Supplementary Materials

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Supplementary Figure 5. Residual network (ResNet)-based ECG age prediction model architecture.

Supplementary Table 1. Anti-arrhythmic drug usage pre-procedure, post-procedure during blanking period, and post-procedure after blanking period in the YUHS discovery cohort.

	YUHS discovery cohort (n=5,466)		
	Normal ECG age (n=3,466)	Aged-ECG (n=2,000)	p-value
Pre-procedure	3335 (96.2)	1950 (97.5)	0.014
Post-procedure during blanking period	1099 (31.7)	761 (38.1)	<0.001
Post-procedure after blanking period	1372 (40.2)	891 (45.5)	0.002

Supplementary Table 1 shows the anti-arrhythmic drug usage in the aged-ECG versus normal ECG age group at pre-procedure, post-procedure blanking period, post-procedure after blanking period. Aged-ECG used anti-arrhythmic drug peri-procedure more often compared to the normal ECG age group. Anti-arrhythmic drug usage in the KUAH evaluation cohort was not available.

Abbreviations are the same as in Table 2.

Supplementary Table 2. Risk of clinical recurrences of AF stratified by ECG age gap using different cut-offs in the YUHS discovery and KUAH evaluation cohort.

	YUHS discovery cohort (n=5,466)		**KUAH evaluation cohort (n=1,564)**	
	Normal ECG age	Aged-ECG	Normal ECG age	Aged-ECG
ECG age gap cut off of 5 years	2617	2849	732	832
ECG age gap	-3.5 (-9.7 to 1.0)	13.6 (9.2 to 20.1)	-2.7 (-8.1 to 0.9)	13.5 (9.1 to 18.9)
Event No.	709 (27.1)	1045 (36.7)	160 (21.9)	264 (31.7)
Event rate (95% CI)[a]	12.0 (11.2-12.9)	16.9 (15.9-17.9)	9.2 (7.8-10.7)	16.4 (14.5-18.5)
Hazard ratio (95% CI)				
Model 1[b]	Reference	1.45 (1.31-1.60)	Reference	1.70 (1.39-2.08)
Model 2[c]	Reference	1.22 (1.10-1.35)	Reference	1.34 (1.08-1.67)
ECG age gap cut off of 15 years	4231	1235	1209	355
ECG age gap	2.0 (-5.7 to 8.2)	21.2 (17.8 to 25.7)	2.3 (-4.4 to 8.6)	20.1 (17.1 to 24.3)
Event No.	1257 (29.7)	497 (40.2)	297 (24.6)	127 (35.8)
Event rate (95% CI)[a]	13.2 (12.5-14.0)	19.3 (17.6-21.0)	10.9 (9.7-12.3)	19.8 (16.5-23.6)
Hazard ratio (95% CI)				
Model 1[b]	Reference	1.54 (1.38-1.72)	Reference	1.72 (1.39-2.14)
Model 2[c]	Reference	1.25 (1.11-1.41)	Reference	1.36 (1.08-1.73)

Supplementary Table 2 shows the risk of AF recurrence in the aged-ECG compared with normal ECG age group using different cut-off values. Regardless of AI-ECG age gap cut-off, aged-ECG was associated with increased risk of AF recurrence compared to the normal ECG age group.

CI, confidence interval; HR, hazard ratio. Other abbreviations are the same as in Table 2.

[a]Event rate per 100 person-years.

[b]Model 1 was adjusted for chronological age and sex.

[c]Model 2 was adjusted for AF type, age, sex, body mass index, hypertension, diabetes, vascular disease, heart failure, LA diameter, E/e', and LV ejection fraction.

