

KHRS 2023

June 23(Fri.) - 24(Sat.), 2023
Grand Walkerhill Seoul, Korea

The 15th Annual Scientific Session of the Korean Heart Rhythm Society

Digital Health 1: Artificial Intelligence and Cardiac Research

Clinical Implication of AI in Early AF Detection



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TOGETHER.
TOMORROW.
EWHHA

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The Korean Society of Cardiology COI Disclosure



Name of First Author: Junbeom Park M.D., Ph.D.

The author acknowledges technical and financial support from the followings in various research studies.

- Synergy AI
- Daewoong

2810 Patients were assessed for eligibility

21 Did not meet inclusion criteria

2789 Underwent randomization at 135 sites in 11 countries

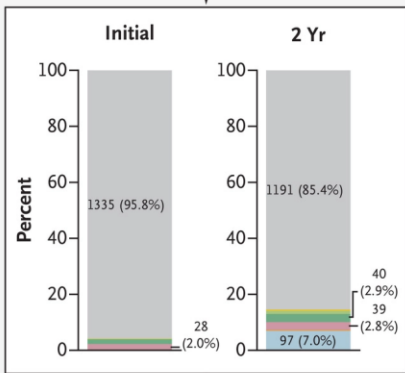
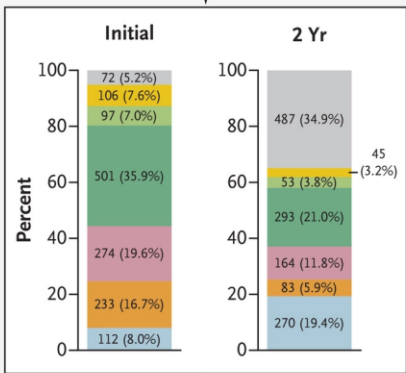
1395 Were assigned to early rhythm control

1394 Were assigned to usual care

1395 Were included in primary analysis

1394 Were included in primary analysis

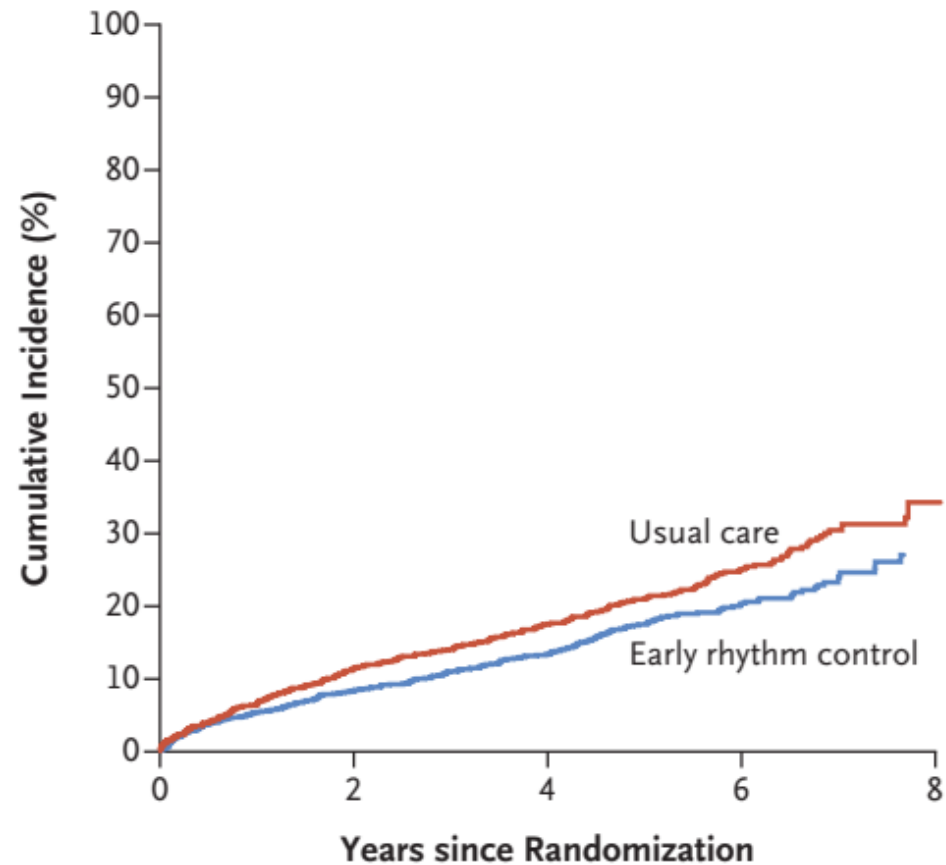
Rhythm Control Chosen by Site



- None
- Other antiarrhythmic drug
- Propafenone
- Flecainide
- Amiodarone
- Dronedarone
- AF ablation

Total follow-up yr lost: 681/7596 (9.0%)
 524 (6.9%) Follow-up yr lost because
 123 Withdrew
 157 (2.1%) Follow-up yr lost because
 102 Were lost to follow-up

Total follow-up yr lost: 491/7479 (6.6%)
 339 (4.5%) Follow-up yr lost because
 83 Withdrew
 152 (2.0%) Follow-up yr lost because
 106 Were lost to follow-up



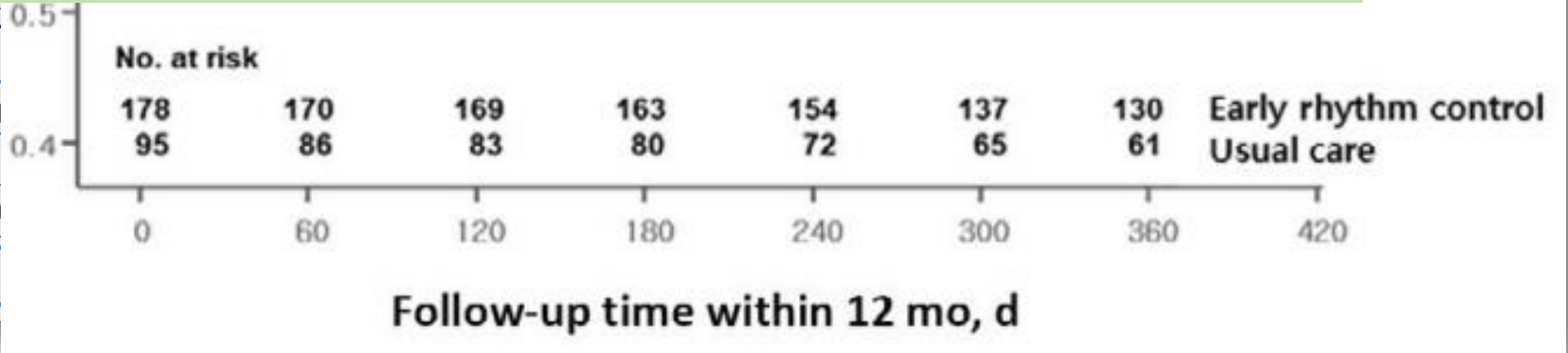
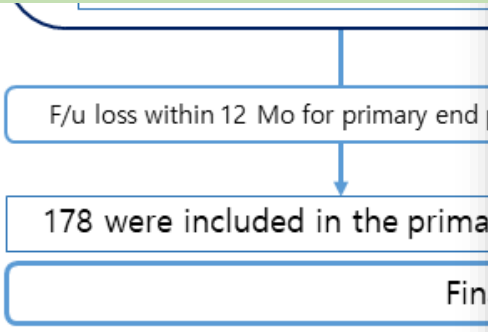
No. at Risk

