이화여자대학교
EWHA WOMANS UNIVERSITY

Current Status of Artificial Intelligence in Cardiology
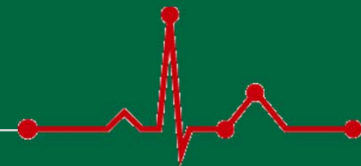
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Ewha Womans University Medical Center, Seoul, Korea

TOGETHER.
TOMORROW.
EWHA

KHRS 2021
The 13th Annual Scientific Session
of the Korean Heart Rhythm Society

Korean Heart Rhythm Society
COI Disclosure

Name of First Author: Junbeom Park

The authors have no financial conflicts of interest
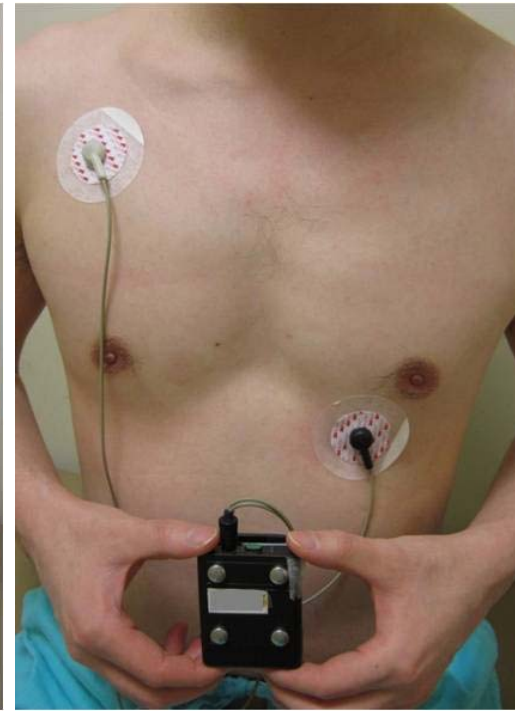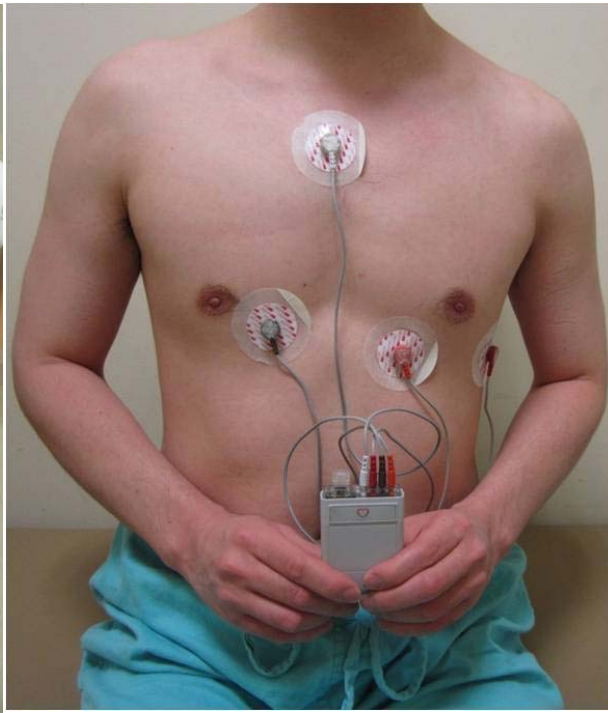
to disclose concerning the presentation

Agenda

1 . Unmet need of Smart Health Care in Cardiology

2 . Standardization of data

3 . De-identification of data

4 . Fusion of Different type of data

5 . Co-work with AI tech, Medical field and Industry
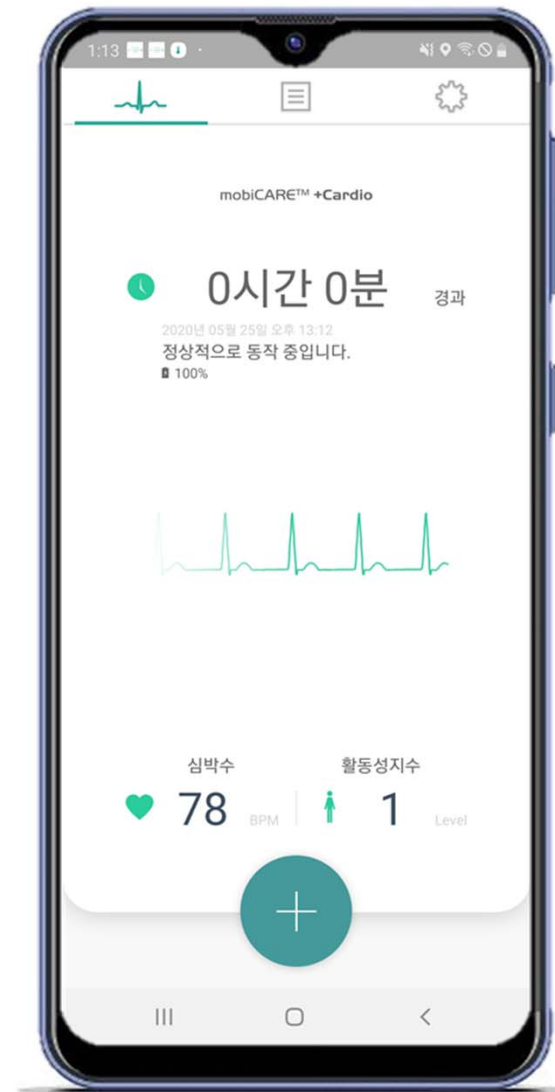
Current ECG detection methods

Current ECG detection methods
☞ ECG, HOLTER, implantable Loop recorder

mobiCARE™ +Cardio 의 모바일 앱은 현재 홀터 검사에서 수행하는 심전도 일지를 기반으로 제작되었습니다.

