

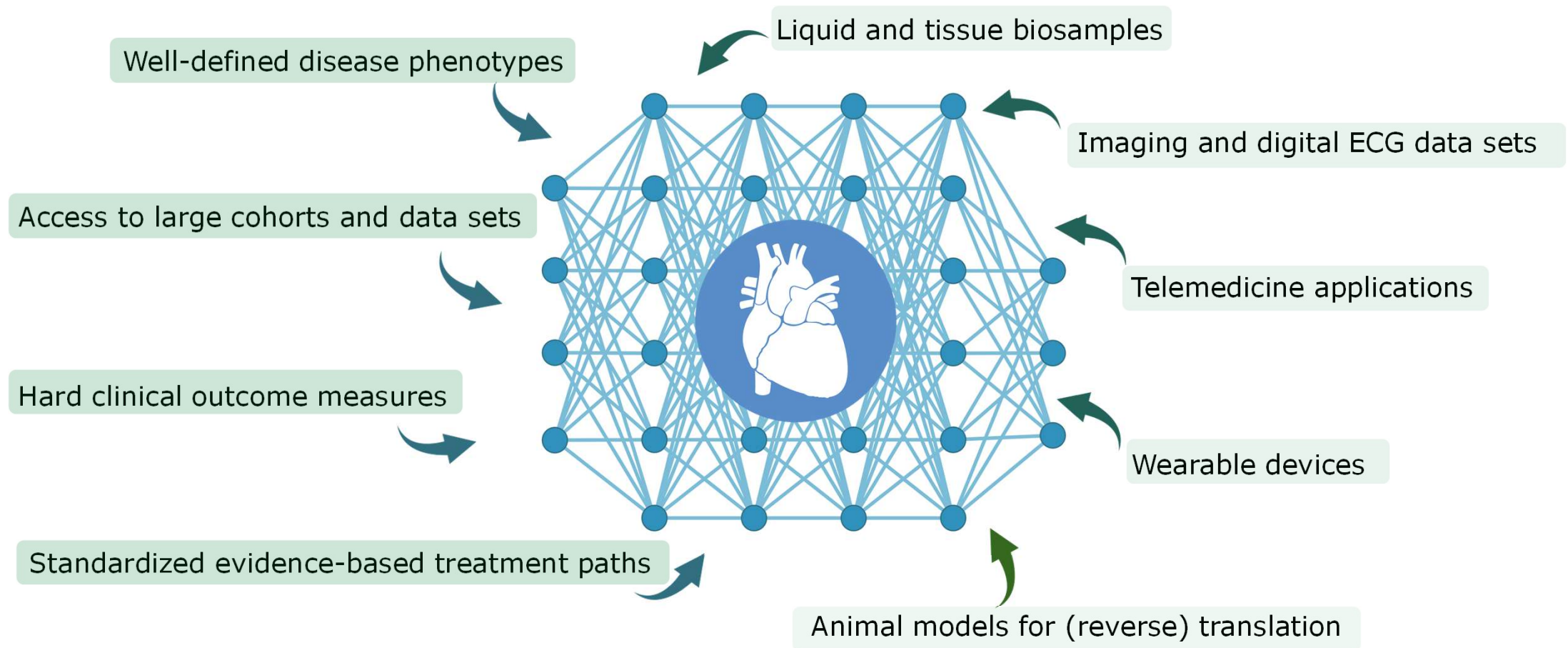
# Digital approaches to optimize(d) patient care – a user's perspective

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Klinikum der Ludwig-Maximilians-Universität München

