Digital Health Care
- Wearables, Mobile Applications

Yoo Ri Kim

Associate professor of Cardiology, Department of Internal Medicine,
Chonnam National University, College of Medicine, Gwangju,
South Korea

Korean Heart Rhythm Society
Disclosure

Yoo Ri Kim:

The author is

a consultant of InterMD (Mobile app) company, Monster-Zym (Fitness)
and an advisor of Digital Healthcare Partners (Venture Capital).
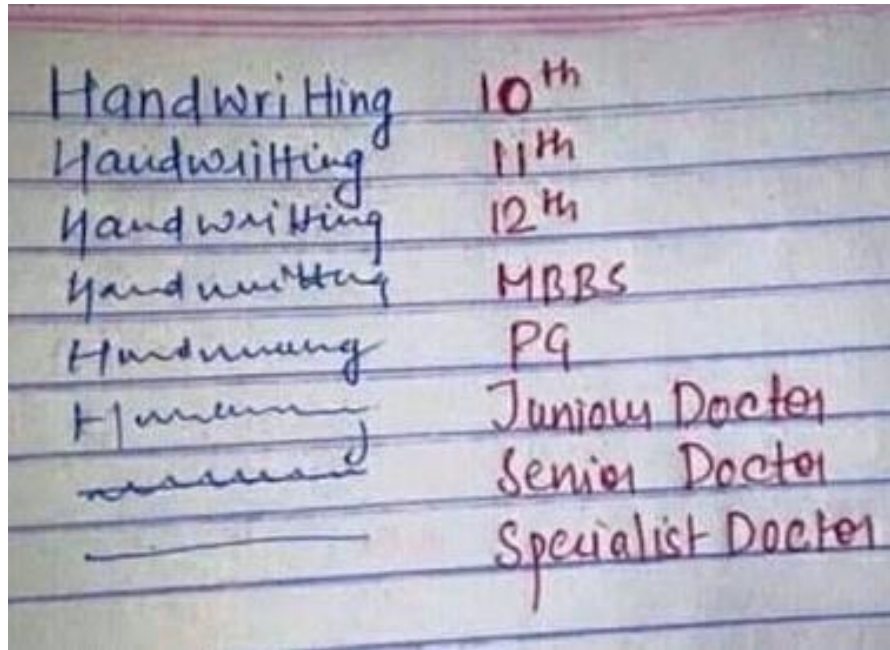
Contents

- What is Digital health?

- Mobile healthcare
  = Mobile applications (Technology for connectivity)

            +

    Wearables (Consumer technology)

        → Digital therapeutics (leveraging technology)
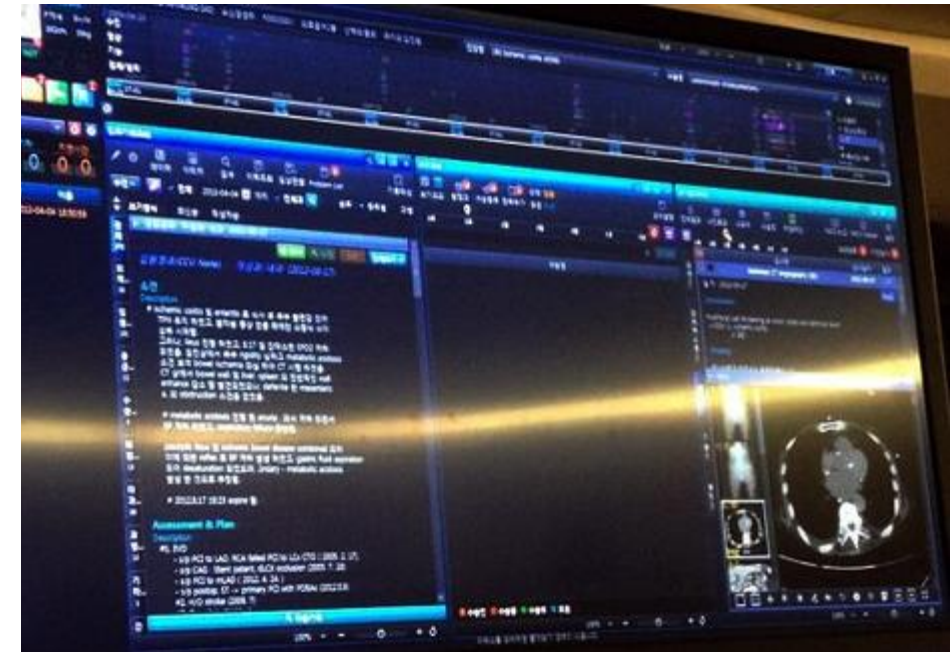
What is Digital?

ANALOG
- Data represented by continuous variables

DIGITAL
- Data represented by 0's and 1's

Handwriting medical records
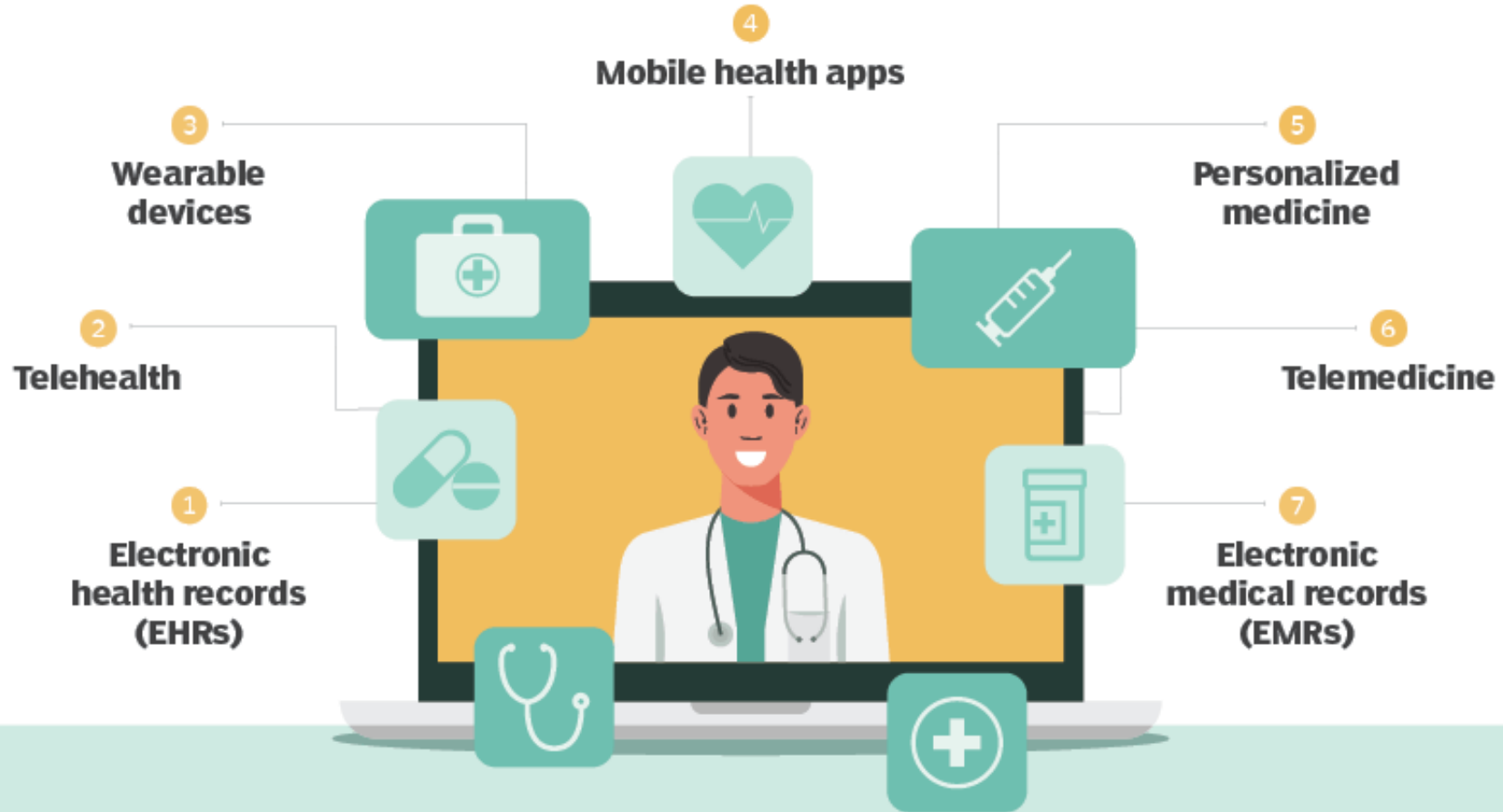
Electronic medical record

What Exactly is Digital Health(care)?

- Health care - two words - refers to provider actions.
- Healthcare - one word - is a system

- **Digital health**
  ① the use of digital information, data, and communication technologies
  ② to collect, share, and analyze health information
  ③ to improve patient health, education, and health care delivery
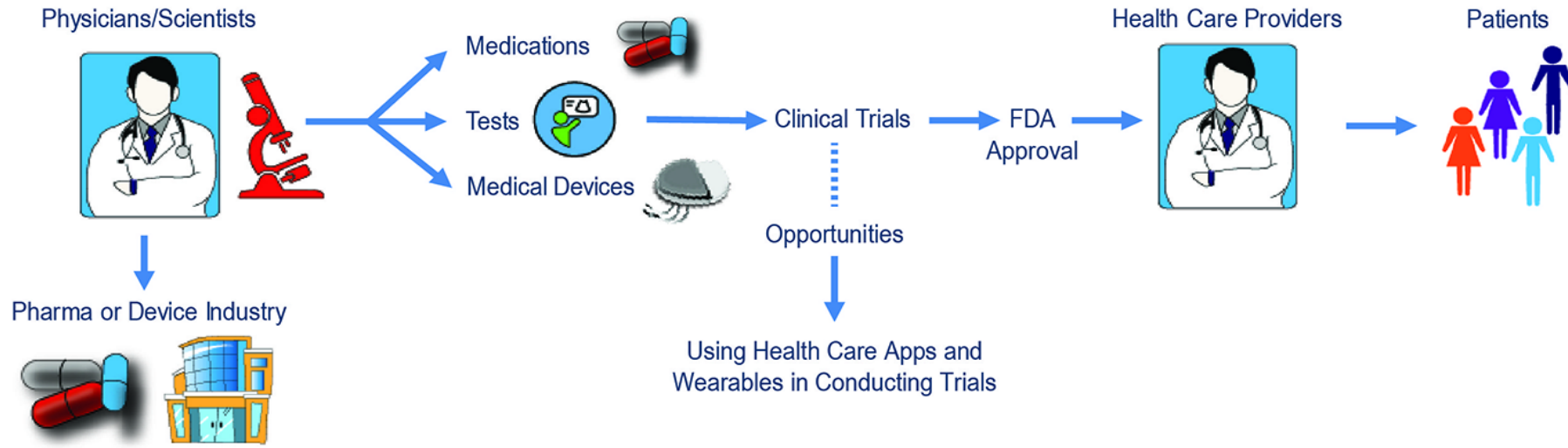
Mobile Health = Apps + Wearables