- 의료진이 부여한 코드의 입력을 통해 활성화
- 패치 부착상태, 배터리 잔량, 블루투스 연결성 확인
- 상태 경고 기능 : 부착 불량, 블루투스 연결 해제
- 패치 연결 끊김 후 자동 연결 복원
- 측정 경과 시간 리뷰
- 실시간 심전도, 심박, 활동량 리뷰
- 심전도 일지를 통해 증상 기록
- 측정 완료 후 서버로 전송

mobiCARE™ +Cardio

0시간 0분 경과

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🔋 100%

심박수 78 BPM   활동성지수 1 Level

Screening for atrial fibrillation

2020 ESC AF Guidline[1]

• Definition and diagnosis of atrialfibrillation

| Recommendations	Class[a]	Level[b]
ECG documentation is required to establish the diagnosis of AF. • 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

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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] • 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 clinical evaluation to confirm the diagnosis of AF and provide optimal management of patients with confirmed AF. • Definite diagnosis of AF in screen-positive cases is established only after physician reviews the single-lead ECG recording of ≥30 s or 12-lead ECG and confirms that it shows AF.	I	B
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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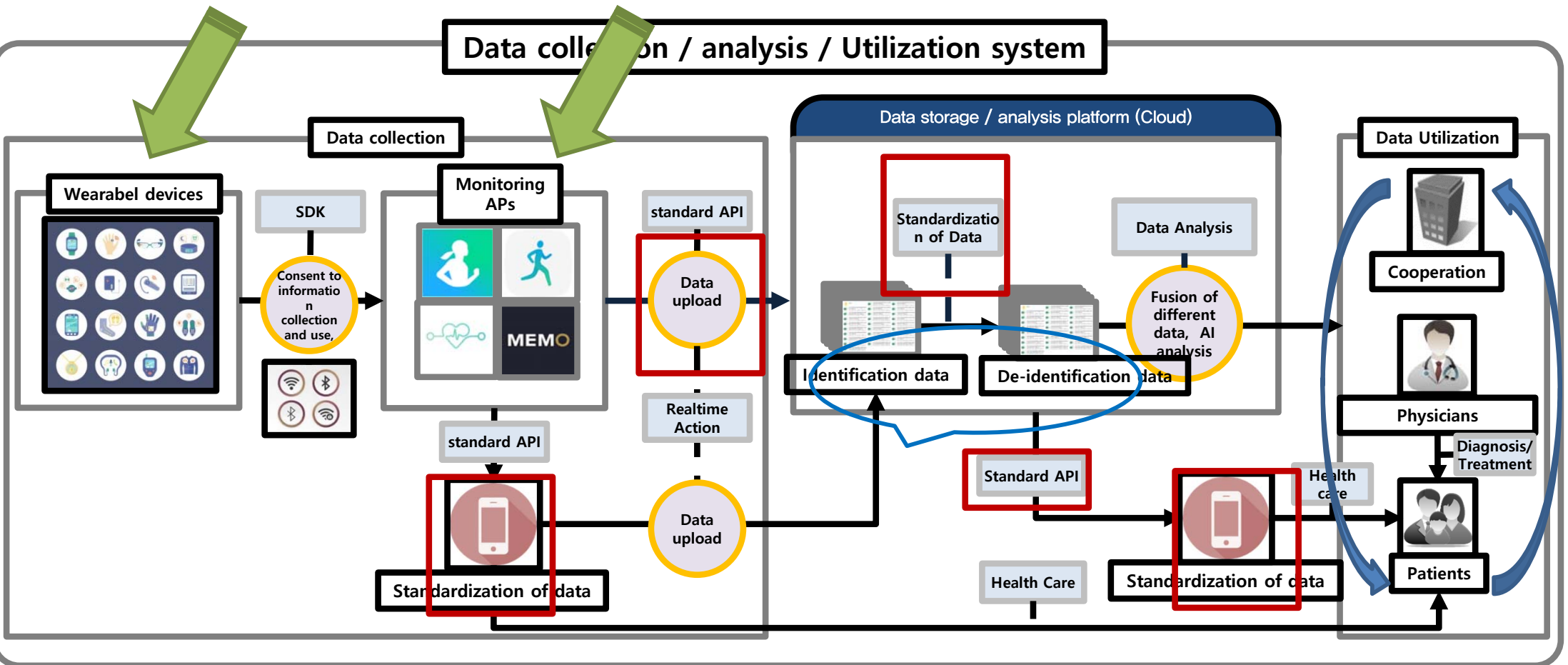Ref.> 1. Hindricks G, et al. *Eur Heart J.* 2020;ehaa612.