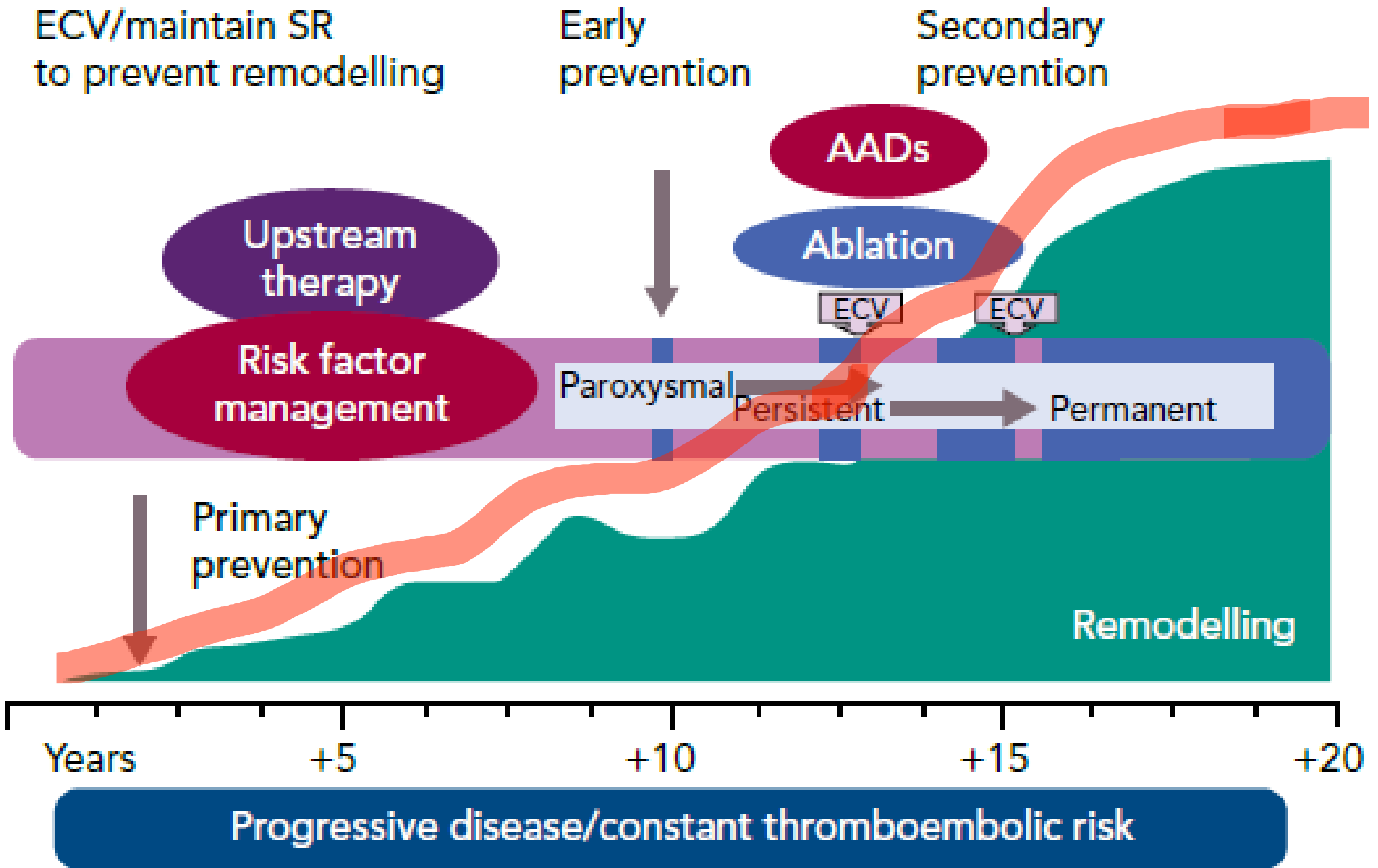
	0	2	4	6	8
Usual care	1394	1169	888	405	34
Early rhythm control	1395	1193	913	404	26

Assessed for Acute stroke (n=11397)



✓ We can conclude that early rhythm control in AF showed better prognosis compared to usual care in acute stroke patients as well as general population.





Various Wearable ECGs for Early detection of AF

	Sensors	Measurements	Clinical applications
	Activity		
	Accelerometer	Step count, impact force, speed, sedentary time, exercise	<ul style="list-style-type: none"> Risk assessment in healthy individuals and those with established CVD Physical activity behavioural interventions in primary and secondary prevention Cardiac telerehabilitation Heart failure management
	Barometer	Stair count	
	GPS	Distance traveled	
		Calories burned estimated from multiple measurements	
	Biometric		
	PPG	HR, HRR, HRV, cuff-less BP, SaO ₂ , cardiac output, stroke volume, pulse-based rhythm detection, sleep and its stages	<ul style="list-style-type: none"> Risk prediction in healthy individuals and those with established CVD Hypertension screening and management Cardiac telerehabilitation Arrhythmia screening and diagnosis Acute coronary syndrome diagnosis Diagnosis of electrolyte abnormalities such as hyperkalaemia Long QTc diagnosis Heart failure management Medication titration such as β-blockers
	ECG	Single-lead and multi-lead ECG, continuous or as-needed ECG monitoring, interval measurements such as QTc, arrhythmia detection and electrolyte abnormality changes	
	Oscillometry	Wrist cuff BP	
	Other		
Biochemical sensors	Invasive for continuous blood glucose and electrolyte monitoring Non-invasive for sweat and saliva electrolytes and hydration status	<ul style="list-style-type: none"> Identifying electrolyte abnormalities Continuous blood glucose monitoring Heart failure management 	
Biomechanical sensors such as ballistocardiograms, seismocardiograms and dielectric sensors	Cardiac output, stroke volume, lung fluid volume, body vibrations, weight		

2020 ESC / KHRS Guideilne

1

- Definition and diagnosis of atrialfibrillation

Recommendations	Class ^a	Level ^b
ECG documentation is required to establish the diagnosis of AF. <ul style="list-style-type: none"> • A standard 12-lead ECG recording or a single-lead ECG tracing of ≥ 30 s showing heart rhythm with no discernible repeating P waves and irregular RR intervals (when atrioventricular conduction is not impaired) is diagnostic of clinical AF.⁶ 	I	B