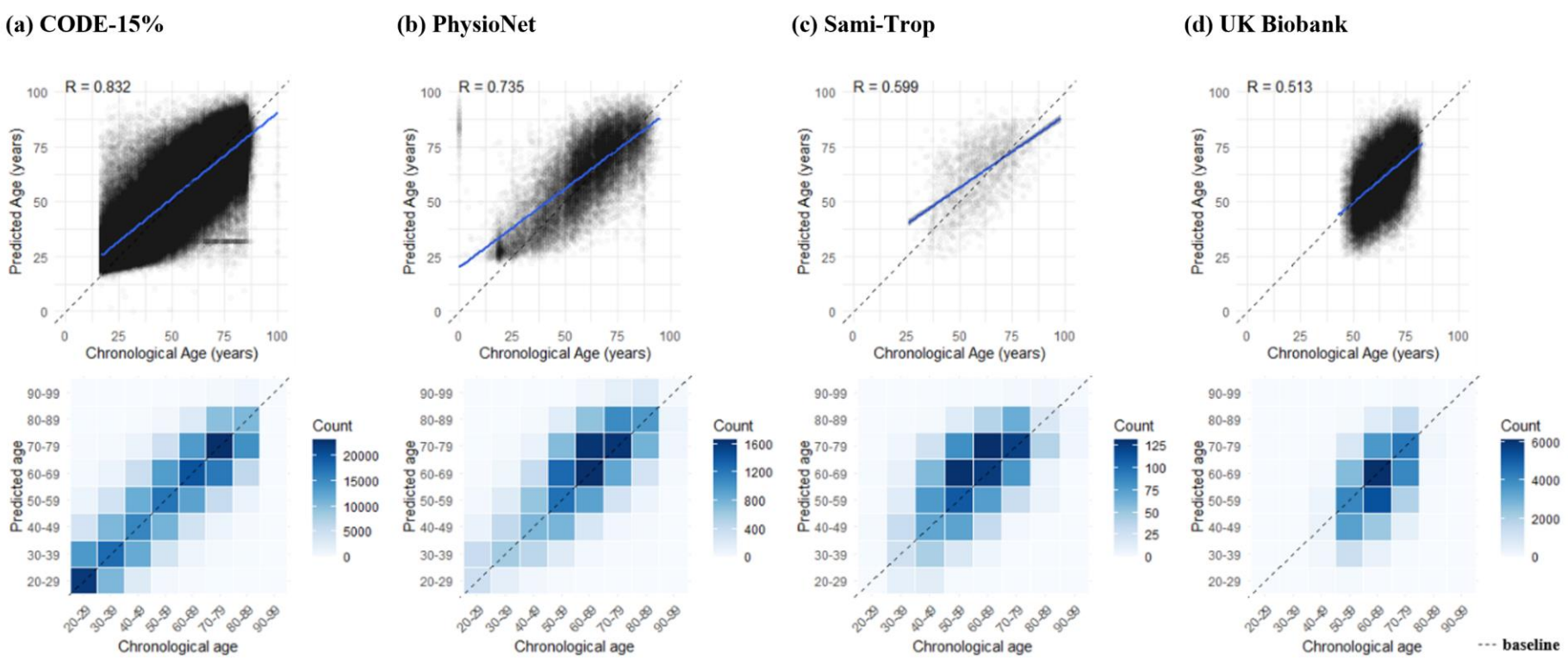
Supplementary Table 3. Harrell's C-index when AI-ECG age gap was added to clinical risk in the YUHS discovery and KUAH evaluation cohorts.

	YUHS discovery cohort (n=5,466)		**KUAH evaluation cohort (n=1,564)**	
	C-index (95% CI)	C-index change (95% CI)	C-index (95% CI)	C-index change (95% CI)
Model				
AI-ECG age gap	0.653 (0.640 to 0.668)		0.683 (0.654 to 0.712)	
APPLE score	0.577 (0.563 to 0.590)		0.614 (0.587 to 0.641)	
APPLE score + AI-ECG age gap	0.662 (0.649 to 0.675)	0.085 (0.072 to 0.098)	0.700 (0.674 to 0.727)	0.086 (0.057 to 0.110)
Clinical risk model	0.636 (0.624 to 0.648)		0.658 (0.629 to 0.686)	
Clinical risk model + AI-ECG age gap	0.677 (0.664 to 0.690)	0.041 (0.034 to 0.047)	0.715 (0.688 to 0.742)	0.057 (0.039 to 0.087)

Supplementary Table 3 shows the Harrell's C-index for risk of AF recurrence of the AI-ECG age gap and the added value of AI-ECG age gap beyond established clinical risk scores or clinical risk factors. The APPLE score is calculated by adding each one point for the following criteria (<65 years, persistent AF, impaired estimated glomerular filtration rate <60 ml/min/1.73m^2, left atrial diameter ≥43mm, left ventricular ejection fraction <50%). The clinical risk model was adjusted for AF type, age, sex, body mass index, hypertension, diabetes, vascular disease, heart failure, LA diameter, E/e', and LV ejection fraction.