DigiMed Bayern Symposium 2024  
November 06, 2024 | Translatum

# Cardiovascular diseases – Inherently suited for digital applications



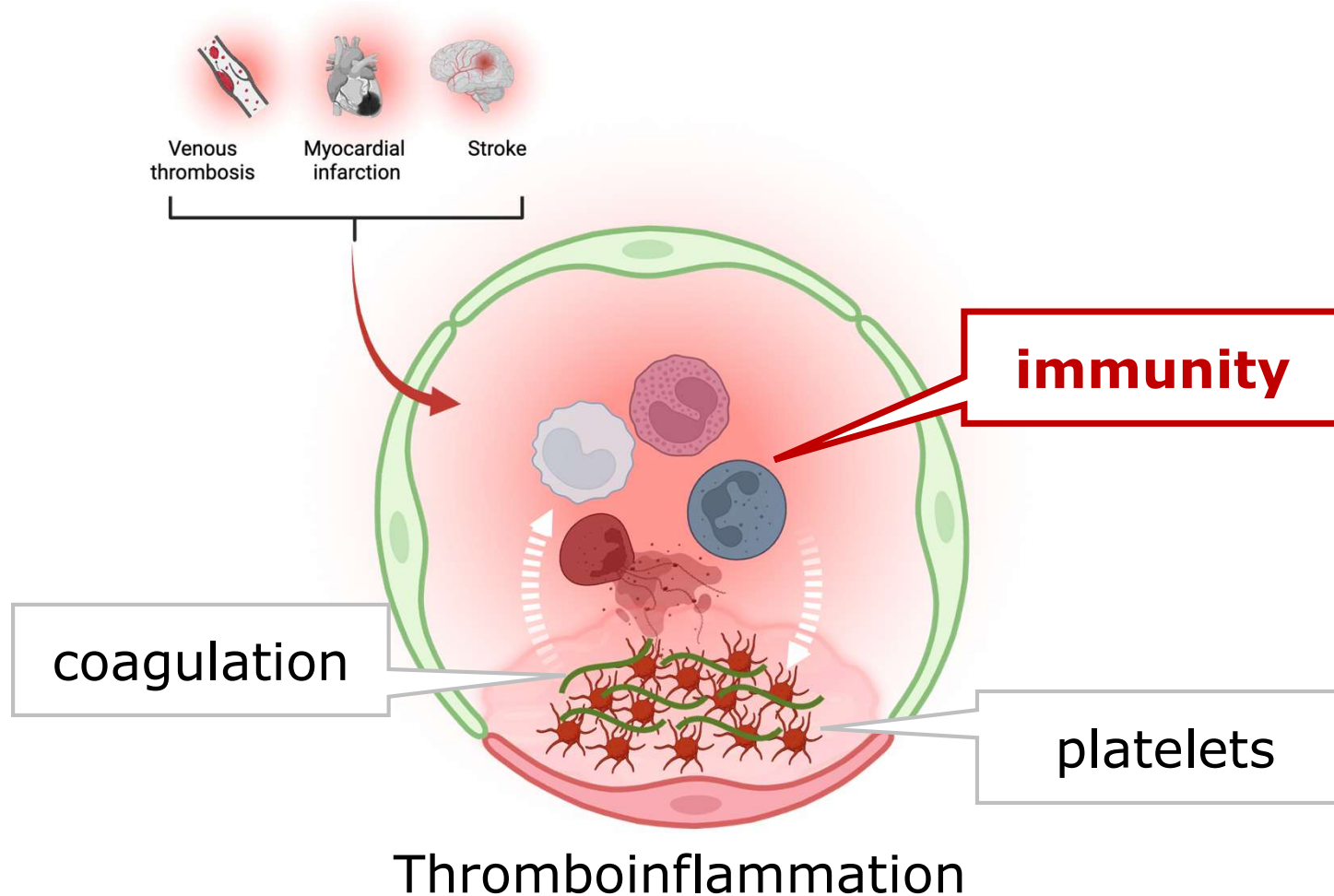
# Emerging areas of digital approaches in cardiovascular healthcare