- Watch : Apple, Samsung, Fitbit, Verily
- Ring : Oura, Motiv, Sleepon, Circular, Viatom
- Patch : Medtronic, VitalConnect, iRhythm, Bardy, Sensium, Isansys, Bio Telemetry, BioBeat, CardioCore, LifeSignals, Ezecg, etc
- Portable Devices : Eko, AliveCor

In Korea,
SEERS, Huino, ATSense, Mezoo, Skylabs, Wellysis, Healthrian·······
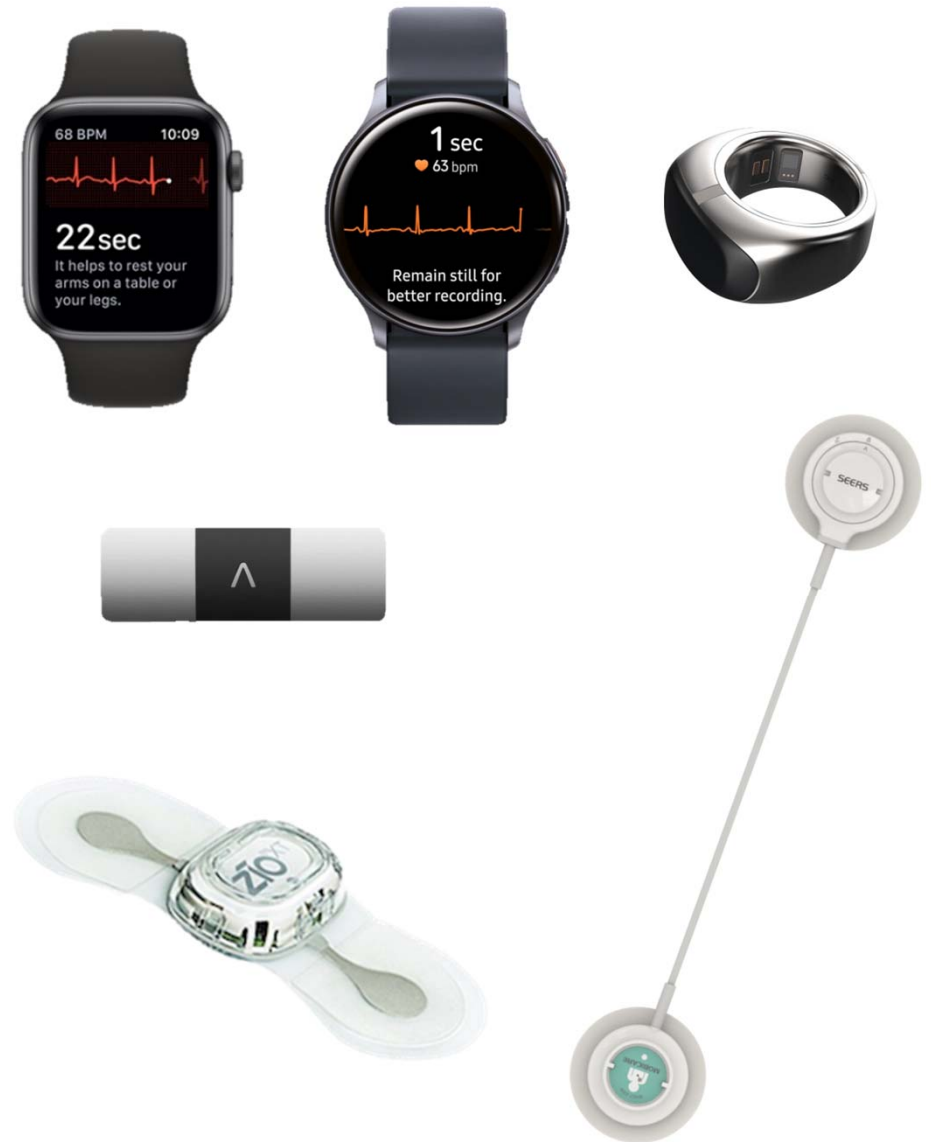
Various Data collection / analysis / Utilization system

Data collection / analysis / Utilization system

Data collection

Wearabel devices

SDK

Consent to information collection and use,

Monitoring APs

standard API

Data upload

Realtime Action

standard API

Data upload

Standardization of data

Data storage / analysis platform (Cloud)

Standardization of Data

Data Analysis

Identification data

De-identification data

Fusion of different data, AI analysis

Standard API

Health Care

Standardization of data

Health care

Data Utilization

Cooperation

Physicians

Diagnosis/ Treatment

Patients

1) Standardization of data

- **The types of data collected through each wearable device are different.**
- **Standardized units, forms, and input methods for each data are required.**

신장	20160226	144400	Y	7
체중	20160226	144400	Y	8
비만도	20160226	144400	Y	13
수축기혈압	20160226	144400	Y	14
이완기혈압	20160226	144400	Y	15
허리둘레	20160226	144400	Y	10
체질량지수	20160226	144400	Y	9
체지방률	20160226	144400	Y	11
복부지방률	20160226	144400	Y	12
초음파(질)	20160226	144400	Y	188
CT(폐-조영	20160226	144400	Y	191
CT(폐-조영	20160226	144400	Y	192
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초음파>복	20160226	144400	Y	197
초음파>유	20160226	144400	Y	200
초음파>갑	20160226	144400	Y	195
초음파>경	20160226	144400	Y	196

신장-cm	20170116	162350	Y	4
체중(kg)	20170116	162350	Y	5
비만도(%)	20170116	162350	Y	6
체지방율(9	20170116	162350	Y	7
허리둘레(c	20170116	162350	Y	8
산소포화도	20170116	162350	Y	9
체질량지수	20170116	162350	Y	10
근육량(kg)	20170116	162350	Y	11
골격근(kg)	20170116	162350	Y	12
혈압(mmH	20170116	162350	Y	13
맥박(회/분	20170116	162350	Y	14
연속혈압측	20170116	162350	Y	15
연속혈압측	20170116	162350	Y	16
≥135 mml	20170116	162350	Y	17
≥ 85 mmł	20170116	162350	Y	18
연속혈압측	20170116	162350	Y	19
≥ 120 mm	20170116	162350	Y	20
≥ 75 mmł	20170116	162350	Y	21