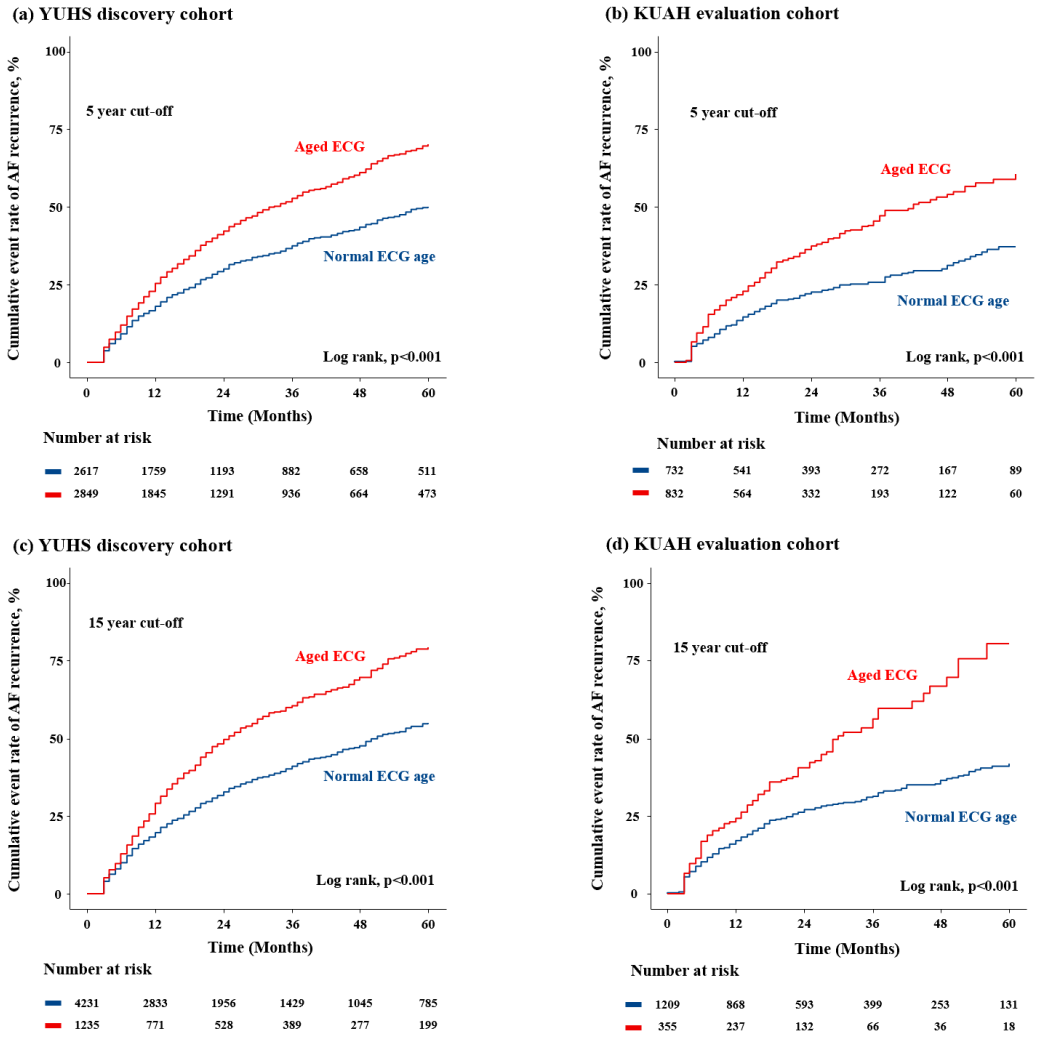
Other abbreviations are the same as in Table 2.

Supplementary Figure 1. Correlation between predicted AI-ECG age and chronological age using scatter plots and confusion matrices in the model validation cohorts.



Supplementary Figure 1 shows the scatter plots and confusion matrices of the AI-ECG age prediction model in the four model validation cohorts; (a) CODE-15%, (b) PhysioNet, (c) Sami-Trop, and (d) UK Biobank. R is the pearson correlation between the chronological age and predicted AI-ECG age.