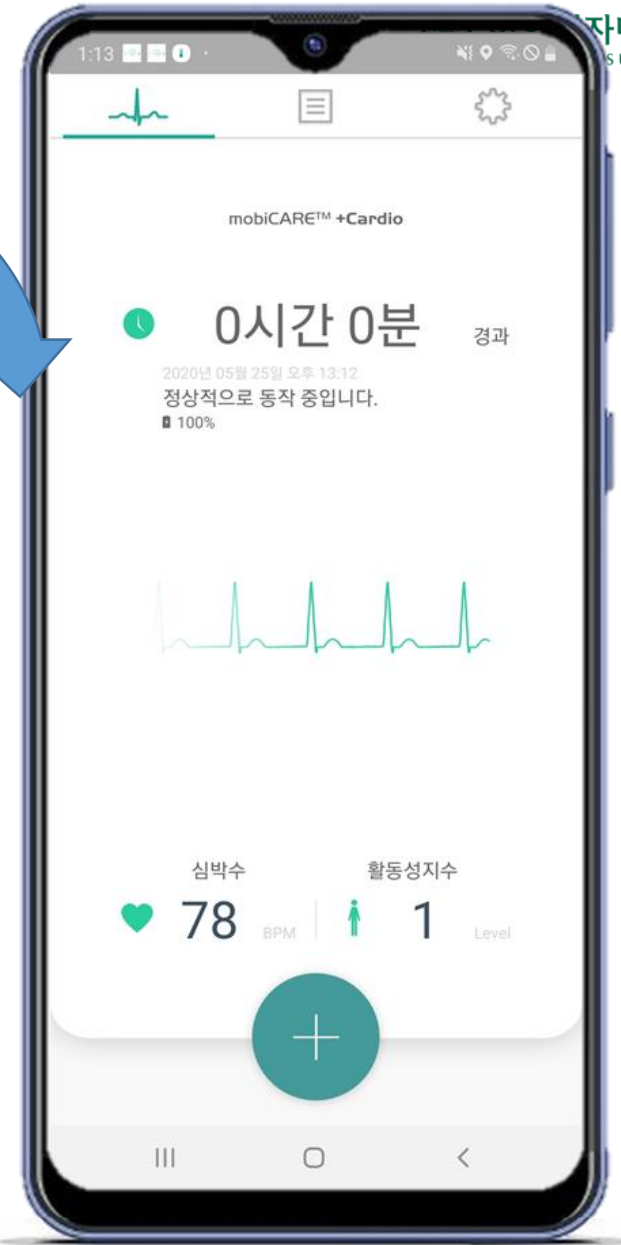
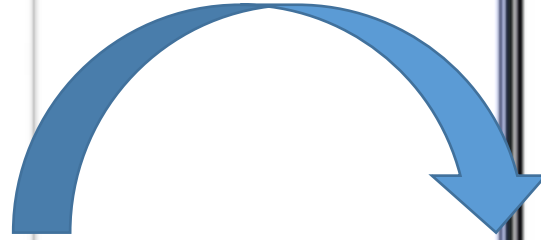
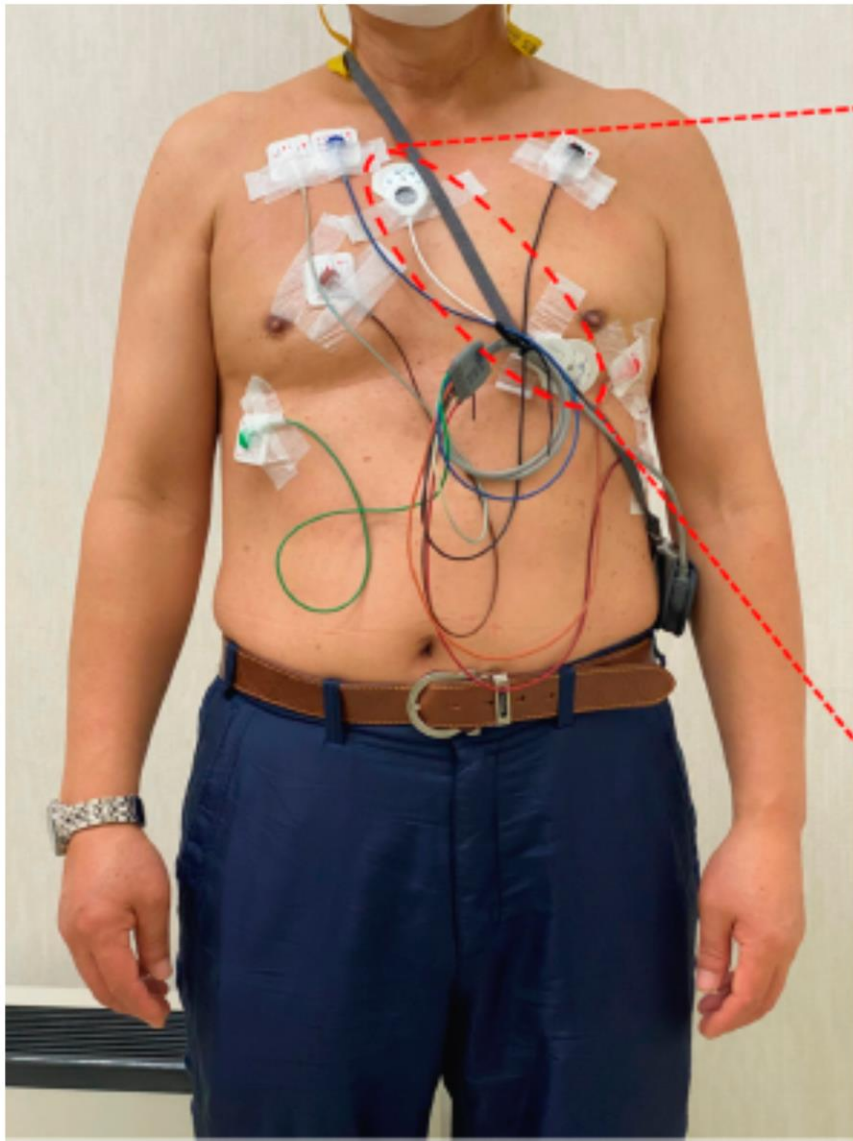
Recommendation	Class ^a	Level ^b
Opportunistic screening for AF by pulse taking or ECG rhythm strip is recommended in patients ≥ 65 years of age. ^{188,211,223,225}	I	B
When screening for AF it is recommended that ^{217,218} <ul style="list-style-type: none"> • The individuals undergoing screening are informed about the significance and treatment implications of detecting AF. • A structured referral platform is organized for screen-positive cases for further physician-led 	I	B

Table 5 Sensitivity and specificity of various AF screening tools considering the 12-lead ECG as the gold standard¹⁷³

	Sensitivity	Specificity
Pulse taking ²⁰³	87 - 97%	70 - 81%
Automated BP monitors ^{204–207}	93 - 100%	86 - 92%
Single lead ECG ^{208–211}	94 - 98%	76 - 95%
Smartphone apps ^{188,189,191,195,212,213}	91.5 - 98.5%	91.4 - 100%
Watches ^{196,198,213,214}	97 - 99%	83 - 94%

AF = atrial fibrillation; BP = blood pressure; ECG = electrocardiogram.