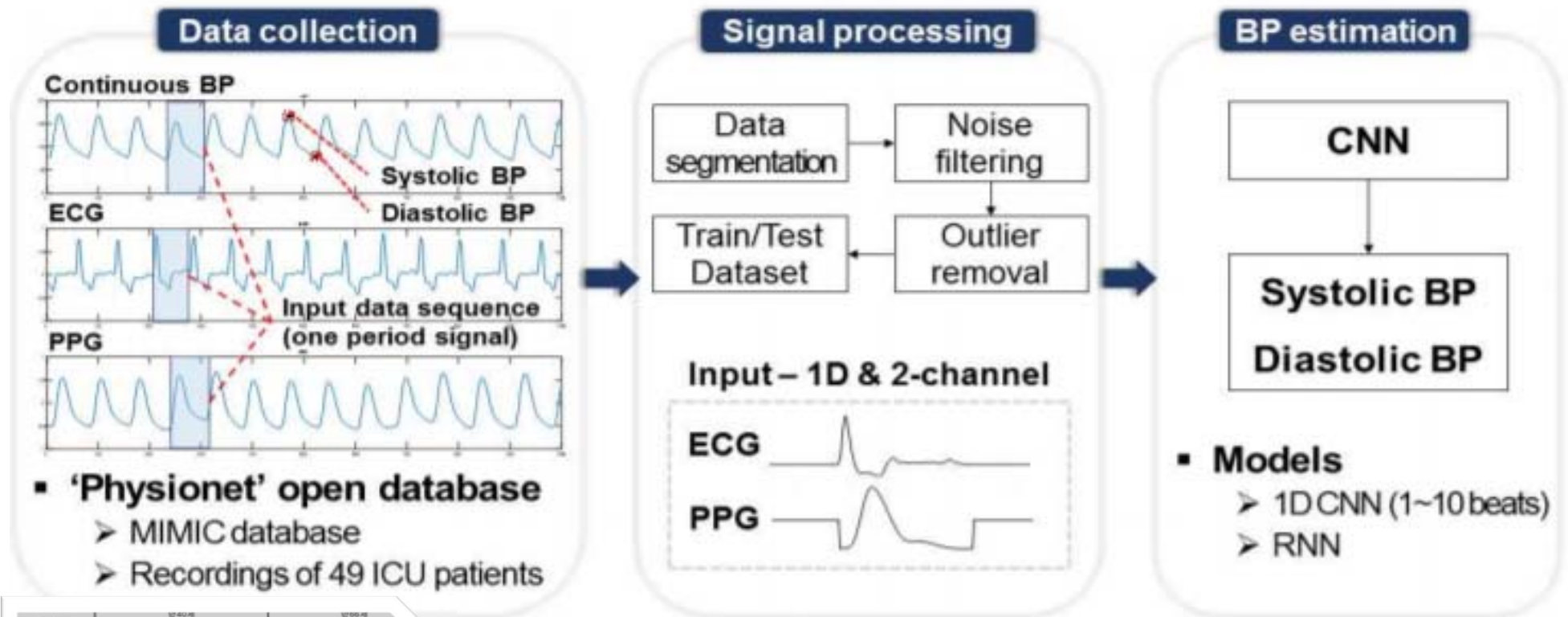|		
키	20170216	180438
몸무게	20170216	180438
체질량지수	20170216	180438
표준체중	20170216	180438
허리둘레	20170216	180438
엉덩이둘레	20170216	180438
근육량	20170216	180438
체지방량	20170216	180438
혈압(수축기)	20170216	180438
혈압(이완기)	20170216	180438
심박수	20170216	180438
시력(우)	20170216	180438
교정시력(우)	20170216	180438
시력(좌)	20170216	180438
교정시력(좌)	20170216	180438
안압(우)	20170216	180438
안압(좌)	20170216	180438
안저촬영(우)	20170216	180438
안저촬영(좌)	20170216	180438
청력검사(양안)	20170216	180438
청력검사(우)	20170216	180438
청력검사(좌)	20170216	180438
백혈구(WBC)	20170216	180438
적혈구(RBC)	20170216	180438
혈색소(Hb)	20170216	180438