Medical Innovation in the Era of Digital Health
Traditional Model

Physicians/Scientists

Medications
Tests
Medical Devices

Pharma or Device Industry

Clinical Trials → FDA Approval → Health Care Providers → Patients

Opportunities

Using Health Care Apps and Wearables in Conducting Trials

Direct to Consumer Products

Tech Industry/Entrepreneurs

Health Care Apps
Wearables

+/- Small Studies → +/- FDA Clearance → Patients/Consumers → Physicians

Opportunities

Larger Clinical Trials and Innovative Studies
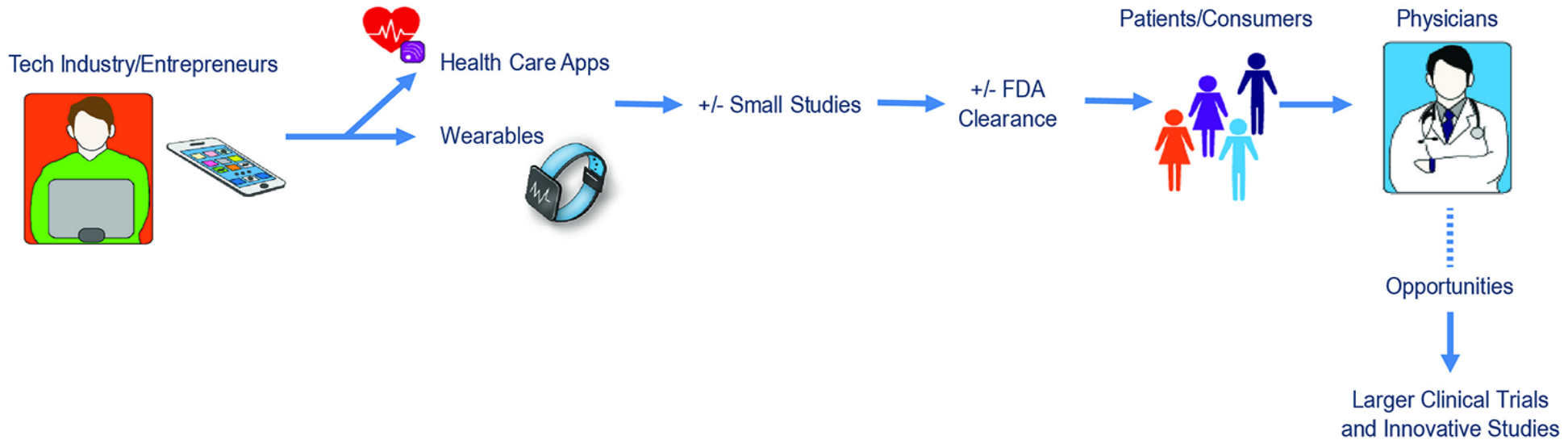
Digital Health apps

Number of digital health Apps
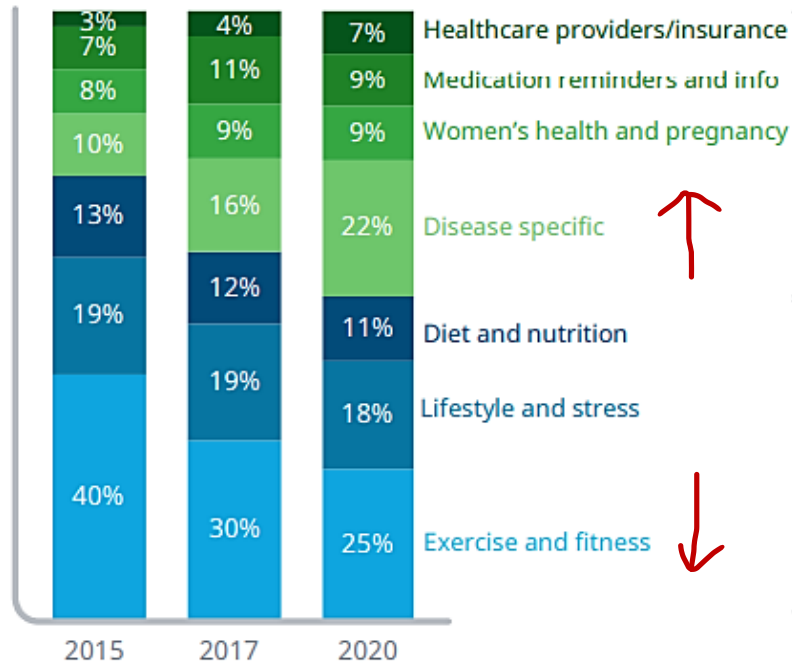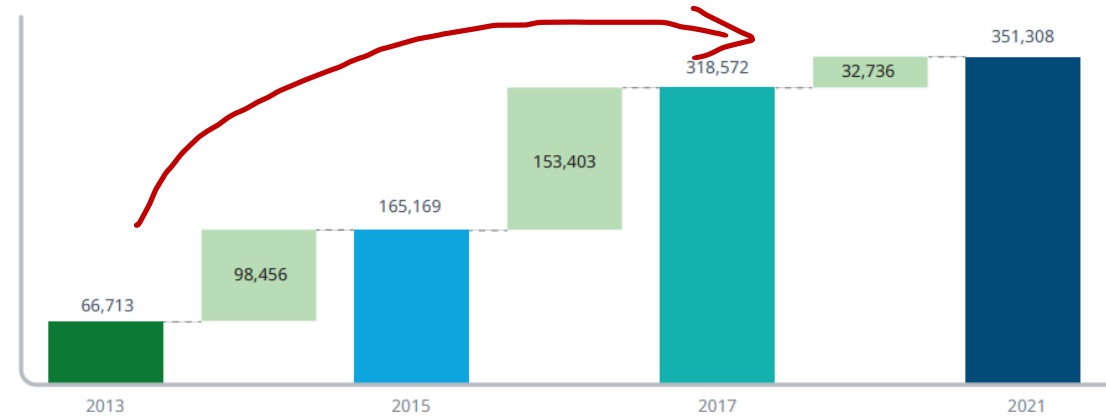2013 through 2021

Exhibit 3: Number of Digital Health Apps 2013–2021

351,308
32,736
318,572
153,403
165,169
98,456
66,713

2013   2015   2017   2021

3% — Healthcare providers/insurance
7% / 4% / 7%
8% / 11% / 9% — Medication reminders and info
10% / 9% / 9% — Women's health and pregnancy
13% / 16% / 22% — Disease specific
19% / 12% / 11% — Diet and nutrition
40% / 19% / 18% — Lifestyle and stress
/ 30% / 25% — Exercise and fitness

Health condition management
Wellness management

2015   2017   2020

Disease specific n=2580 apps
22% — Mental health and behavioral disorders
15% — Diabetes
10% — Heart/circulatory system
8% — Digestive system (GI)
7% — Respiratory system
6% — Musculoskeletal system and connective tissue
6% — Cancer
6% — Nervous system
4% — Eyes and ears
3% — Pain
2% — Skin and subcutaneous tissue
3% — Endocrine, nutritional and metabolic diseases
4% — Infectious and parasitic diseases
3% — Genitourinary system
1% — Kidney disease
1% — Hematology
0% — Other
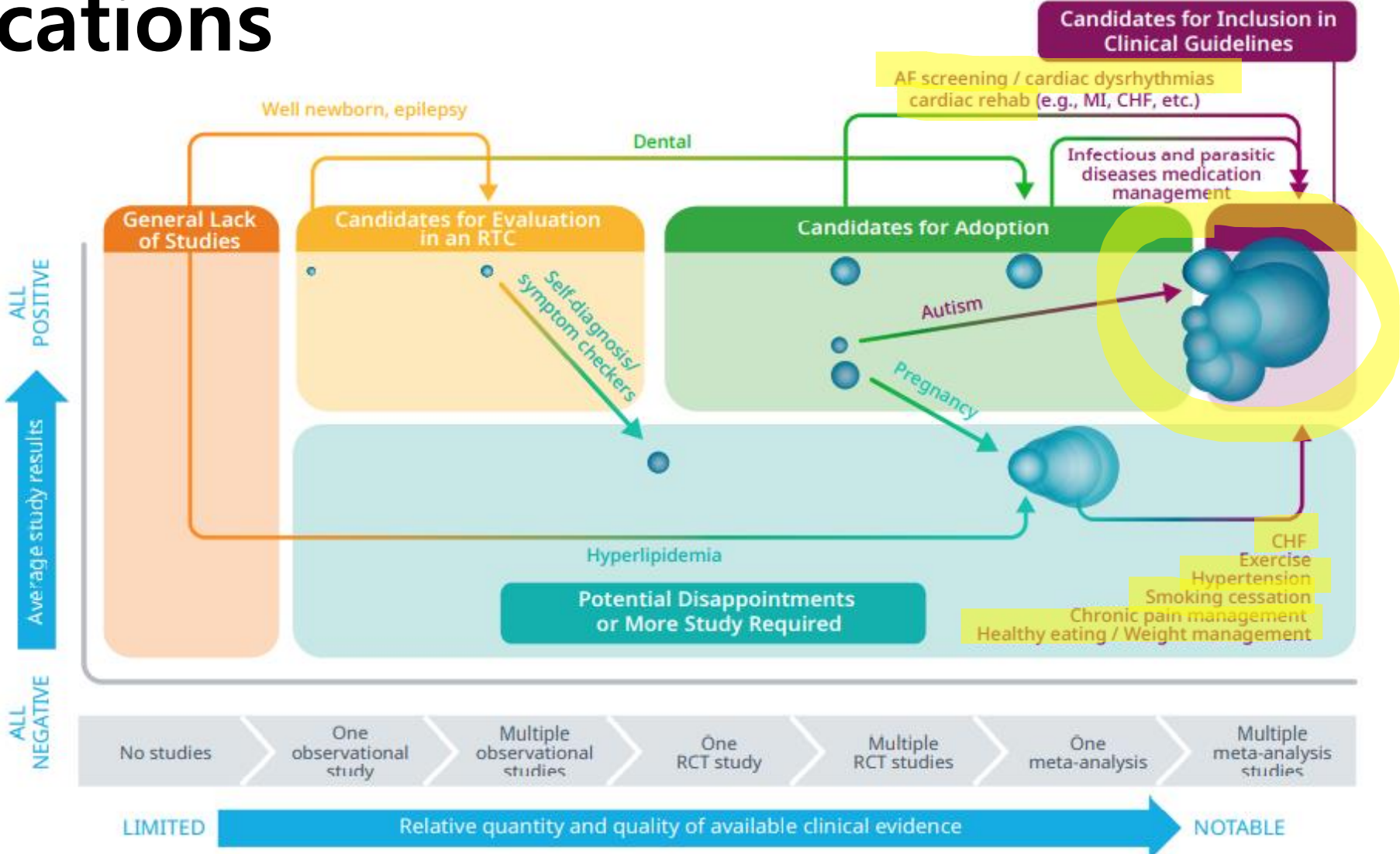
Digital Health Trends IQVIA(2021)