Systematic ECG screening should be considered to detect AF in individuals aged ≥ 75 years, or those at high risk of stroke. ^{212,224,227}	IIa	B
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Total QRS complexes

Total VEBs

Total SVEBs

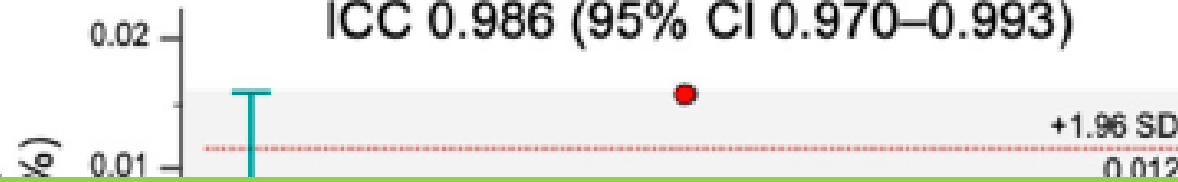
Burden of VEBs

ICC 0.987 (95% CI 0.973–0.994)

ICC 1.000 (95% CI 0.999–1.000)

Burden of SVEBs

ICC 0.986 (95% CI 0.970–0.993)



- The two cardiologists , 29 participants.
- The single-lead adhesive device could be an acceptable alternative for ambulatory ECG monitoring in patients with general arrhythmia.

0.0

0.1

0.2

Burden of SVEBs (%)

CANDLE - AF Trial (cris.nih.go.kr / KCT0005592)

frontiers | Frontiers in Cardiovascular Medicine

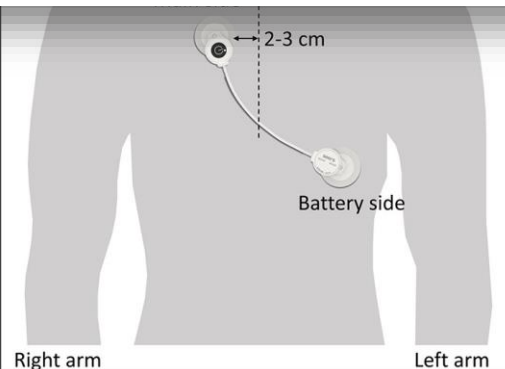
STUDY PROTOCOL
published: 04 April 2022
doi: 10.3389/fcvm.2022.837958

Clinical Implications of Atrial Fibrillation Detection Using Wearable Devices in Patients With Cryptogenic Stroke (CANDLE-AF) Trial: Design and Rationale

Sodam Jung¹, Hye Ah Lee², In Sook Kang¹, Sang Hoon Shin³, Yoonkyung Chang¹, Dong Woo Shin⁴, Moo-Seok Park⁵, Young Dae Kim⁶, Hyo Suk Nam⁶, Ji Hoe Heo⁶, Tae-Hoon Kim⁷, Hee Tae Yu⁷, Jung Myung Lee⁸, Sung Hyuk Heo⁹, Ho Geol Woo⁹, Jin-Kyu Park¹⁰, Seung-Young Roh¹¹, Chi Kyung Kim¹², Young-Soo Lee¹³, Jin Kuk Do¹⁴, Dong-Hyeok Kim^{3*}, Tae-Jin Song^{5*}, Junbeom Park^{1*} and CANDLE-AF Trial Investigators

- 뇌졸중 진단 7일 ~ 30일 사이의 퇴원전 원내 EKG monitoring
- 퇴원 이후 정기적인 외래 방문과 심전도 (필요시 Holter), 증상 발현시 심전도

- 뇌졸중 EKG monitoring
- 퇴원 후 정기적인 외래 방문 (필요시 Holter), 증상 발현시 심전도
- 외래 방문 시 심전도



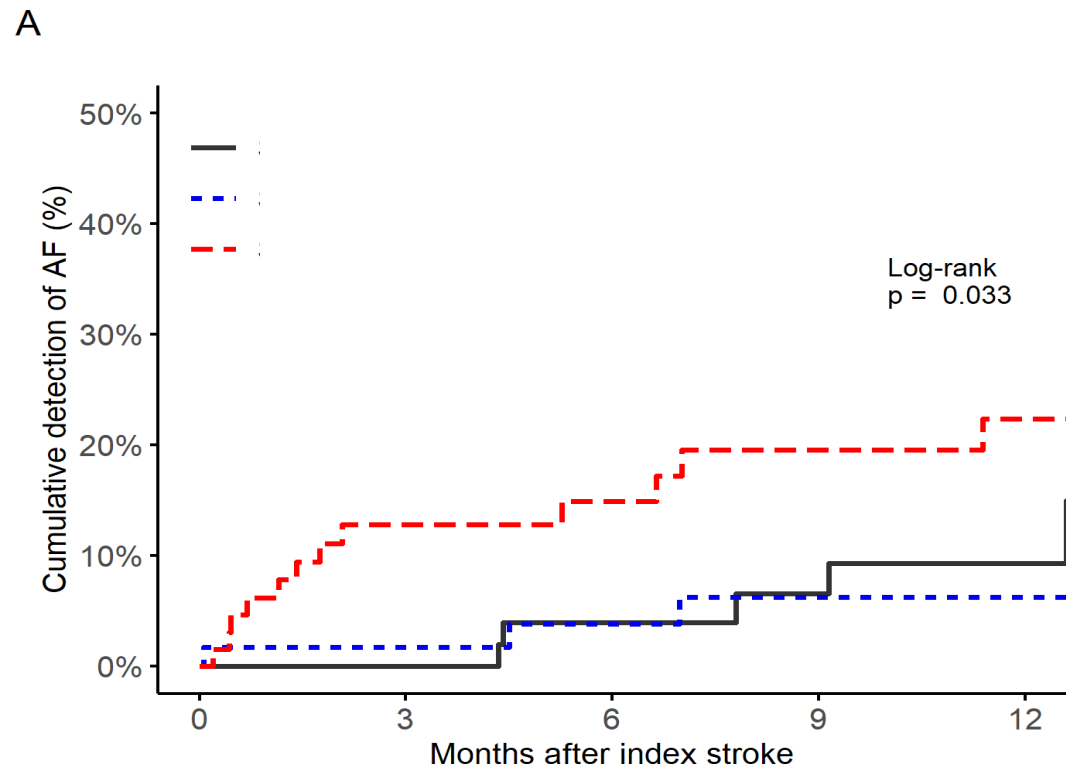
환자 (Unknown origin Stroke)

Patients with cryptogenic stroke
are monitoring (CANDLE -AF Trial)