2) De-identification of data

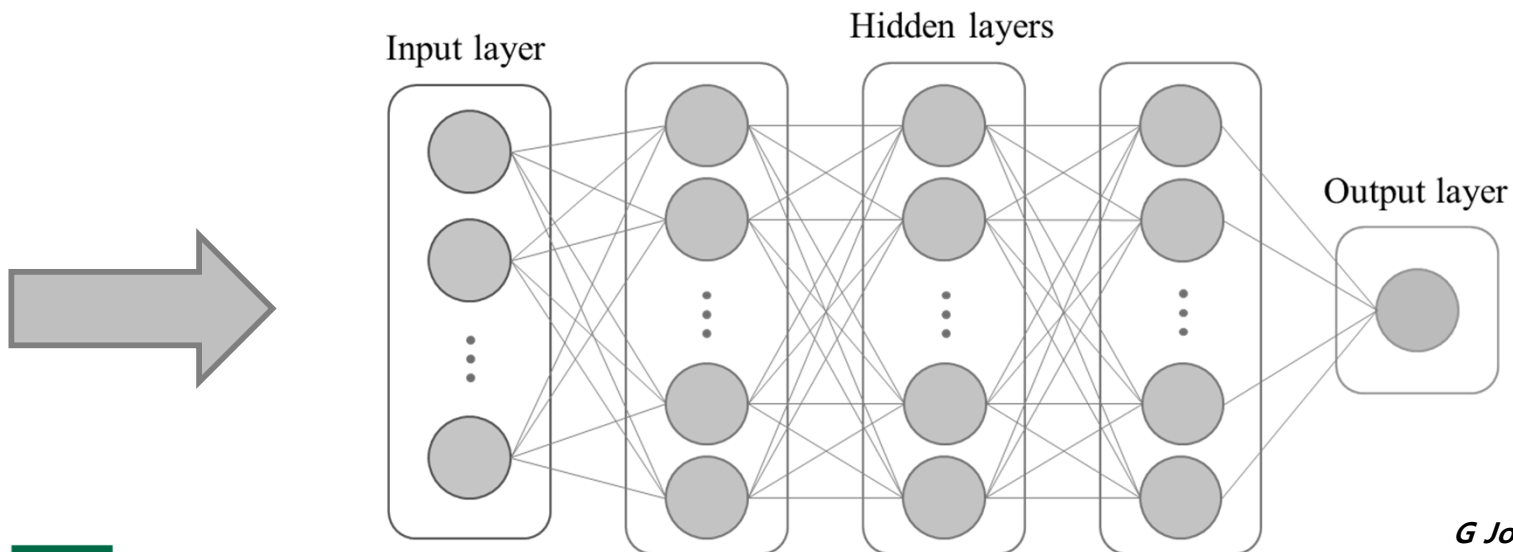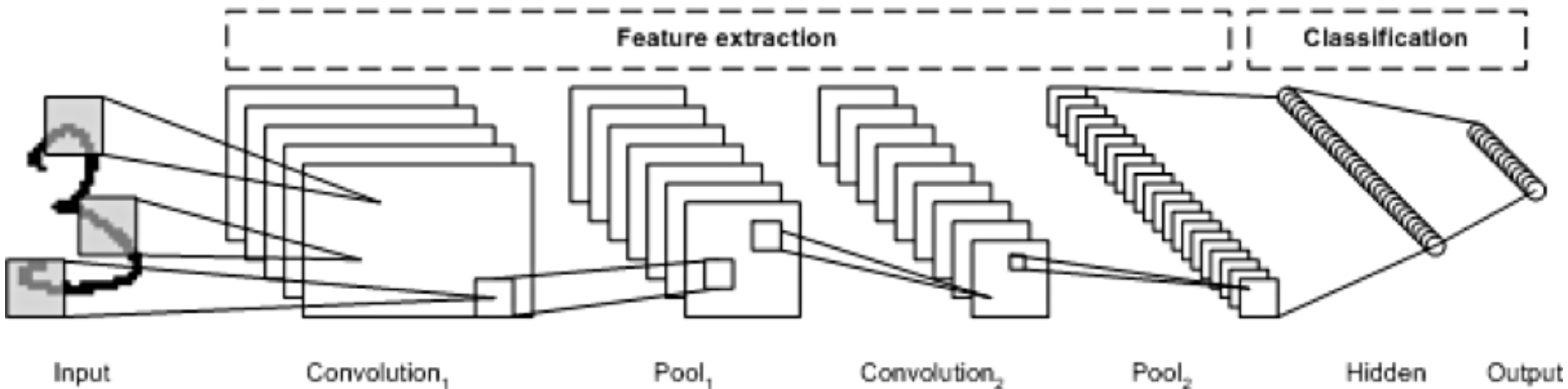- **It is necessary to establish a standardized database capable of storing de-identified biosignal data.**