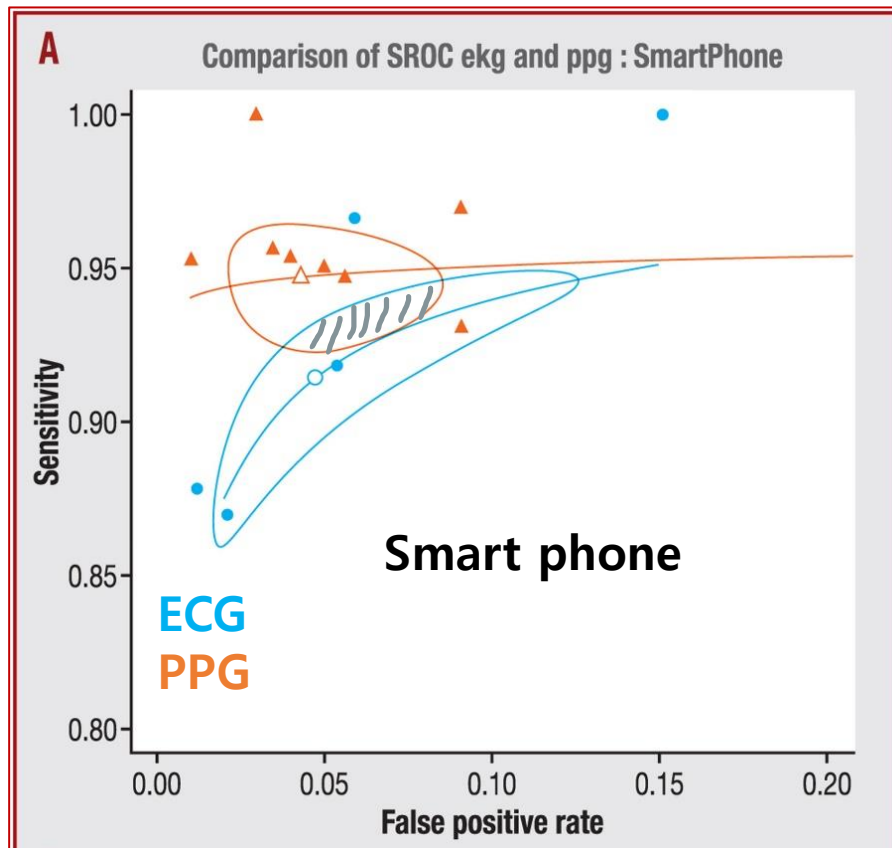# Number of Published Digital Health Efficacy Studies and Percentage of Meta-analyses and Systematic Reviews

AppScript Clinical Evidence Database, Jan 2021
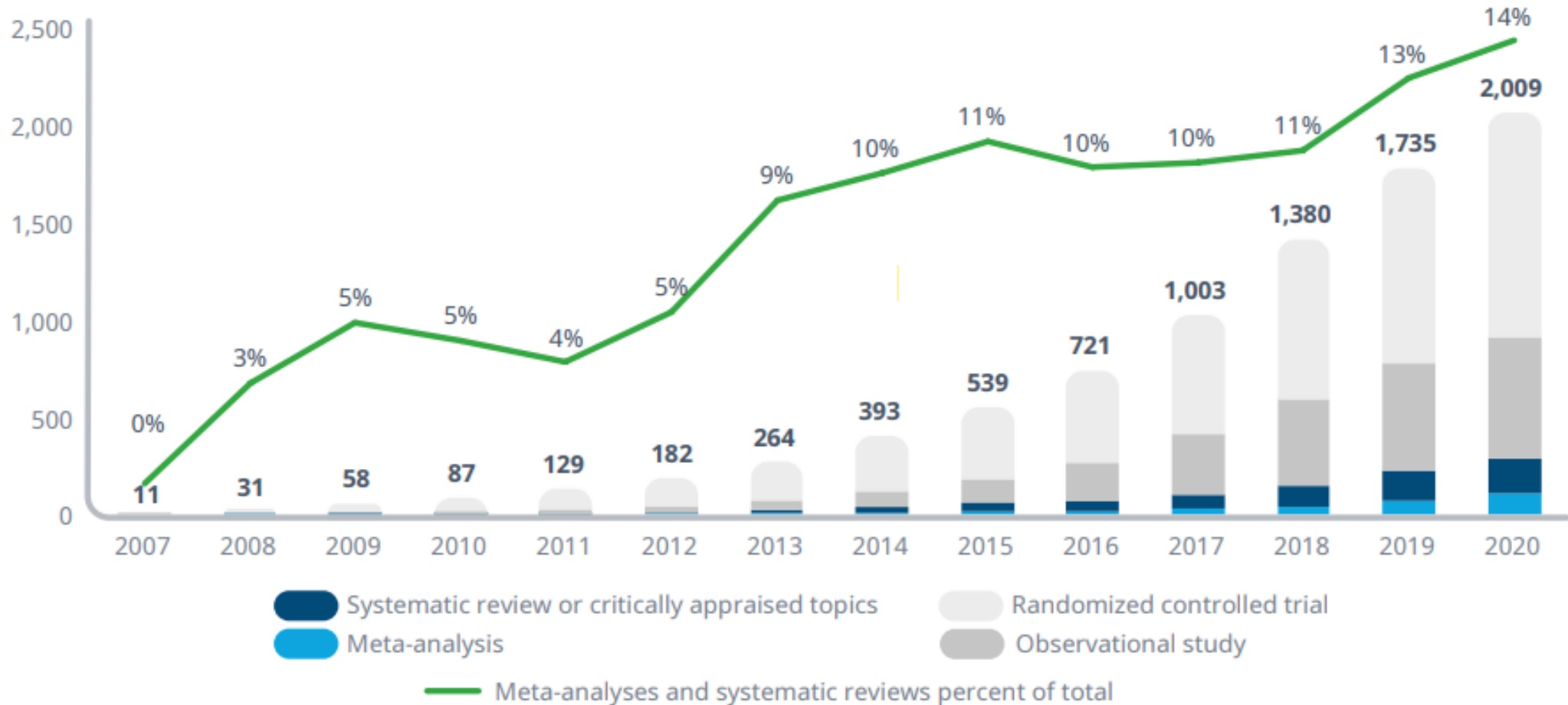
Recent shift in evidence; cardiovascular applications
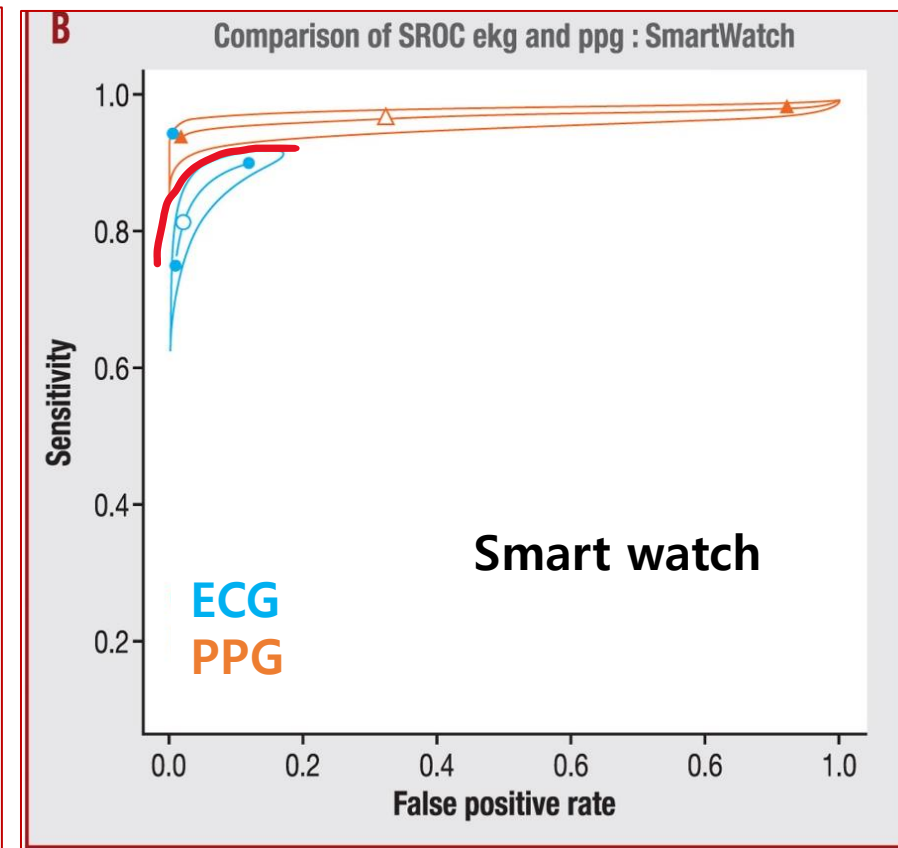