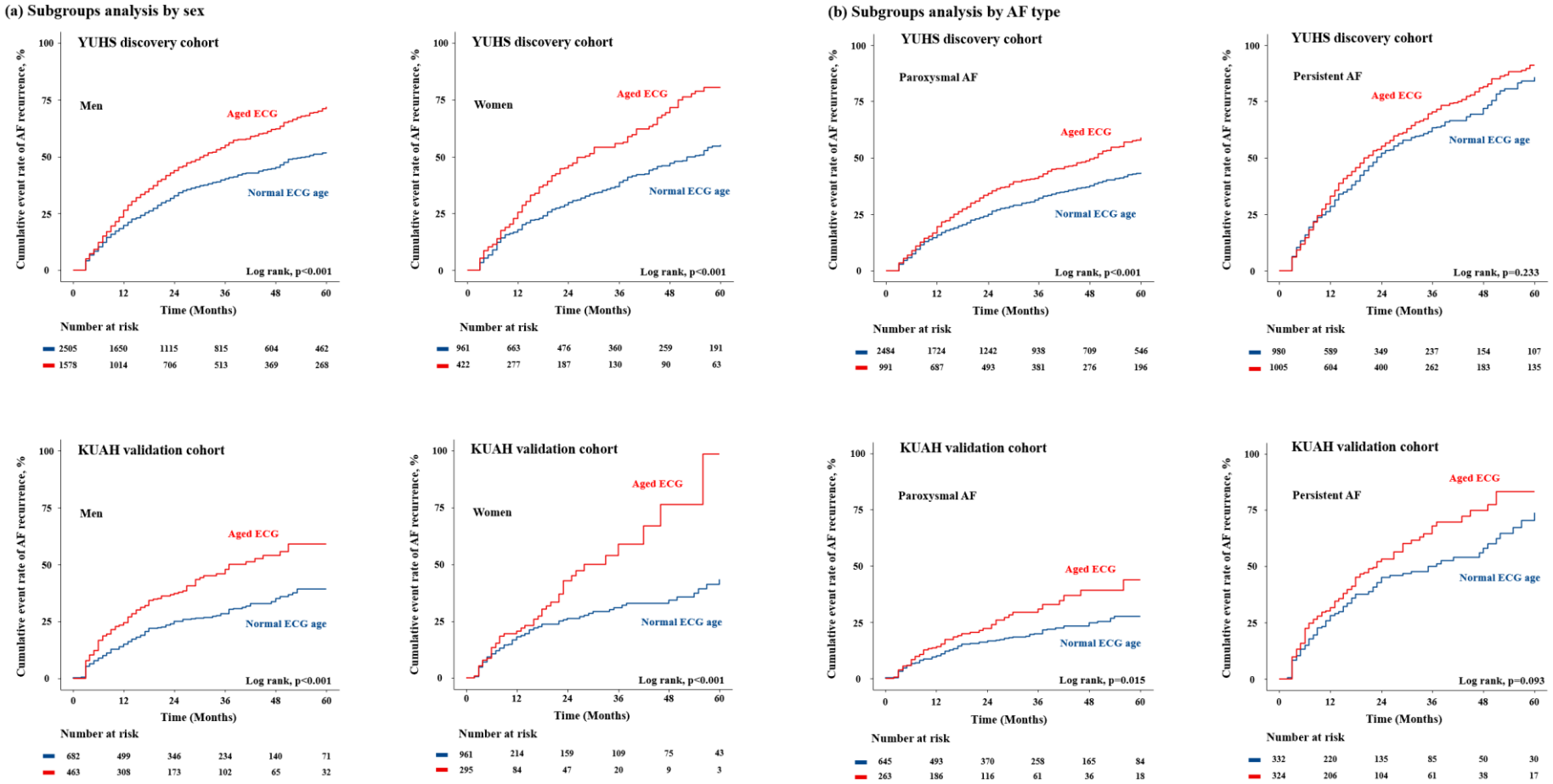
Supplementary Figure 2. 5-year cumulative event rate of AF recurrence stratified by AI-ECG age gap using different cut-off thresholds in the YUHS discovery and KUAH evaluation cohorts.



Supplementary Figure 2 shows the 5-year cumulative event rate of AF recurrence in the aged-ECG compared with normal ECG age group using different cut-off values. Regardless of AI-ECG age gap cut-off, the 5-year cumulative event rate of AF recurrence was greater in the aged-ECG compared to the normal ECG age group.

Abbreviations are the same as in Table 2.

Supplementary Figure 3. 5-year cumulative event rate of AF recurrence stratified by AI-ECG age gap and (a) sex and (b) AF type in the YUHS discovery and KUAH evaluation cohorts.

