letter	£1.48	390	£577.20		
Research clinic appointment	Recording of baseline characteristics	£8.94	266*	£2,378.04	**Average cost (per participant) in the intervention arm**	**£17.53**
	12-lead ECG	£11.93	266*	£3,170.72		
	Cardiologist review	£2.33	251	£584.83		
KardiaMobile implementation	Purchase of KardiaMobile devices	£99.00	50^	£4,950.00		
	Device training for participants	£11.92	148	£1,764.16		
	Pre-paid envelope for device return	£5.00	148	£740.00	**Average cost of the intervention per participant diagnosed**	**£1,046.56**
	Cardiologist review	£9.32	148	£1,379.36		
Ongoing care	Referral	£2.98	16	£47.68		

* accounting for indirect nurse time for participants who did not attend scheduled research clinic appointments; ^ based on an assumption of purchasing one device for every five participants at high risk of AF

Results

- 779 participants randomised to the intervention arm at high risk of AF were invited for diagnostic testing (12-lead ECG +/- KardiaMobile), of these, 251 attended the research clinic, 16 of whom were diagnosed with AF or related arrhythmias as a direct result of the intervention
- The average cost of the intervention per participant diagnosed was £1,047

Table 2. Summary of incremental costs and benefits based on the PULsE-AI trial

Costs	Undiagnosed patient	Patient diagnosed with AF or related arrhythmias	
		Prescribed warfarin	Prescribed a DOAC^
Total cost	**£12,956**	**£18,698**	**£23,990**
Per patient intervention cost	£0	£1,047	£1,047
Lifetime per patient total costs	£12,956	£17,651	£22,943
Event costs	£12,956	£12,639	£10,723
Treatment costs	£0	£5,012	£12,220
Total QALYs	**5.90**	**6.92**	**7.30**
Net monetary benefit	**£164,121**	**£188,765**	**£195,033**
Incremental cost	**-**	**+£5,742**	**+£11,034**
Incremental QALYs	**-**	**+1.01**	**+1.40**
Incremental net monetary benefit*	**-**	**+£24,644**	**+£30,912**

AF: atrial fibrillation; DOAC: direct oral anticoagulant; QALYs: quality-adjusted life years
^ Includes: apixaban, dabigatran, edoxaban, rivaroxaban
*A positive incremental net monetary benefit indicates the intervention is cost-effective at a willingness-to-pay threshold of £30,000

- Despite a lower incidence of events in diagnosed patients, estimated lifetime costs were higher in this group compared with patients who remain undiagnosed, driven by treatment acquisition costs (total intervention and lifetime costs were estimated at £23,990 for a diagnosed patient receiving DOAC therapy vs. £12,956 in a patient who remains undiagnosed; Table 2)
- After accounting for QALY gains (+1.40 years vs. undiagnosed), diagnosis of AF as a result of the trial intervention resulted in an incremental NMB of £30,912 for a patient receiving DOAC therapy compared with a patient who remains undiagnosed

Conclusions

This health economic impact assessment demonstrates that diagnosis of AF in previously undiagnosed patients via application of this machine learning AF risk prediction algorithm combined with diagnostic testing is cost-effective in a UK primary care setting

References

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Disclosures

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