(1:1:1) 배정

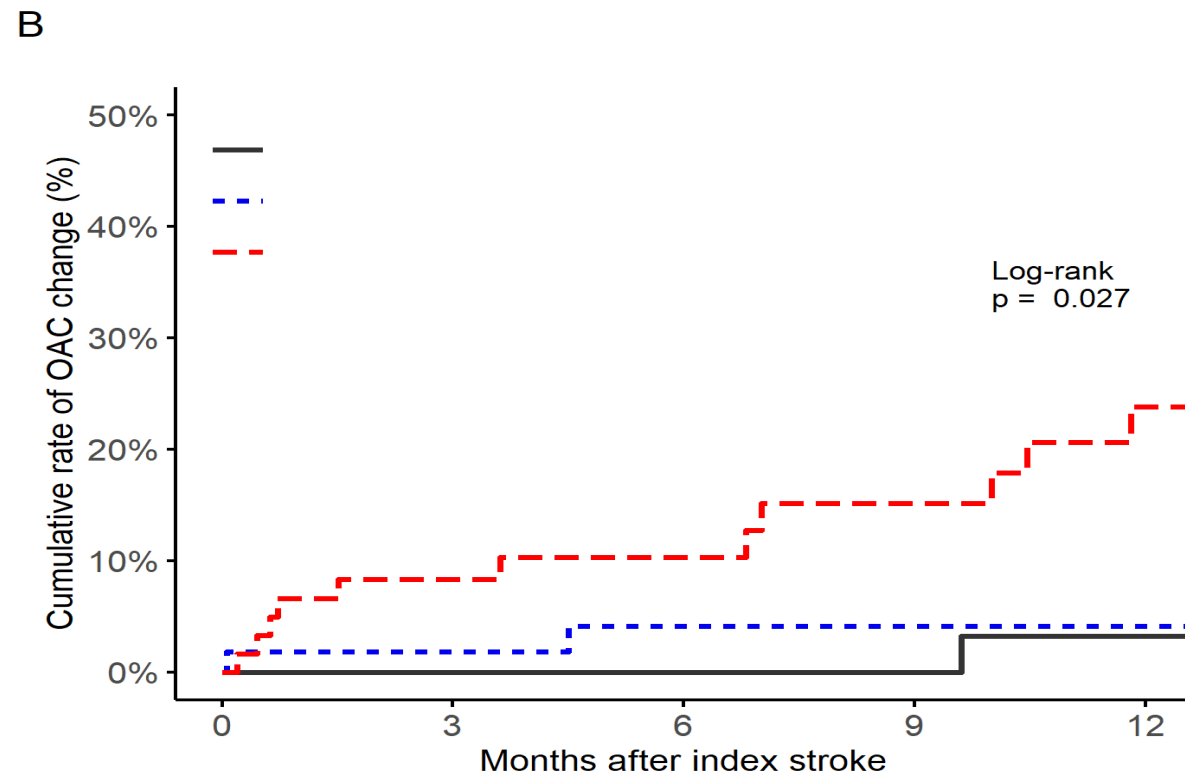
스, 대구 가톨릭, 충북대, 길병원





Number at risk

—	63	57	46	34	23
—	59	49	42	33	23
—	65	49	39	33	21



Number at risk

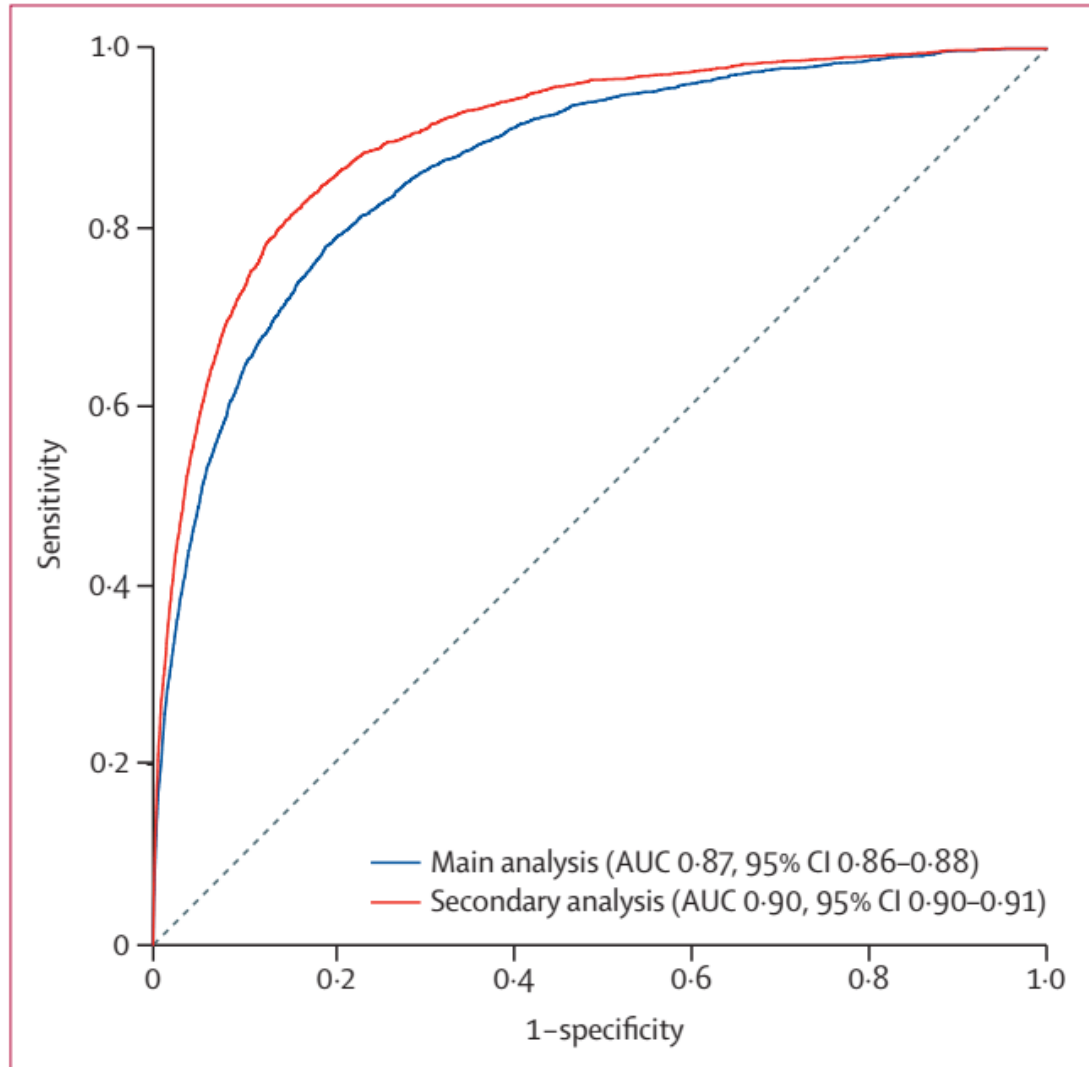
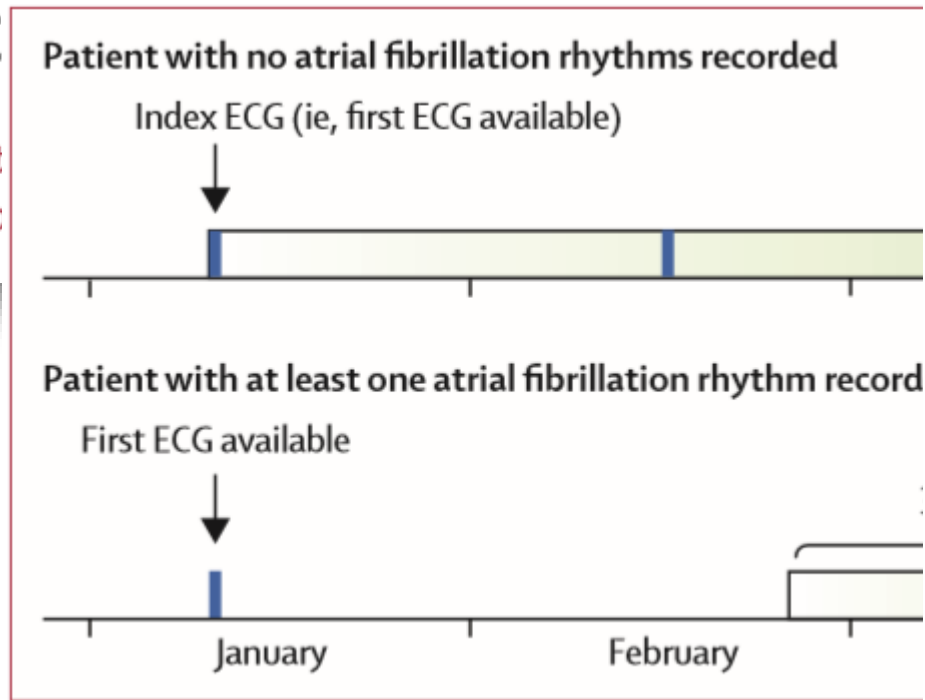
—	53	48	41	32	24
—	54	46	39	32	23
—	61	49	40	34	20