이주성(2002), XML 기반의 데이터 표준화를 위한 생체 신호 통합관리 시스템에 관한 연구
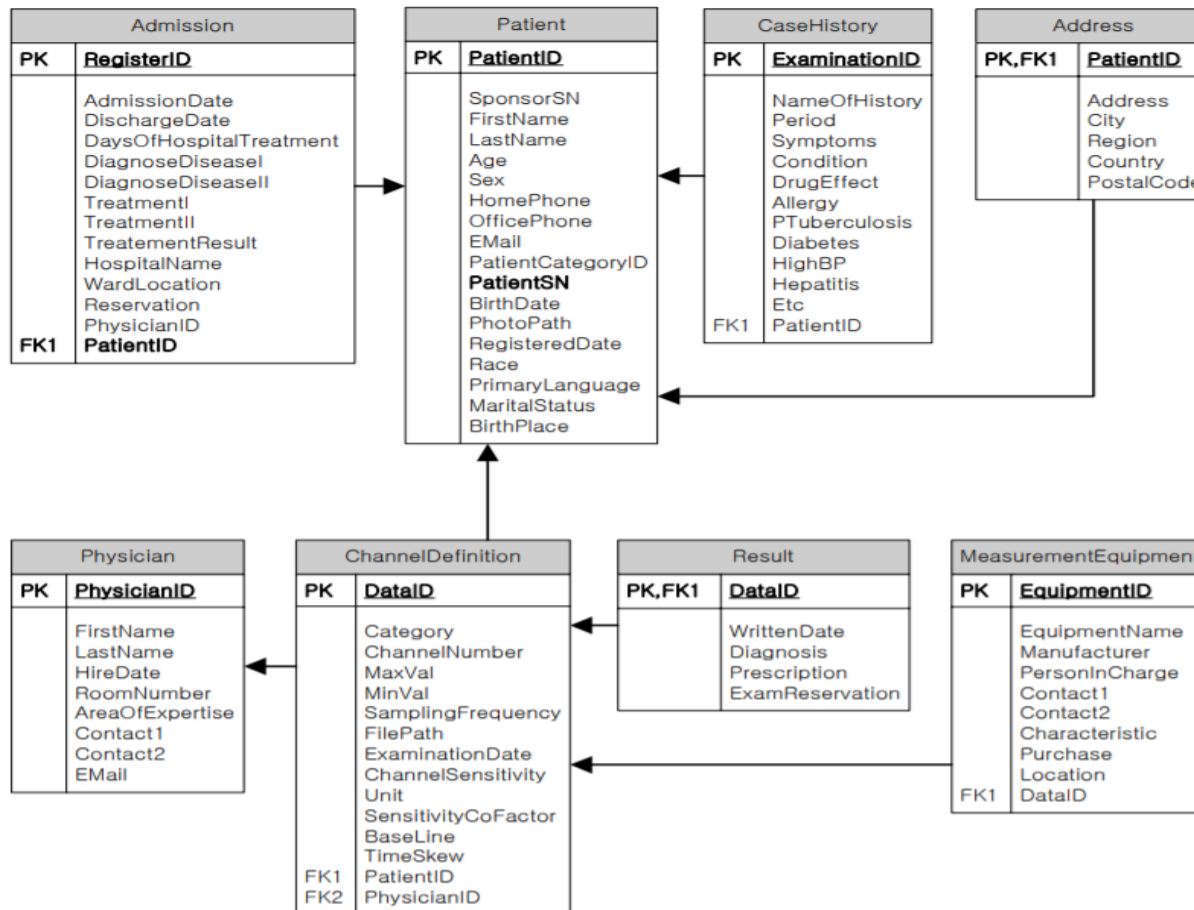
3) Fusion of Different type of data

- **Analyze de-identified standardized biosignal data using artificial intelligence algorithms**

조진우, 최아영 (2020), 휴대용 및 웨어러블 측정기를 위한 ECG 와 PPG 신호를 활용한 합성곱 알고리듬 기반의 비가압식 혈압 추정 방법
SS Kim, JB Park,. European Society Cardiology (ESC) 2018. Poster presentation

3) Fusion of Different type of data

Input   Convolution$_1$ Pool$_1$ Convolution$_2$ Pool$_2$ Hidden   Output

Feature extraction   Classification

Input layer   Hidden layers   Output layer

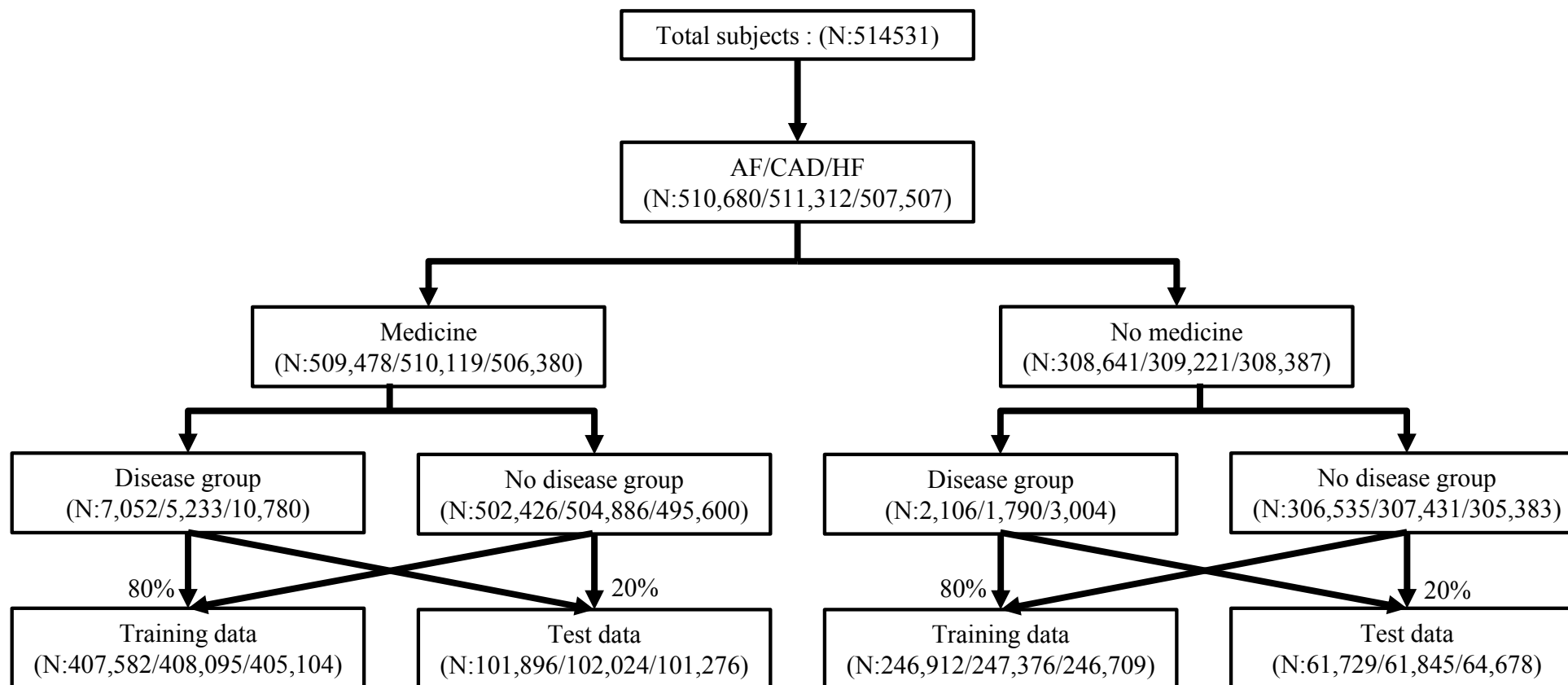*G Joo, JB Park,. In Press IEEE Access 2020*