## New translational approaches (\*omics)

- Advanced Omics technologies
- Bioinformatic analysis

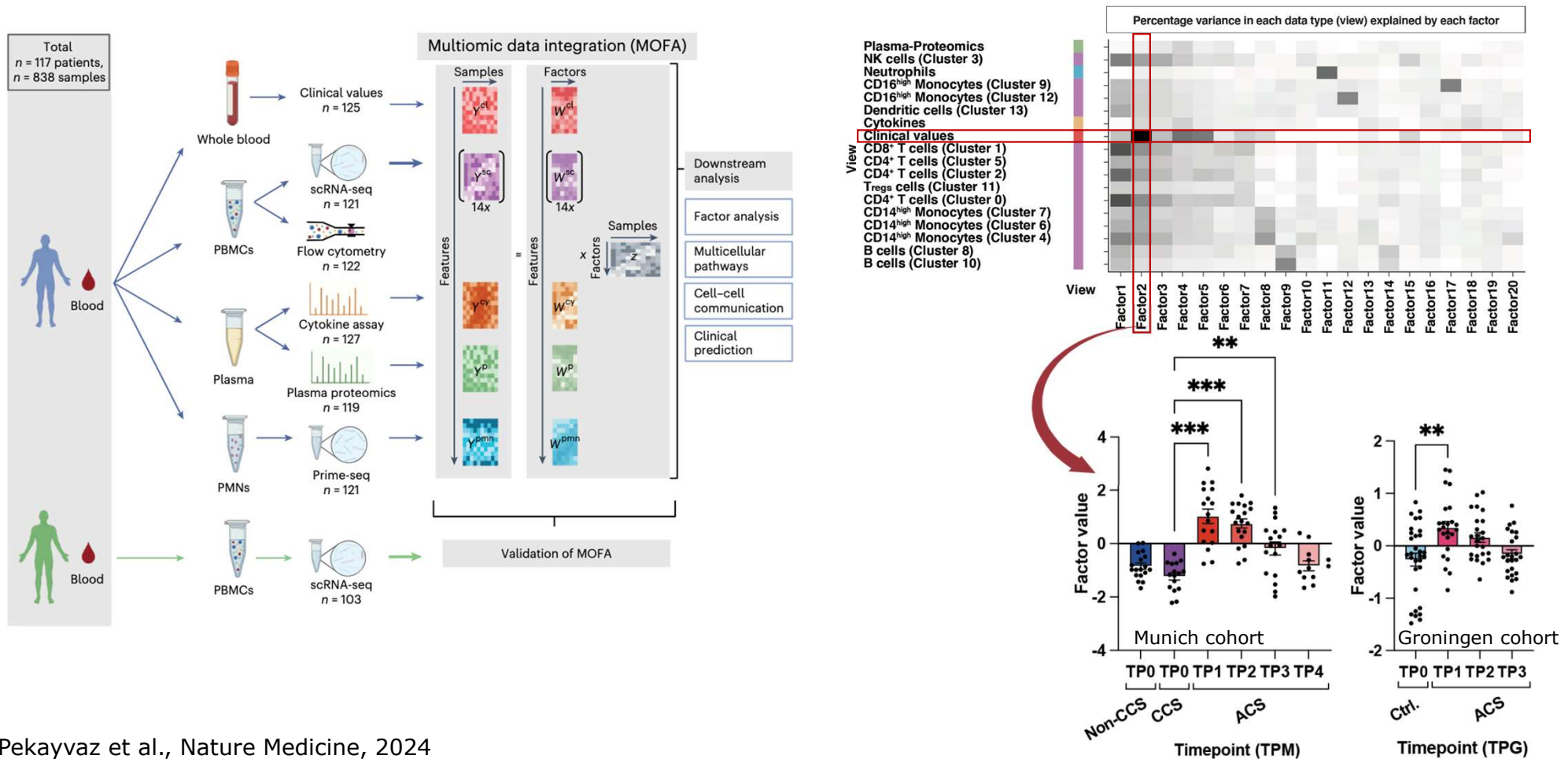
# Translating mechanism into clinical application

Clots complicate cardiovascular diseases



# Multi-Omics in cardiovascular risk stratification

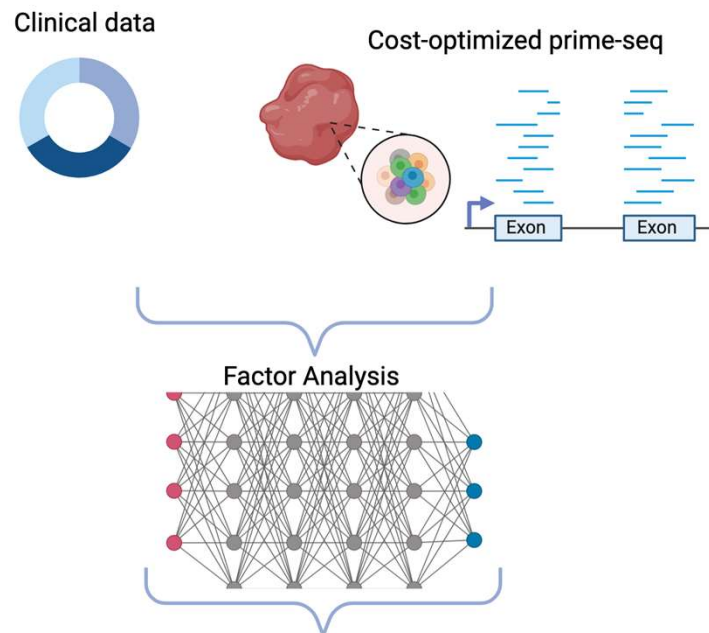
Use case: Acute and chronic coronary syndromes