IQVIA AppScript Clinical Evidence Database, 2021

Mobile health (wearables + apps)
For patients

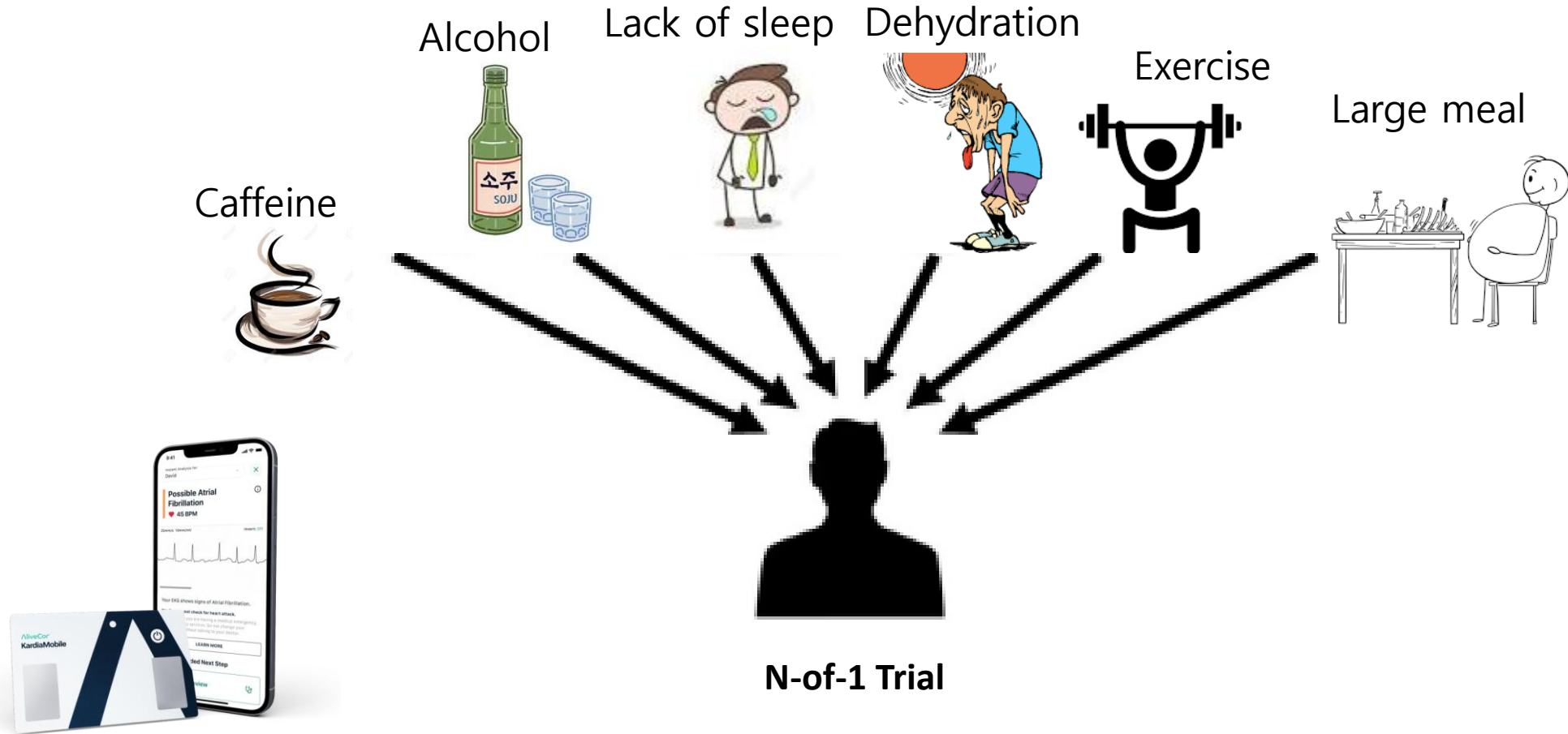# Meta-analysis for apps of AF diagnosis

Diagnostic accuracy 0.94

Diagnostic accuracy 0.96

RCT for trigger AF with mobile ECG & App

RCT for trigger AF with mobile ECG & App

	On		Off				
Trigger type	No.	Total No.	No.	Total No.	OR (95% Crl)		PR (OR >1)
Alcohol	148	578	141	913	2.15 (1.27-3.61)		1.00
Caffeine	291	841	268	885	0.84 (0.51-1.40)		.26
Exercise	88	508	99	448	1.10 (0.58-2.06)		.61
Cold food and drink	6	52	6	56	0.74 (0.14-3.80)		.37
Lying on the left side	106	462	108	403	0.92 (0.52-1.66)		.39
Large meals	67	243	143	448	0.67 (0.30-1.45)		.14
Diet	49	180	34	224	2.11 (0.91-4.73)		.96
Custom	47	197	30	213	4.09 (1.49-11.58)		1.00

B Per protocol
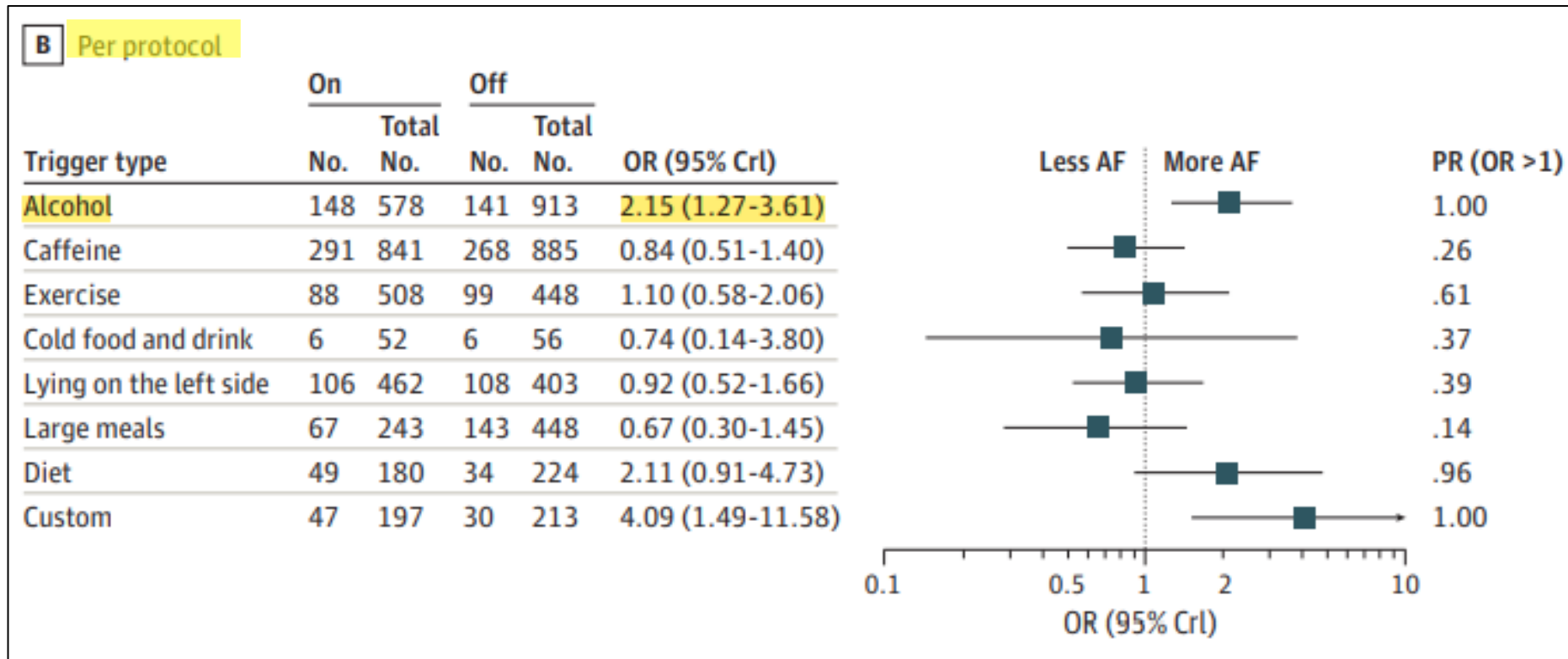
The I-STOP-AFib Randomized Clinical Trial

Drug adherence

Kim et al. BMJ Open 2022;12:e048777

REACT-AF: "Pill-in-Pocket" anticoagulation.