Preliminary Results. Figure. KM of AF detection rate, OAC change rate, Re-admission rate of 3 groups

ECG and AI application

An artificial intelligence-enabled ECG algorithm for the identification of patients with atrial fibrillation

Zachi Attia
Xiaoxi Yao



Artificial intelligence-guided screening for atrial fibrillation using electrocardiogram during sinus rhythm: a prospective non-randomised

Peter A Noseworthy, Zachi I Attia, Jun Yin, Bernard J Gersh, Jonathan

Atrial fibrillation

Atrial fibrillation

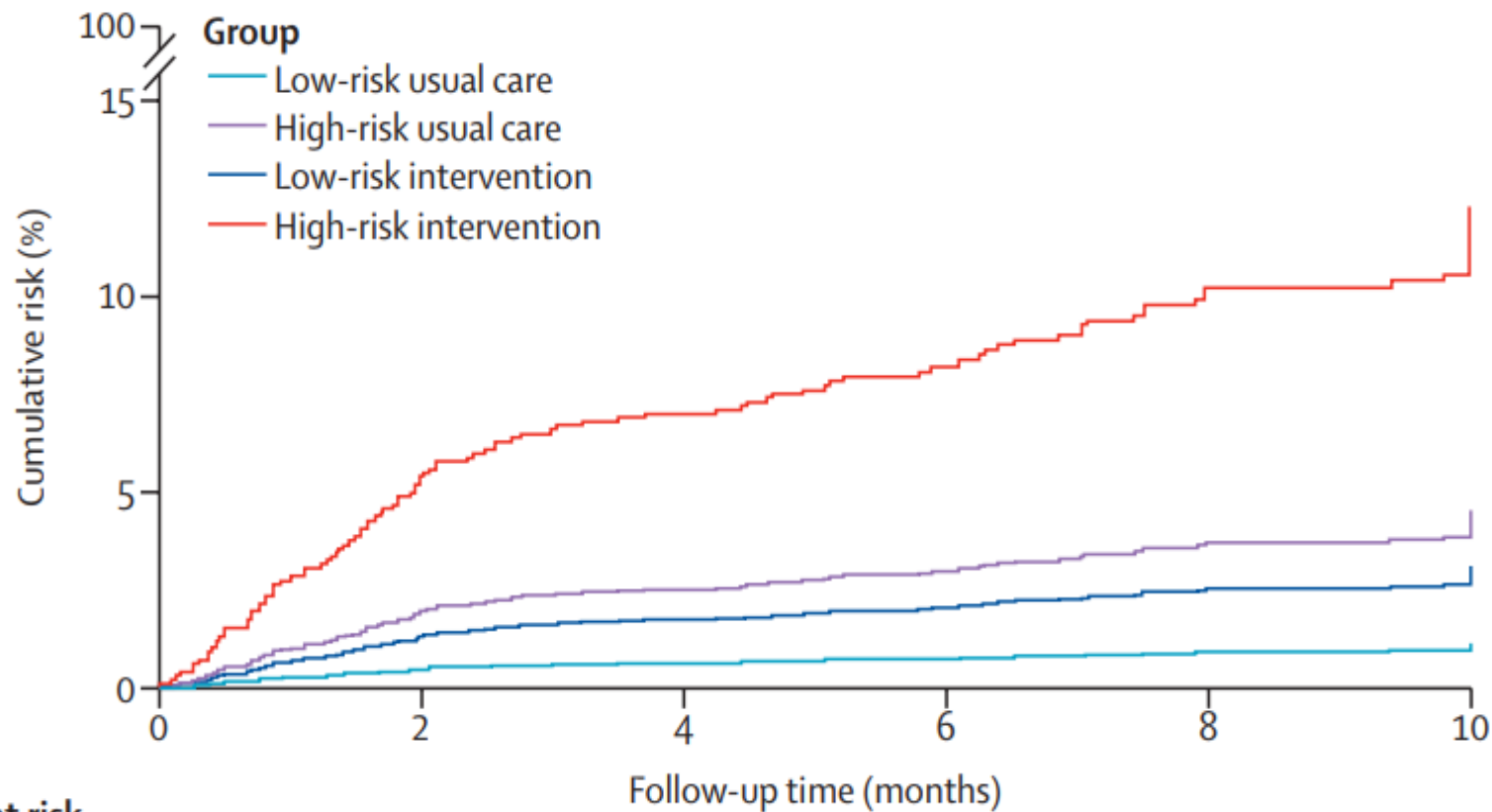
Atrial fibrillation

Atrial fibrillation

Longest episode of fibrillation within

Time to atrial fibrillation diagnosis, days*

Data are n (%) or median diagnosed with atr



	Number at risk					
	0	2	4	6	8	10
Low-risk usual care	342	341	338	236	149	90
High-risk usual care	661	648	638	570	412	382
Low-risk intervention	371	365	364	253	145	99
High-risk intervention	632	593	577	514	399	375

AI algorithm for early detection of PAF and prospective validation

Prospective validation study of artificial intelligence-based prediction algorithm for the prediction of paroxysmal atrial fibrillation (PROVISION-AF Trial)