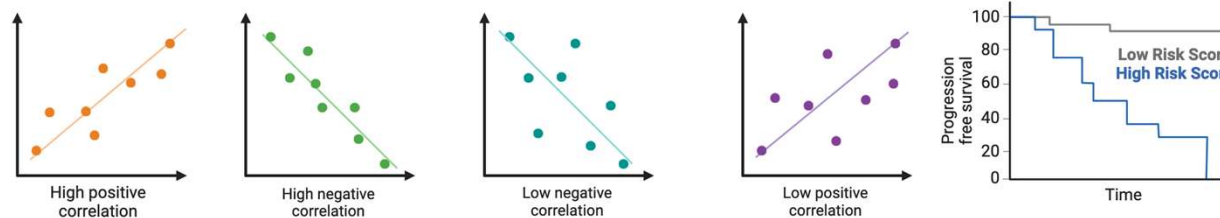
# Multi-Omics in cardiovascular risk stratification

Use case: Acute and chronic coronary syndromes

LMU MULTIBASE-PREDICT Project

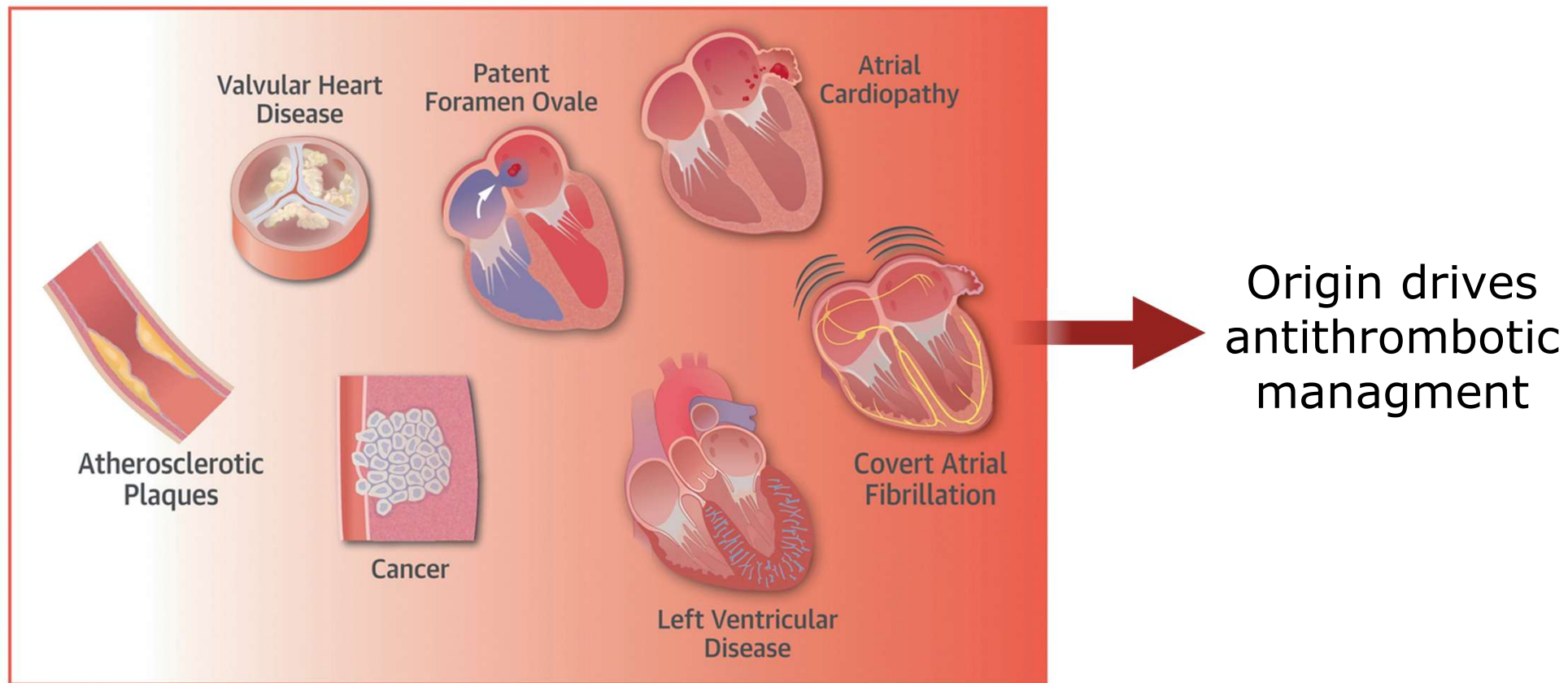


Deducing complex immune signatures to single factors that correlate with clinical characteristics in a non-invasive cross-sectional and prospective manner