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FIGURE 1. Study population and data extraction procedures. The analysis cohort was divided into disease and no disease groups, which were then divided into training and test sets. The training set was used to build a prediction model and the test set was used to validate the model.
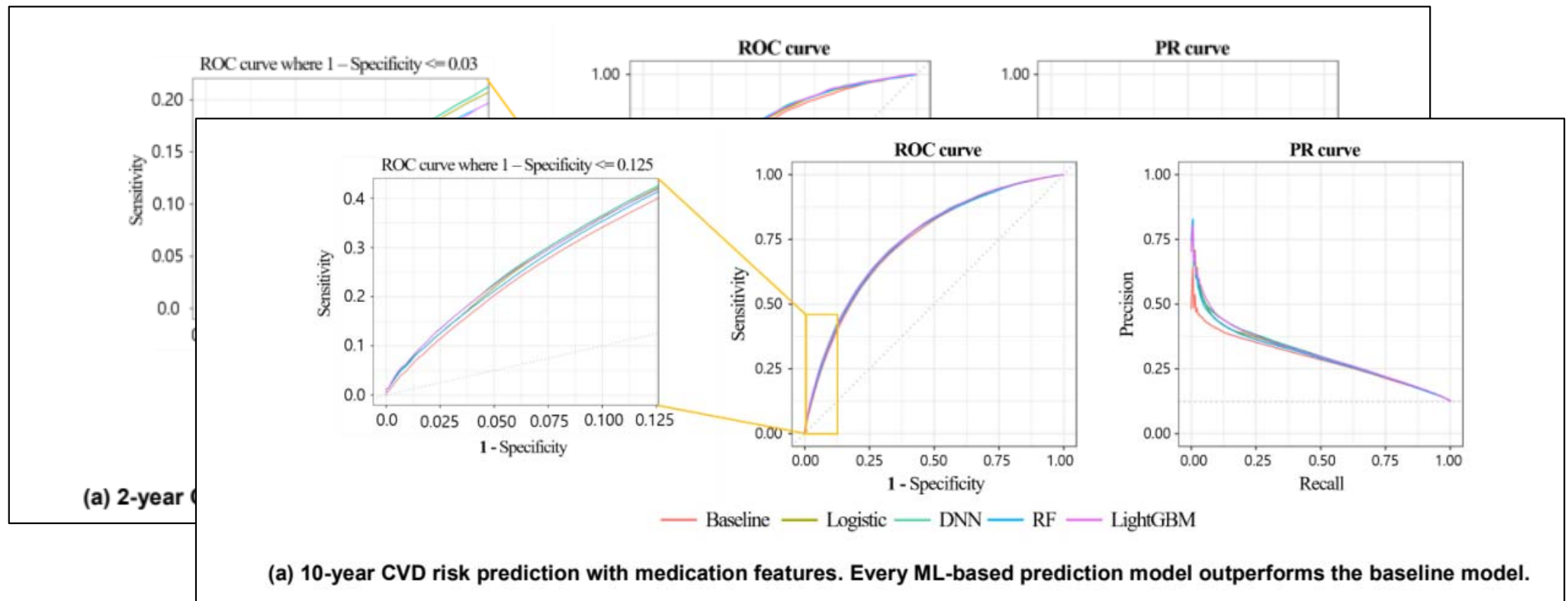
(a) 10-year CVD risk prediction with medication features. Every ML-based prediction model outperforms the baseline model.

Can artificial Intelligence Prediction Algorithms Exceed Statistical Predictions?

Editorial

Check for updates

Can artificial Intelligence Prediction Algorithms Exceed Statistical Predictions?

- **Development of artificial intelligence model using heterogeneous* medical data based on artificial intelligence technology***

- **It means the convergence of different medical data.**

- Therefore, although there is the advantage that the prediction error is less and the accuracy is higher than that of previous statistical models, when new diseases occur, the predictive power is reduced to a great extent.