Continuous NOAC:
High AF burden
High vascular risk
Low bleeding risk

LAAO:
High AF burden
High vascular risk
High bleeding risk

Smartwatch-guided intermittent NOAC:
Low-intermediate AF burden
Low-intermediate vascular risk
All bleeding risk
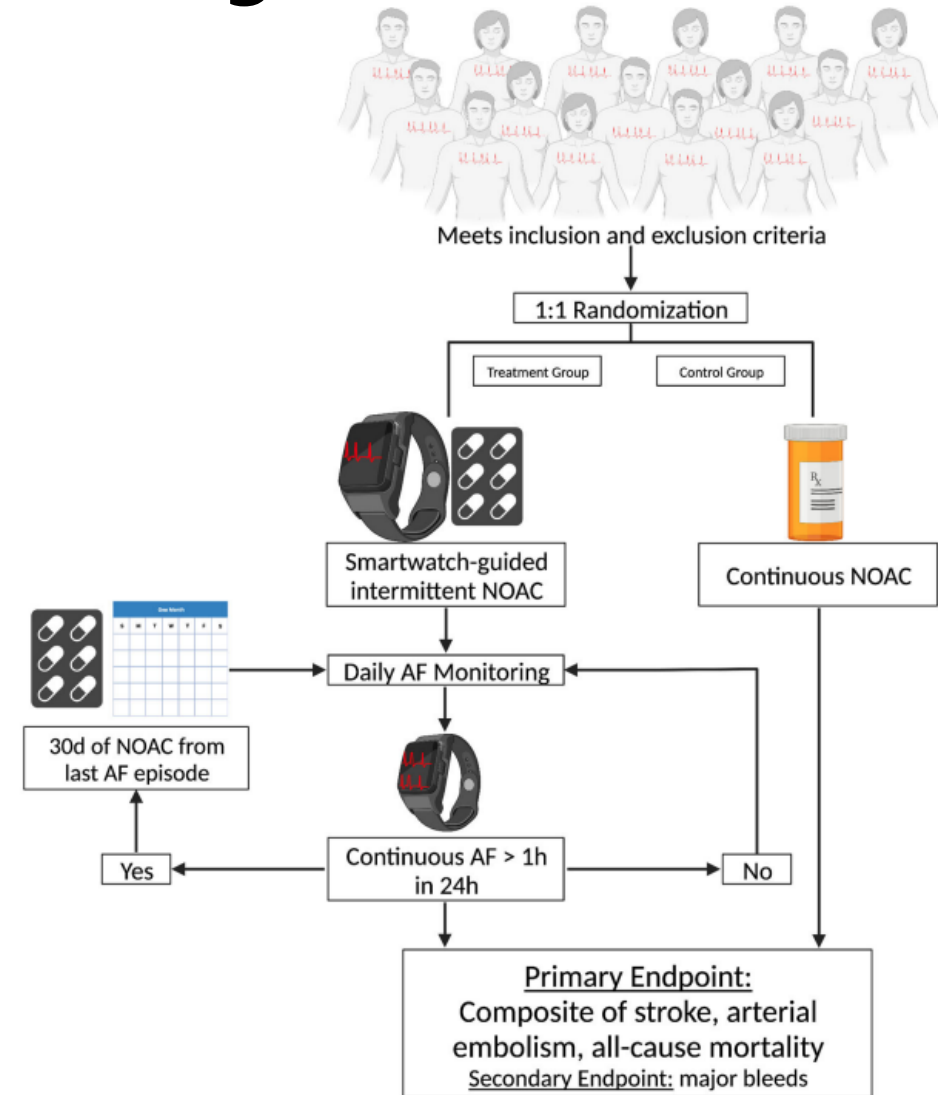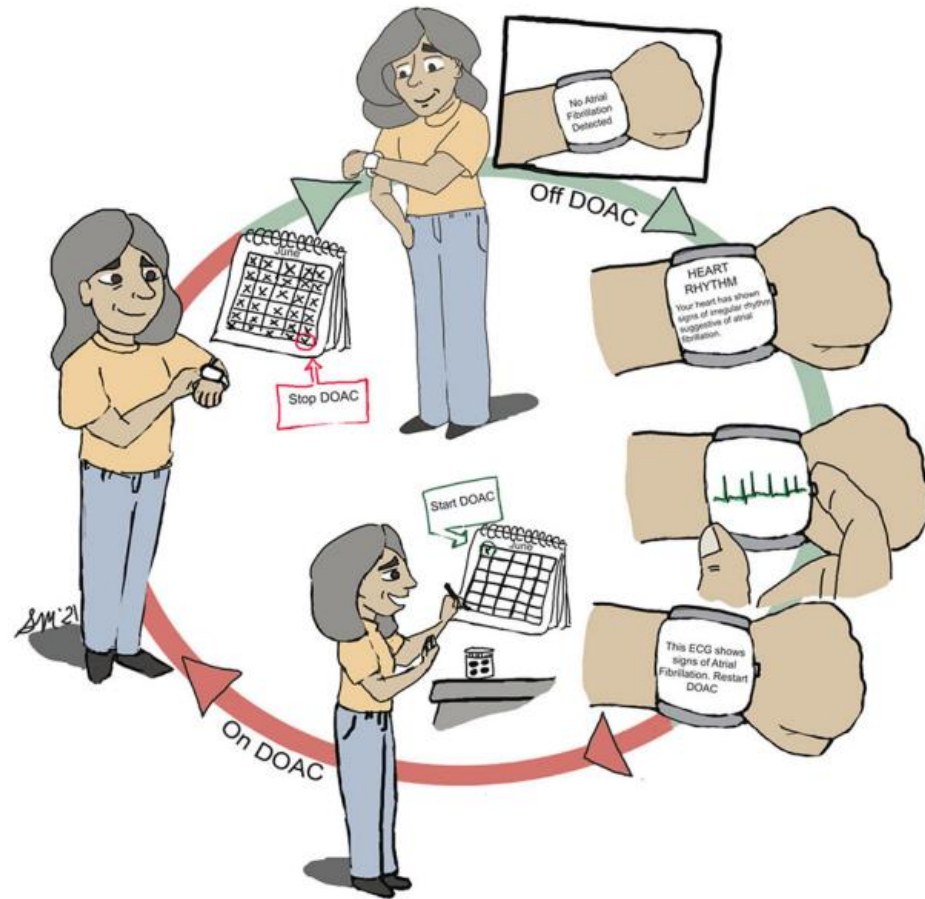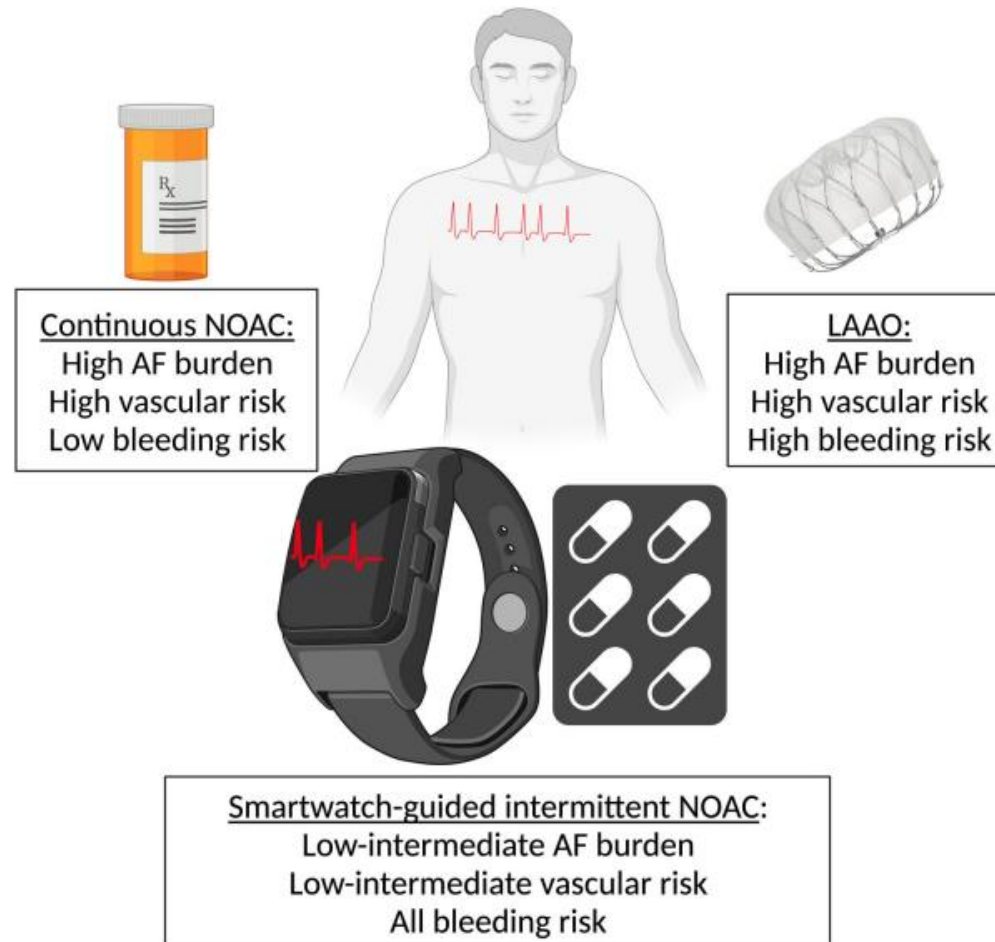
Mobile health apps For Doctors?