# Multi-Omics in cardiovascular risk stratification

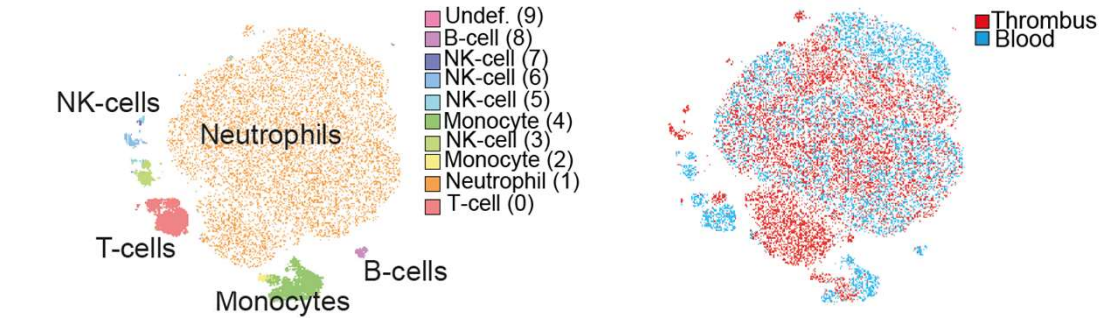
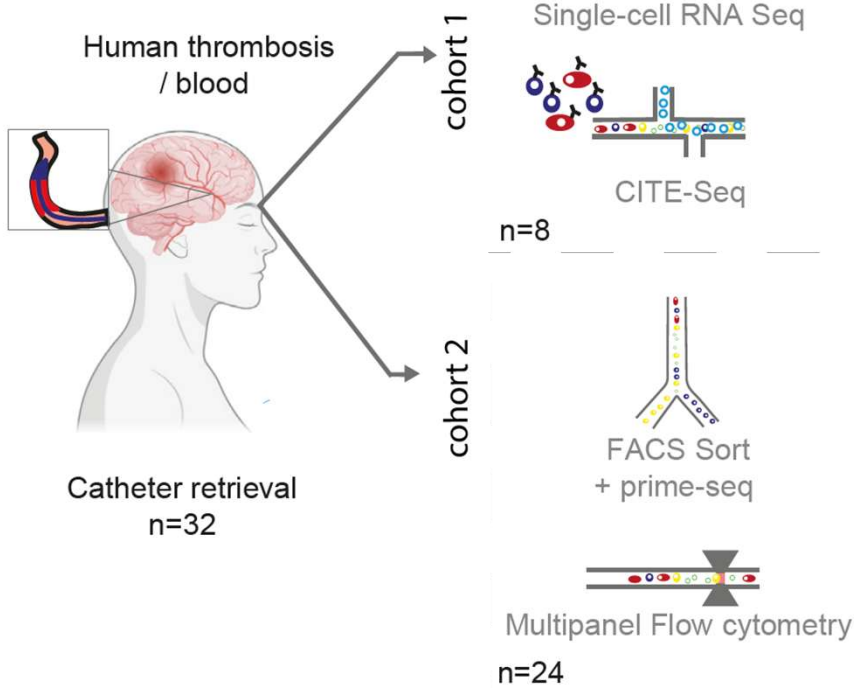
Use case: Acute embolic stroke



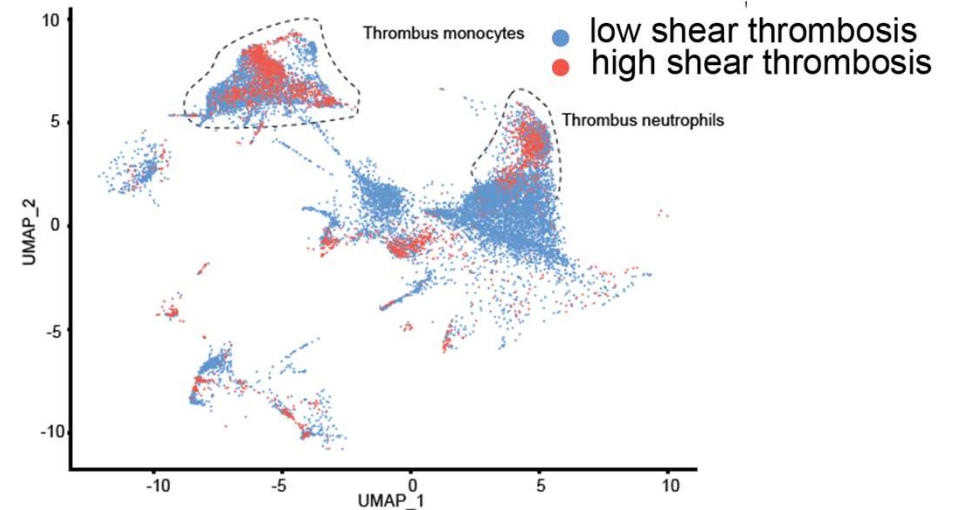
# Multi-Omics in cardiovascular risk stratification