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Clinical Data + ECG + Cardiac MRI (images) + etc,.
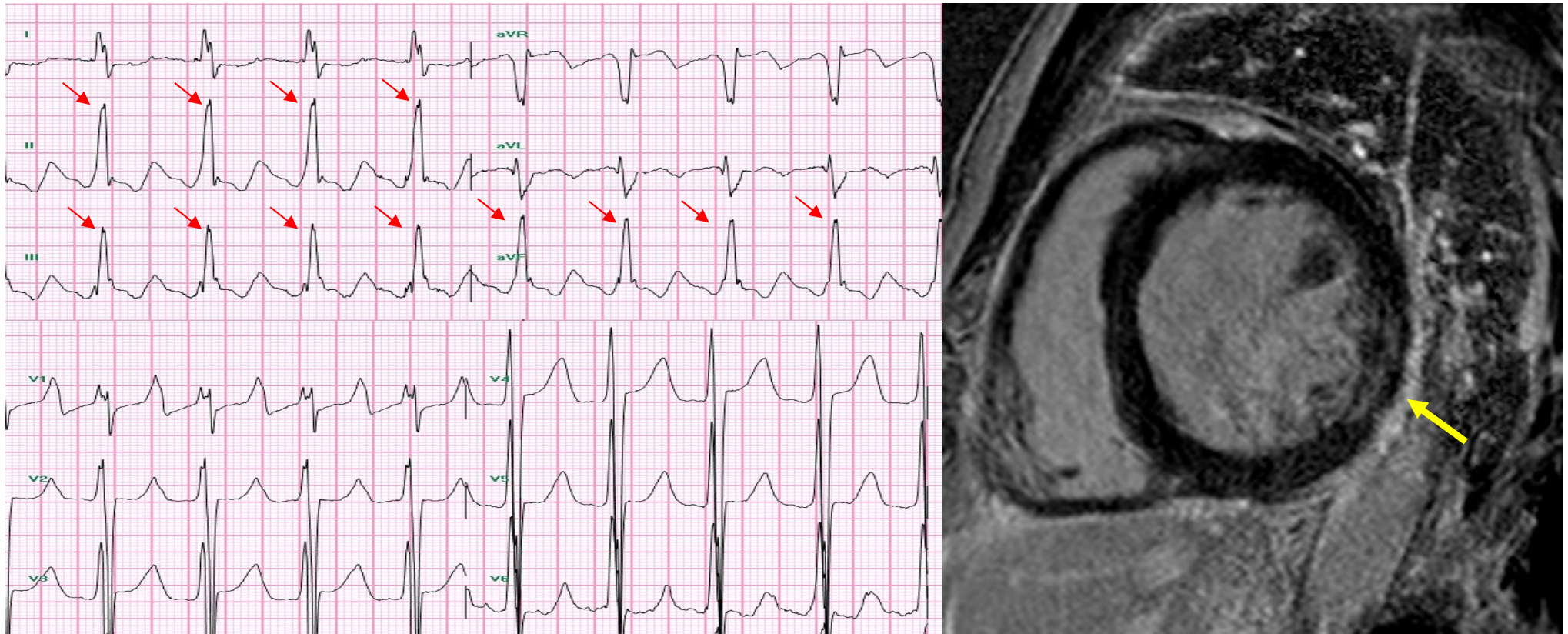
Age, Sex, HTN, Diabetes, Non-Ischemic Cardiomyopathy + Ejection fraction, LV chamber size

Figure. The inferior fragmented QRS(fQRS) was associated with late gadolinium enhancement(LGE) in non-ischemic cardiomyopathy(NICM) patients. Examples of patients with LGE / inferior fQRS

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4) Co-work with AI tech, Medical field and Industry

구분	업체명*	측정데이터	주요 기술 및 서비스	비고
1	휴이노			
2	대웅제약 씨어스			
3	헬스리안			
4	얼라이브코어			
5	마젤원			
6	메디코넥스			
7	올비			
8	피에스 솔루션			
9	초이스테크놀로지			
10	휴레브			
11	스마디			
12	참케어			

* 삼성, LG 등 대기업 제외 ※ 출처: 제안기관 연구진 자[...]

업체	대표	주요 기술 및 서비스	비고
이와이어라이너 주식회사	전윤식	• 브라켓 없는 치아교정장치 개발	602호
㈜스키아	이종명	• 의료영상데이터 기반 증강현실 솔루션 개발	603호
셀미트 주식회사	박길준	• 근육줄기세포를 이용한 배양육 개발 스타트업	605,608-1호
미라셀㈜	신현순	• 줄기세포 전문기업, 줄기세포 분리장치 국산화 개발	606호
바스테라 주식회사	강상원	• 혈관질환을 표적으로 하는 혁신치료제 신약개발	607호
주식회사 넥시온바이텍	서정택,김성욱	• Cholesterol sulfate 조절법 치료제 개발을 통한 골질환 치료제 개발	608-2호
㈜아이큐어비앤피	최영권	• 골다공증, 비만, 당뇨에 대한 펩타이드 약물개발	609호
시너지에이아이 주식회사	신태영	• 세계최초 인공지능 부피측정 플랫폼 개발 스타트업	702호
㈜뉴로소나	서선일	• 비침습적 뇌질환 치료 목적 저강도집속초음파 자극기 개발	703호
㈜마이체크업	이향구	• PHR기반 모바일 헬스케어 및 의료 빅데이터 플랫폼 개발	704, 706호
이원다이애그노믹스(EDGC)	이민섭,신상철	• 유전체분석 전문, 코스닥 상장기업	708,709호
㈜메디헬프라인	박옥남	• 인허가 컨설팅 및 임상시험수탁기관 전문 기업	지하1층

Summaries

- Should make a sustainable wearable healthcare data collection pipeline

- The development of an integrated platform for collecting, storing, and analyzing wearable healthcare data (Standardization)

- Should make new research and development projects based on real medical field (Not just research)

- Network formation of wearable healthcare manufacturing and service companies, and Academic institution (Co-Work)