Evolving Dynamics of Digital Healthcare

Remote Patient Monitoring

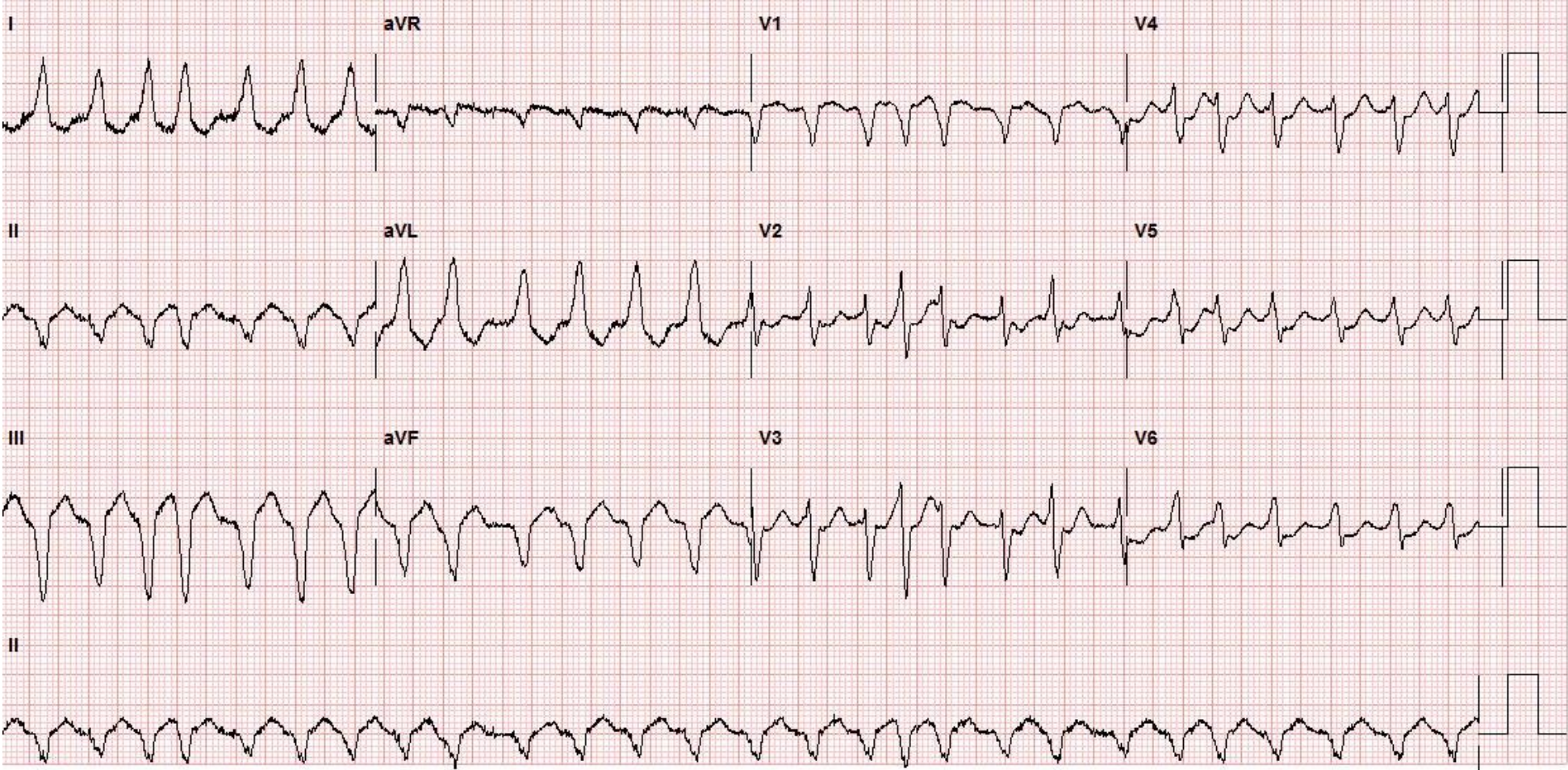Virtual Visits

Digital Symptom Checkers
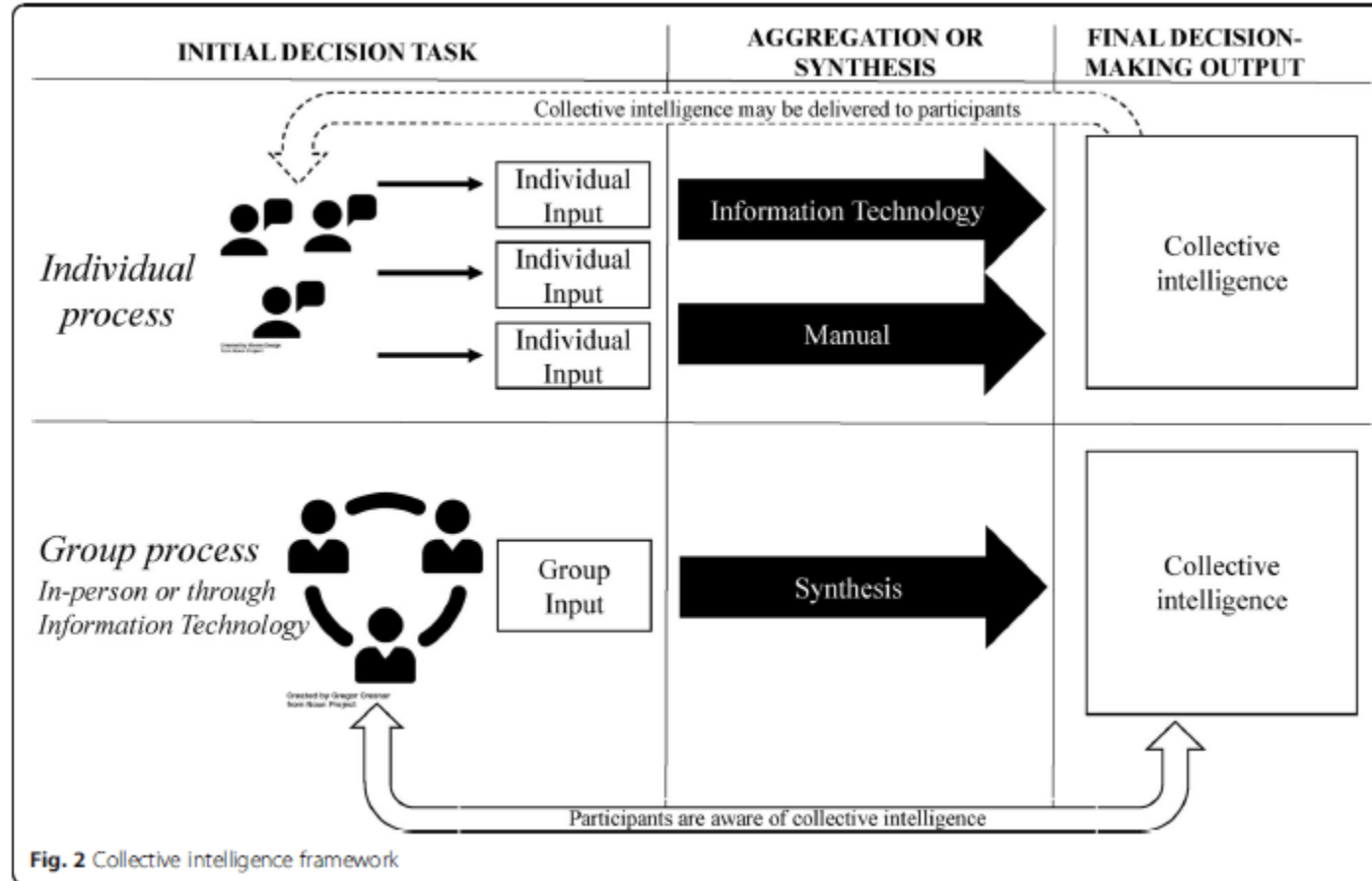
Cybersecurity in Healthcare

MedTech

Digital Pharmacies

Why ECG interpretation by collective intelligence

Two type of CI for medical decision making

Fig. 2 Collective intelligence framework

ECG interpretation Mobile app with collective intelligence

Simply, Click the app.

Upload the Question!

Answer & feedback
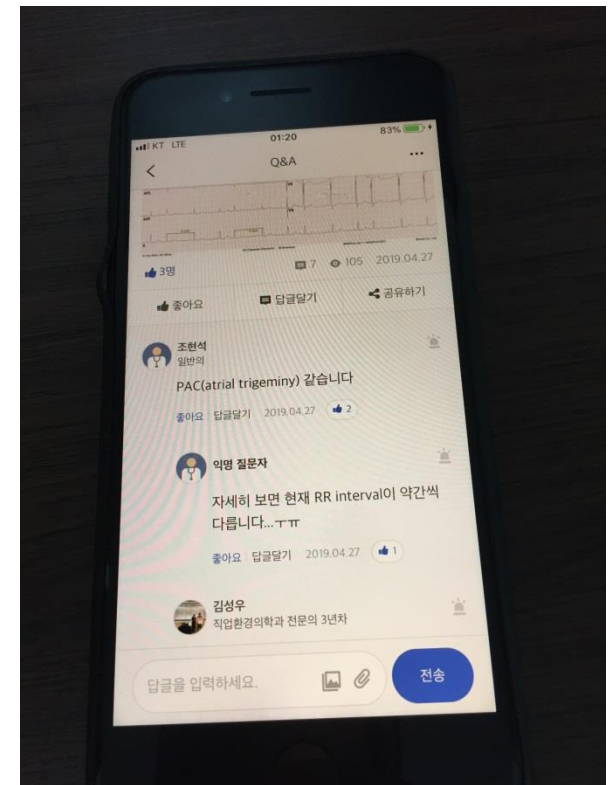
Mobile & web-based platform
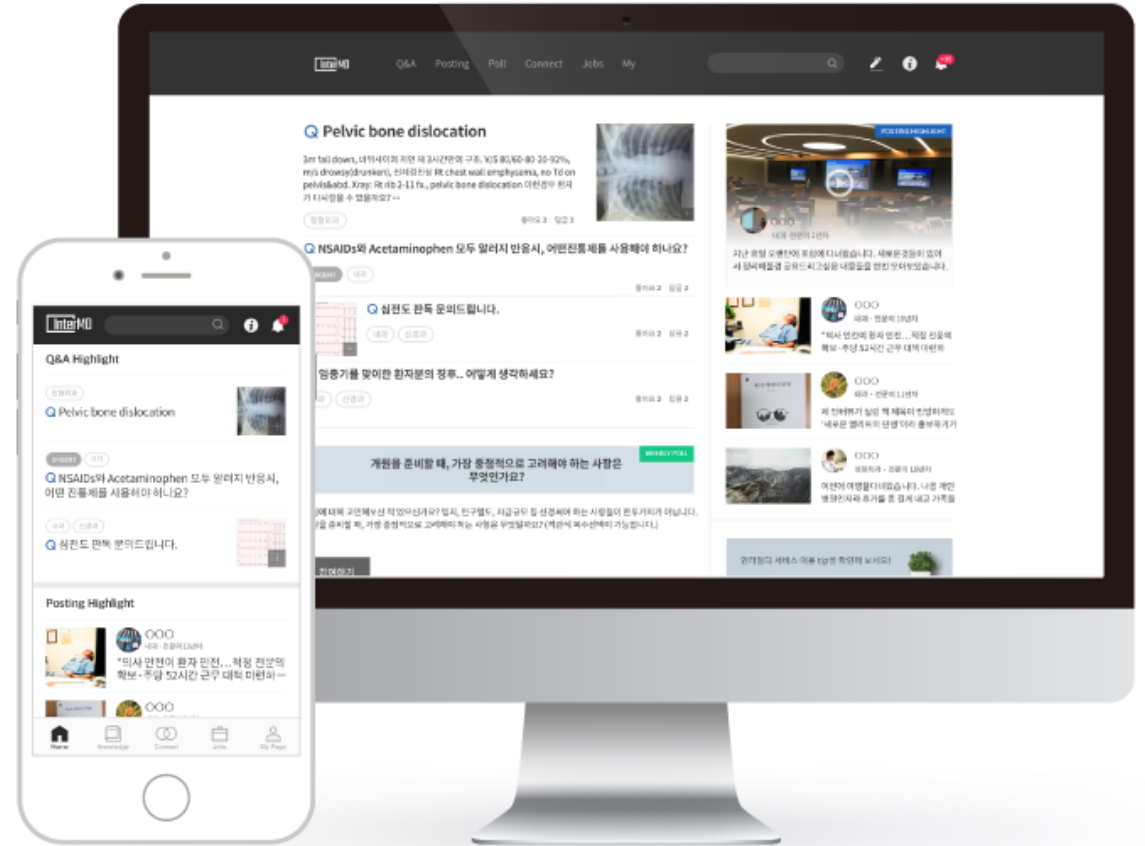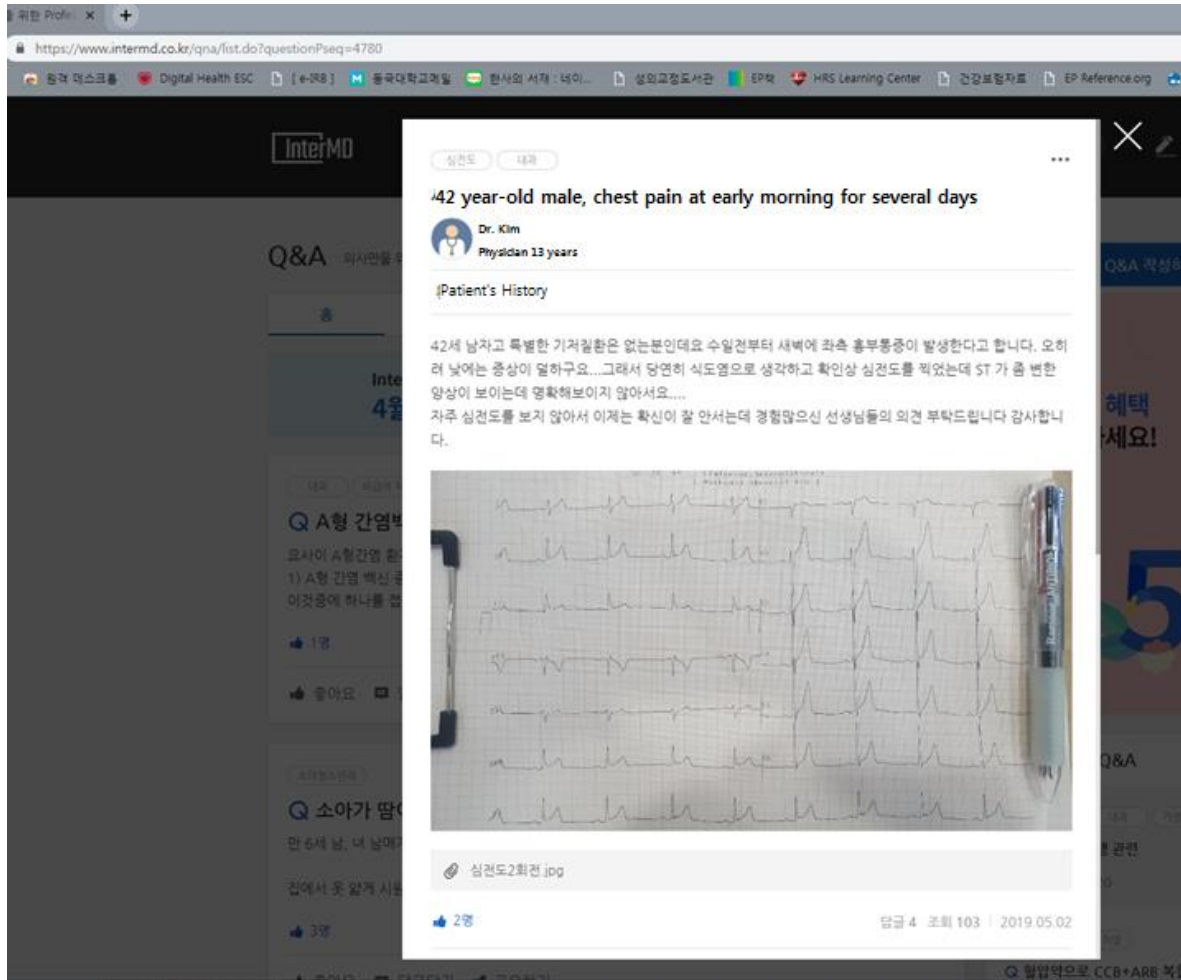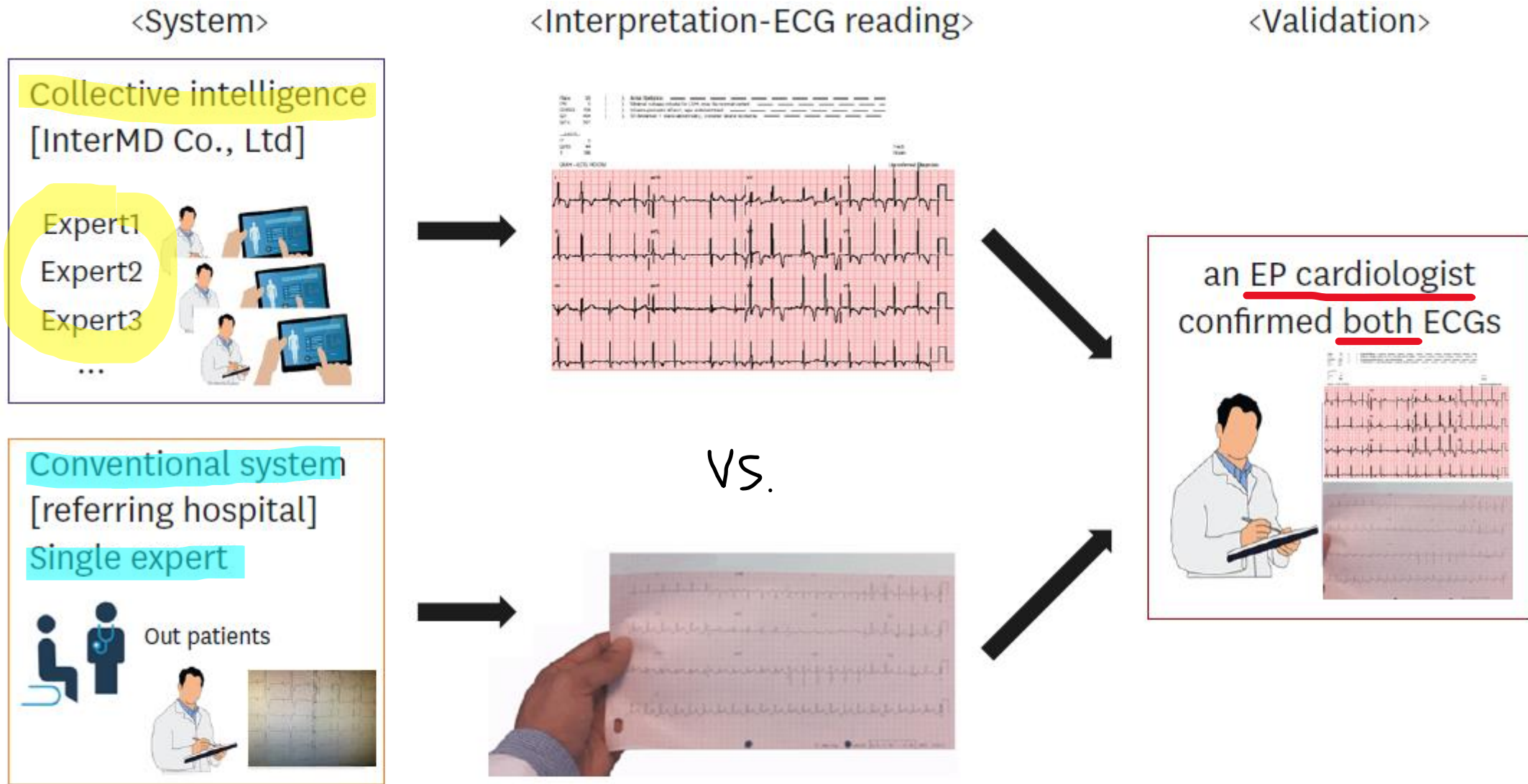
Figure 2. Comparison and validation of ECG readings by collective intelligence (InterMD) vs. by conventionl system in a referrring hospital.
ECG = electrocardiogram; EP = electrophysiologist.