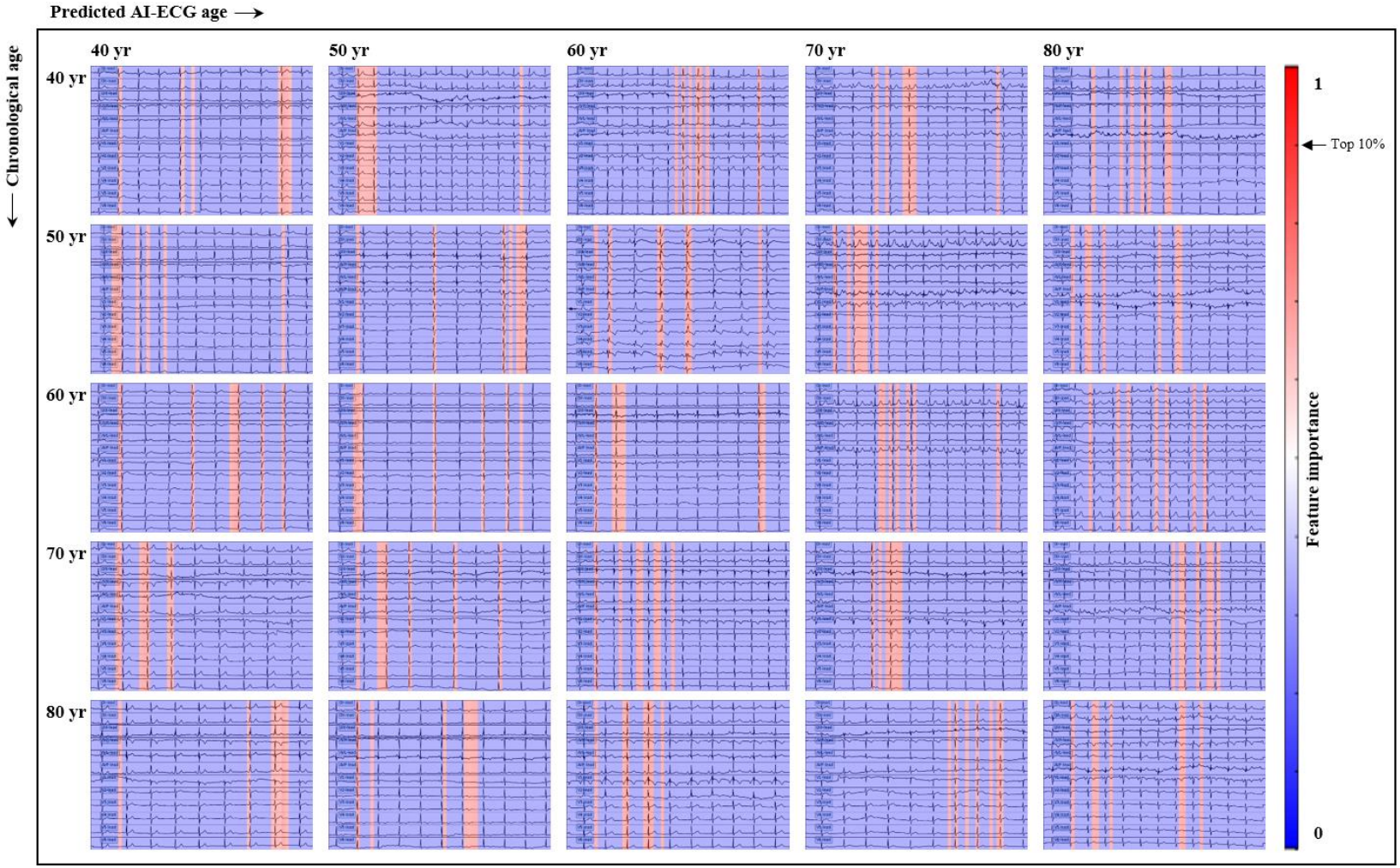


Supplementary Figure 3 shows the 5-year cumulative event rate of AF recurrence in the aged-ECG compared with normal ECG age group stratified by (a)

sex and (b) AF type. Regardless of sex, the 5-year cumulative event rate of AF recurrence was greater in the aged-ECG compared to normal ECG age group. In contrast, the 5-year cumulative event rate of AF recurrence was significantly greater in the aged-ECG group among participants with paroxysmal AF whereas not among those with persistent AF.

Abbreviations are the same as in Table 2.