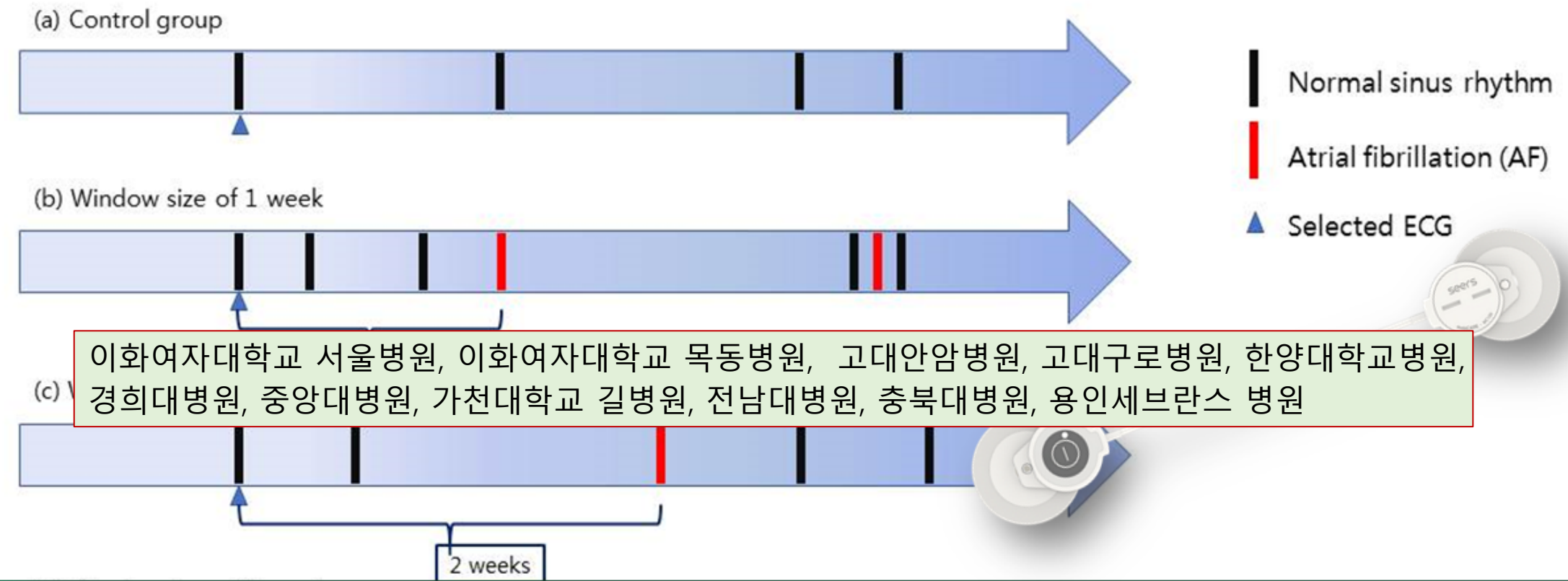
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927 (C
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736 ECGs
1 week
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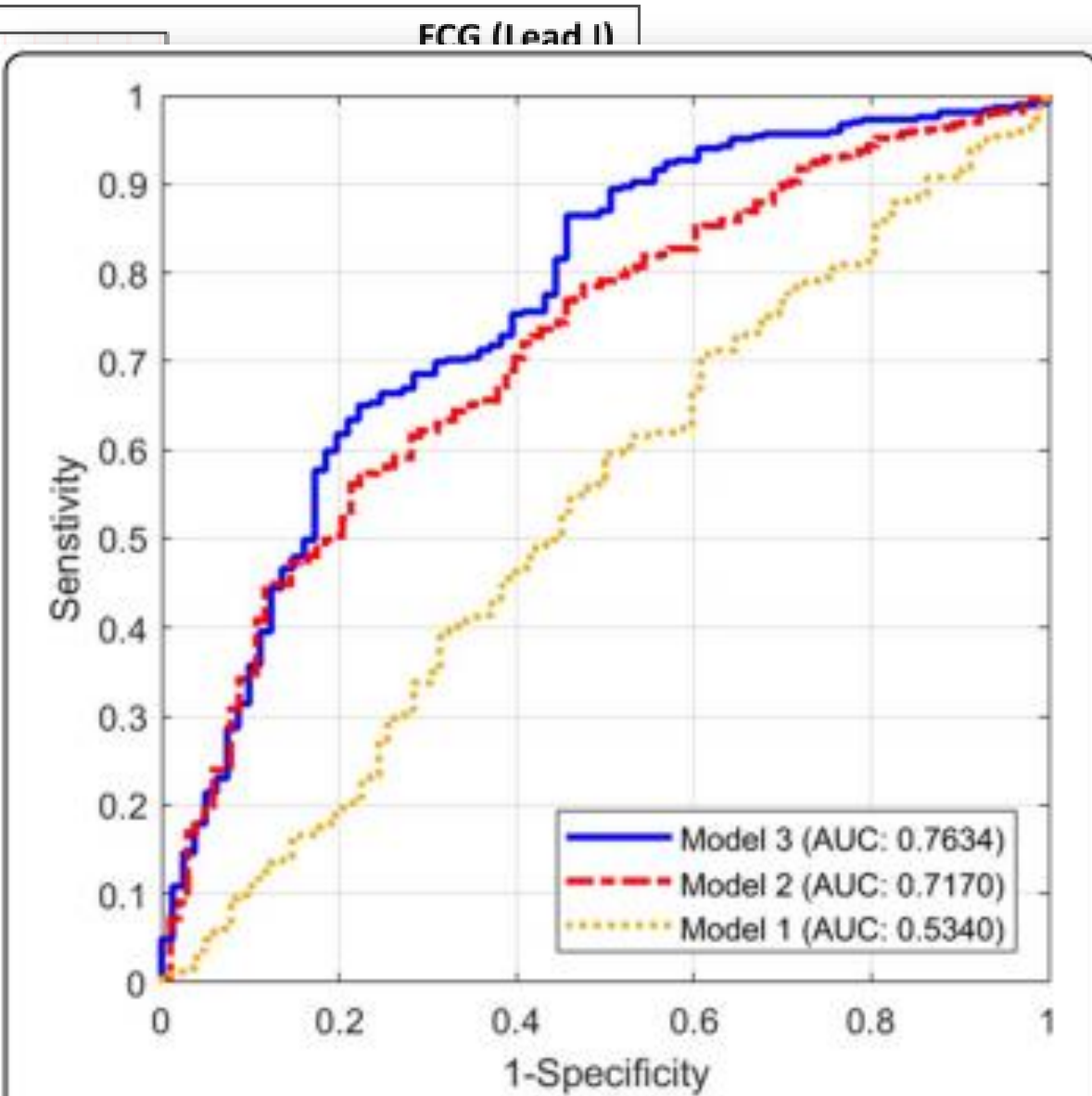
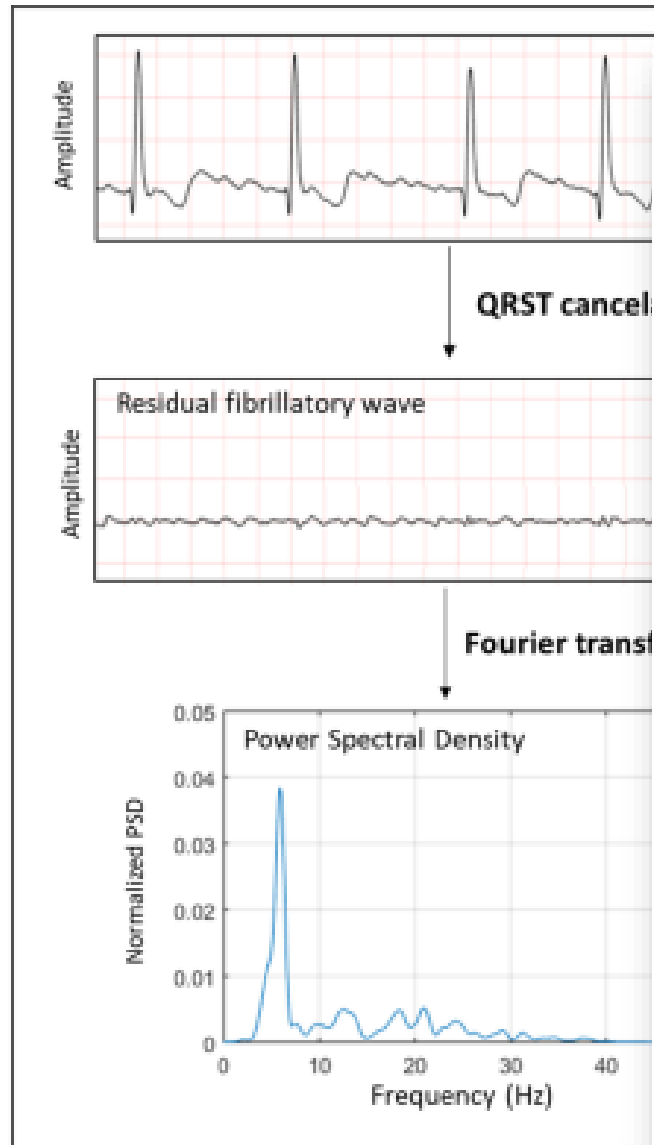
Figure1. Pa