Collective intelligence vs. a Conventional system

Table 2. Comparison between collective intelligence system and conventional system in a referrring hospital

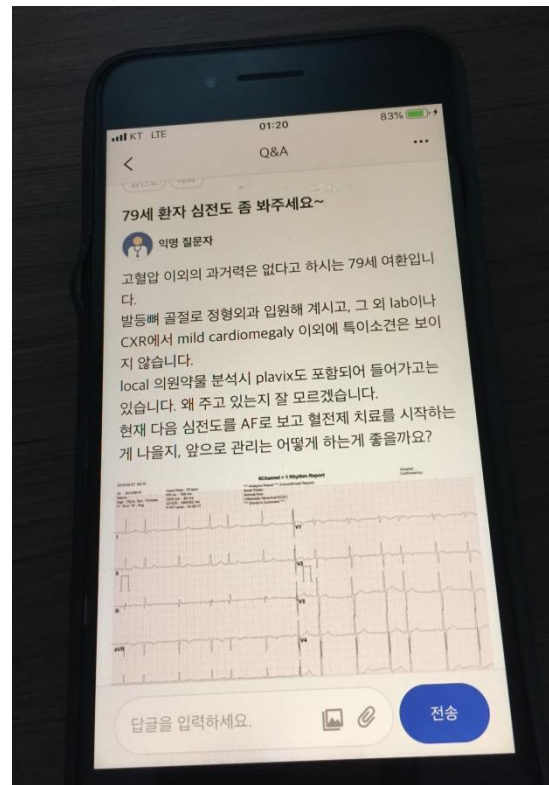| Comparison variables	Collective intelligence system (interMD) (n=159)	Conventional system (n=217)	p value
Time to first response (hours)	6.6±6.4	35.8±10.8	<0.001
Time to the last response (hours)	55.2±34.7	69.3±50.7	0.075
Total number of ECG answers	3.3±2.5	1.2±0.5	<0.001
Consensus with cardiac EP (%)	98.6	100	0.158

ECG = electrocardiography; EP = electrophysiologist.

Mobile app for health care providers

"40,000 + members, 40% of Korean Doctors"

■ 인터엠디의 전반적인 서비스에 대해 어느 정도 만족하시나요?
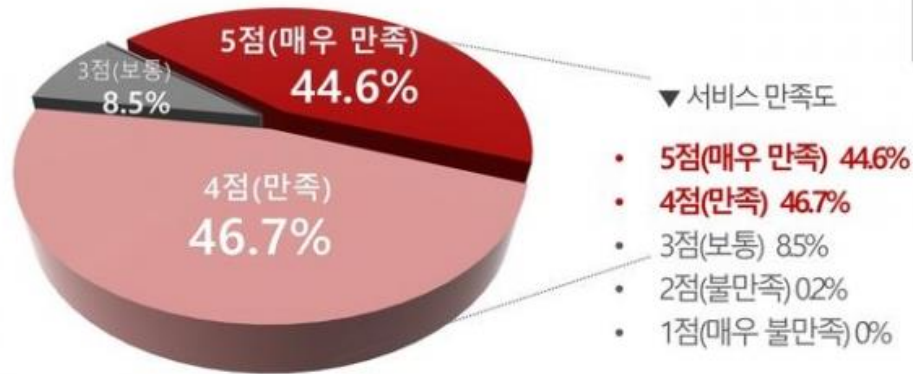
조사기간: 2022년 10월 5일
조사대상: 인터엠디 의사 회
총 조사인원: 1,000명

5점(매우 만족) 44.6%
4점(만족) 46.7%
3점(보통) 8.5%

▼ 서비스 만족도
- 5점(매우 만족) 44.6%
- 4점(만족) 46.7%
- 3점(보통) 8.5%
- 2점(불만족) 0.2%
- 1점(매우 불만족) 0%

Q. 인터엠디는 의사 선생님들의 진료에 도움을 주는 서비스라고 생각하시나요?

98.8% 도움이 된다.
1.2% 도움이 되지 않는다.

Q. 인터엠디에서 가장 만족스러운 서비스는 무엇인가요? (복수응답 가능)

24% Q&A(다양한 주제의 질의 응답)
15.2% 웹 세미나(온라인으로 진행되는 라이브 강의)
13.7% Posting(정보, 소식, 의견 공유 및 인터엠디 추천 게시글)
10.5% 오늘의 퀴즈(흥미로운 퀴즈 도전 등)
7.6% 이벤트
7.1% Poll(서베이 참여를 통한 견해 확인)
4.4% 초빙공고(의사 위한 맞춤형 초빙 공고 서비스)
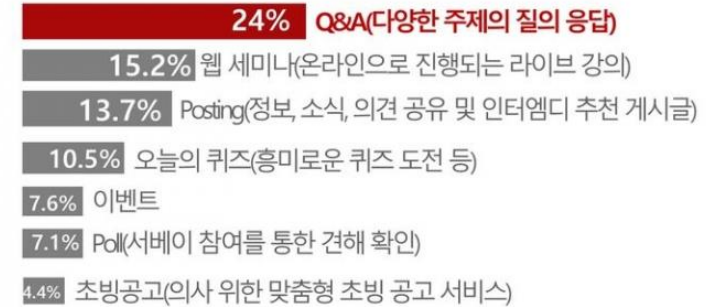
Q. Q&A에 작성된 선생님들의 답변을 어느 정도 신뢰하시나요?

5점(매우 신뢰) 34.2%
4점(신뢰한다) 53.2%
3점(보통) 12.4%

▼ Q&A 답변 신뢰도
- 5점(매우 신뢰한다) 34.2%
- 4점(신뢰한다) 53.2%
- 3점(보통이다) 12.4%
- 2점(신뢰하지 않는다) 0.2%
- 1점(전혀 신뢰하지 않는다) 0%

https://www.doctorsnews.co.kr
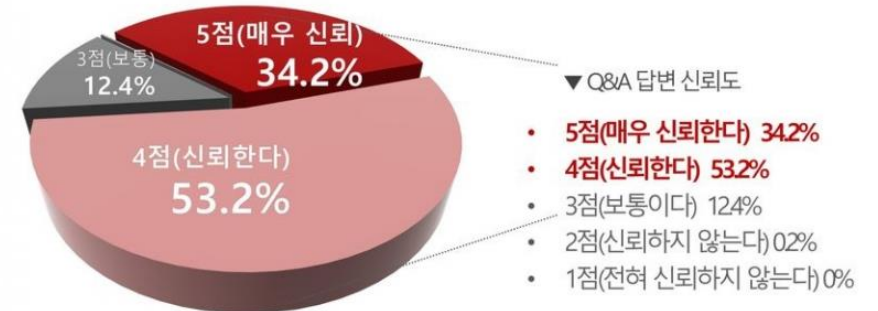
What is important to maintain apps better?