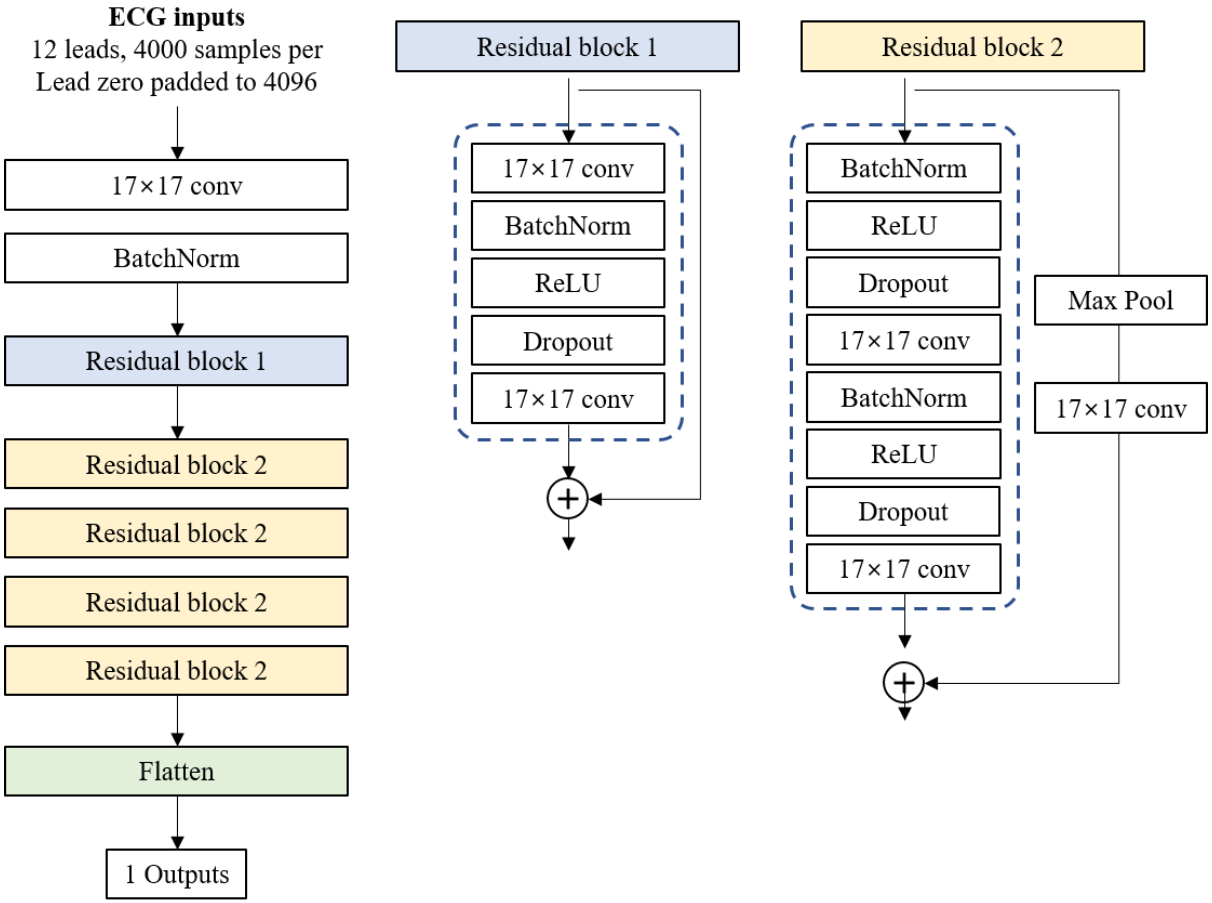
Supplementary Figure 4. Grad-CAM visualization of the ECG feature importance of the AI-ECG age prediction model (focusing on the top 10% percentile).



Supplementary Figure 4 shows the Grad-CAM feature importance stratified by chronological age and predicted AI-ECG age. There was no recognizable pattern evaluated by cardiologists.

Grad-CAM; Gradient-Weighted Class Activation Mapping. Other abbreviations are the same as in Table 2.

Supplementary Figure 5. Residual network (ResNet)-based ECG age prediction model architecture.



Supplementary Figure 5 graphically shows the ResNet-based ECG age prediction model architecture. The ResNet-based model architecture included residual blocks composed of 1D convolutional layers, each followed by batch normalization, ReLU activation, and dropout layers.

ReLU; rectified linear unit.