Machine learning based potentiating

impac
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Sungsoo Kim
Hye Jin Hwa



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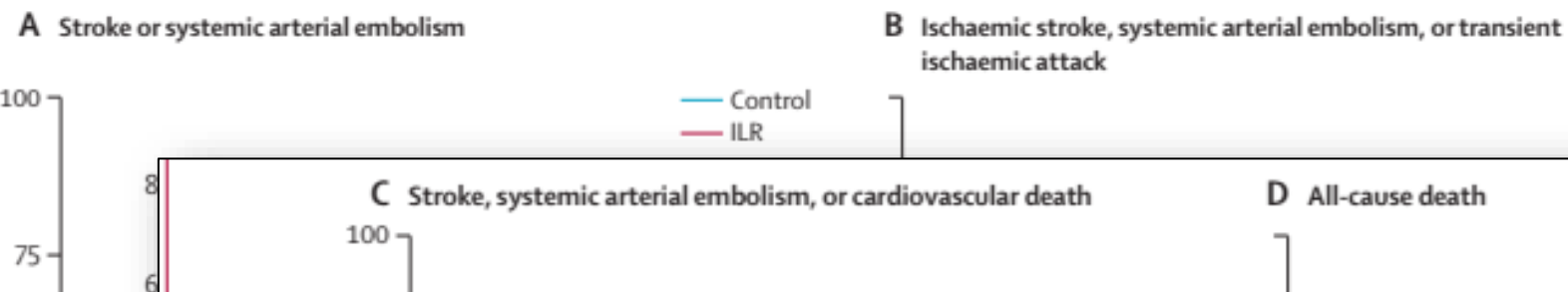
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LOOP Study – ILR (a randomised controlled trial)

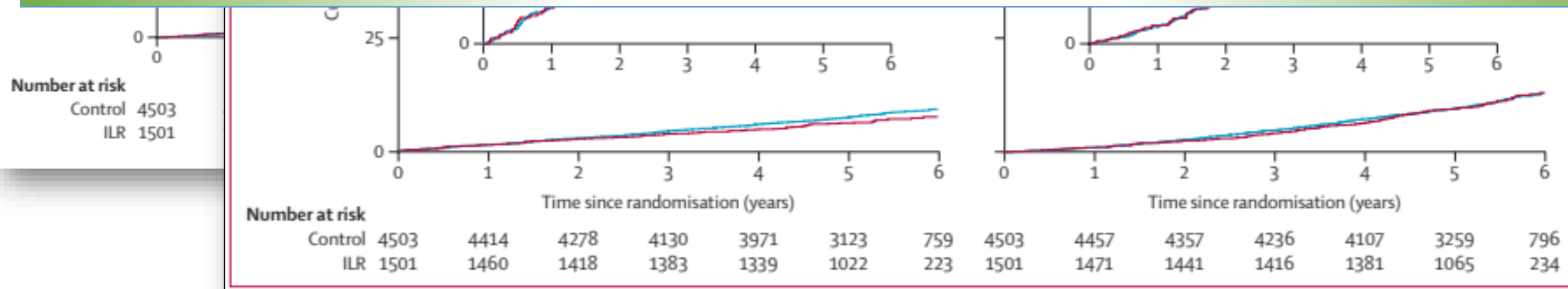
	ILR 1501	Control 4503	HR/(95% CI)	P
AF	477(31.8%)	550 (12.2%)	3.17 (2.81-3.59)	<0.0001
OAC	445 (29.7%)	591 (13.1%)	2.72 (2.41-3.08)	<0.0001
Stroke/SE	318 (4.5)%	251 (5.6%)	0.80 (0.61-1.05)	0.11
CV death				차이없음
Major bleeding	65 (4.3%)	156 (3.5%)	1.26 (0.95-1.69)	0.11

Not all AF is worth screening for, and not all screen-detected AF merits anticoagulation

LOOP Study – ILR (a randomised controlled trial)



- ✓ LOOP study showed that short time of AF events is not related to stroke or embolic events.
- ✓ We are collecting 24~72hr HOLTTER data for making AI algorithm to predict AF burden as well as the presence of AF.



Clinical Implication of AI in Early AF Detection

1. Early detection and early rhythm control of AF

(1) Early Anticoagulation (CHA2DS2-VASc score)

=> Prevention of stroke by AF

(2) Screening of AF

: immediate and continuous monitoring through a wearable ECG can increase the early detection of AF and increase the use of anticoagulant treatment

2 . AI algorithm to determine Optimal AF burden for improving MACE

(1) Active rhythm control of AF through early detection

(2) Early detection of AF patients who need optimal anticoagulation treatment



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