IQVIA 2021
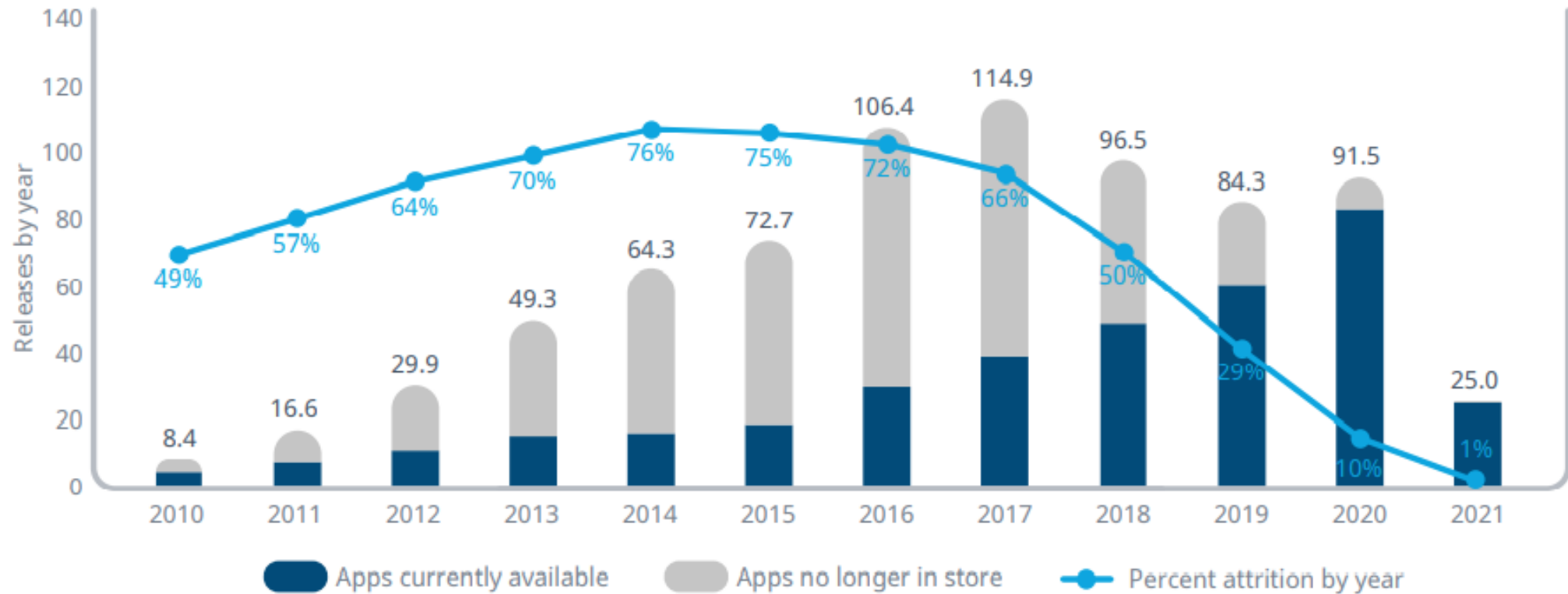
How makes the app better?

1.0　　　　　　2.0　　　　　　3.0

	Type	기간	특징	개발 기간	안정화 기간	개발 인력	운영 인력	순수 개발/운용 비용
1단계	Native	2017	사용성은 좋으나, 확장성에 한계	3개월	1개월	4억	2명	4억
2단계	Hybrid	2018~2019	사용성 강화를 위해 지속적인 추가 개발 필요, 콘텐츠 확장 및 Update 용이	4개월	10억	10억	6명	10억
3단계	Hybrid +	2020~	타 Application 결합 후 안정화 및 UX 발전을 위한 지속적 개발 필요, 다양한 경험 제공 강화	4개월	10억	10억	6명	10억

Commercial Models

Direct-to-Consumer

App Developer

Patient downloads app

Patient pays a subscription fee

Physician

Physician prescribes app

Patient

- App manufacturer sells directly to patients / end users, who pay a subscription fee
- Payment frequency may vary (monthly, annually, etc.) and some could pay with HSA/FSA
- User downloads disease management app, sometimes from App Stores

"Device-Like" Reimbursement (Medical Benefit)

App Developer

Price negotiated and app covered by plan

Patient downloads app

Patient pays coinsurance

Physician

Physician prescribes app

Health Plan

Patient pays health insurance premium

Patient

- App manufacturer sets the price for solution, insurance covers up to a certain amount as part of core medical benefit or medical exception
- Patient pays coinsurance

"Drug-Like" Reimbursement (Pharmacy Benefit)

App Developer

Price negotiated and app covered by plan

Patient downloads app

Patient pays copay

Physician

Physician prescribes app

Health Plan

Patient pays health insurance premium

Patient

- Reimbursed price negotiated between app manufacturer and payer for the solution to be listed on pharmacy benefit or digital formulary
- Patient pays copay
- Typically, an NDC code exists/issued for app

Value-Based Contracting

App Developer

App manufacturer contracts with payer, employer or IDN

Patient provides insurance details and then downloads app

Health Plan   Employer   IDN

Patient / Member / Employee

Physician prescribes app

Physician

- App manufacturer contracts with payer, employer or IDN
- Contracts structured around improved outcomes or reduced costs
- Generally paid on a per member per month basis
- Payers may require a pilot and/or robust evidence & ROI before adopting
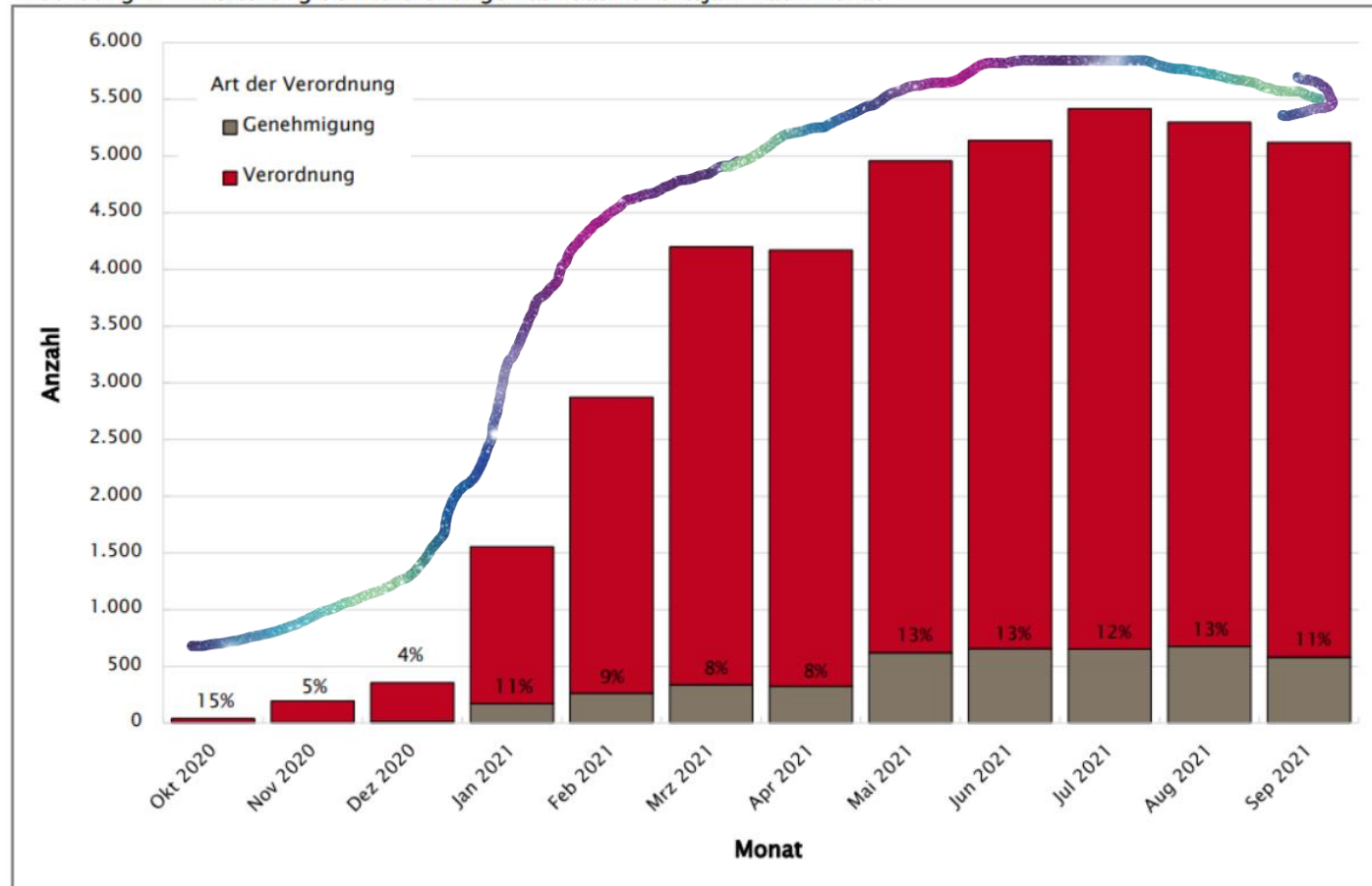- Contract renewal/payment often based on usage/ engagement/KPIs

→ Payment Flow

"Does everything go smoothly with reimbursement?"

Abbildung 4: Verteilung der Verordnungen auf das Berichtsjahr nach Monat

Art der Verordnung
- Genehmigung
- Verordnung

Quelle: Daten des GKV-Spitzenverbandes gem. § 33a Abs. 6 SGB V; n=39.318

Why don't doctors prescribe digital therapeutics?

Lack of framework pertaining to device use — 40%

Unproven reliability of devices — 34%

Lack of training — 27%

Liability unclear — 27%

Threat to medical confidentiality — 22%

Benefits of digital health apps

DATA QUALITY	FOR PATIENTS	FOR HEALTHCARE PROFESSIONALS	FOR THE HEALTH SYSTEM	FOR MANUFACTURERS
• Precise, objective, reproducible measurements • Real-time collection • Structuring, integration and diversity of sources	• Intuitive user interface • Personalised content • Adapted to lifestyle • Improved adherence and compliance • Improved care and quality of life	• Barriers of patient care broken down • Real-time remote monitoring • Responsiveness and disease change management	• Empowerment of patient • Better prevention • Better adherence and compliance • Correct use checked • Reduction of health costs	• Wider recruitment • Fewer dropouts • Real-time responsiveness • Heightened pharmacovigilance • Reduction in errors, data re-entries, admin costs and duration of studies

Summary

- Digital health : impeccable if used properly

- Clinical impact of Wearables & Mobile apps

  1) For patients : inclusion in Guideline
     - Self detection, management, adherence

  2) For doctors : beyond knowledge sharing
     - Collective & artificial intelligence

- Future direction : hard endpoint, reimbursement, continuous efforts for quality of the mobile health

경청해 주셔서 감사합니다.