Use case: Acute embolic stroke

## Human study design



## Immune trajectories identify thrombus origin





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## Precision medicine

- Personalized treatment
- AI-powered Clinical Decision Support

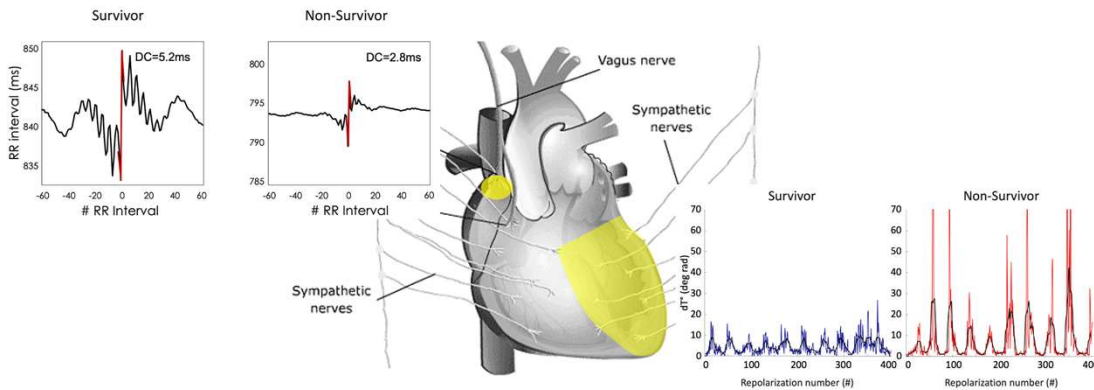
# Biosignals for cardiovascular risk stratification

Use case: Prediction of outcome

## Autonomic function predicts outcome

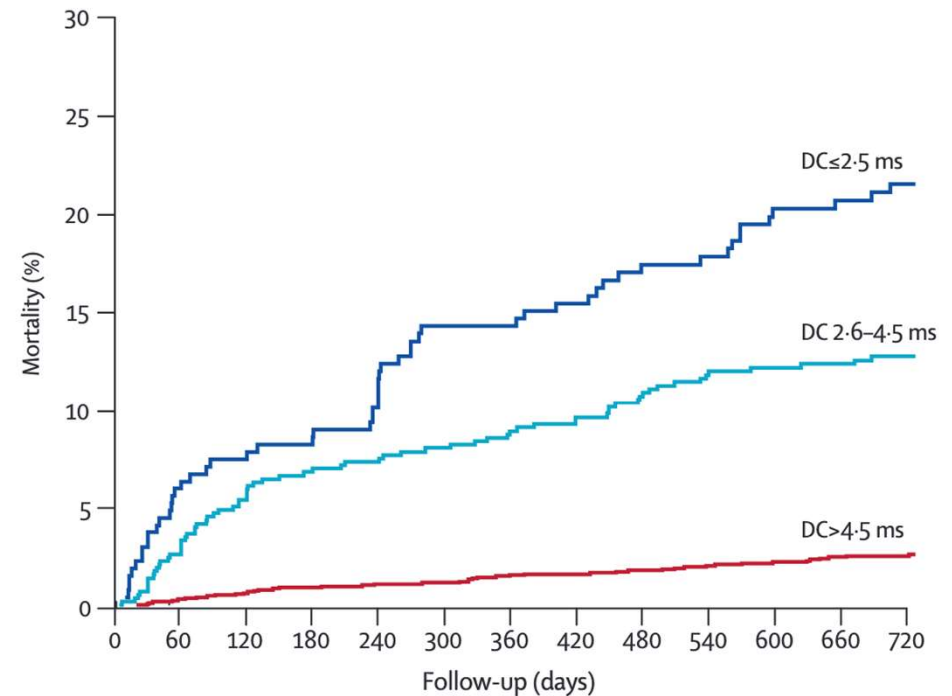
### Deceleration capacity

Integral measure of vagal tone



### Periodic repolarization dynamics

Sympathetic effect on repolarization

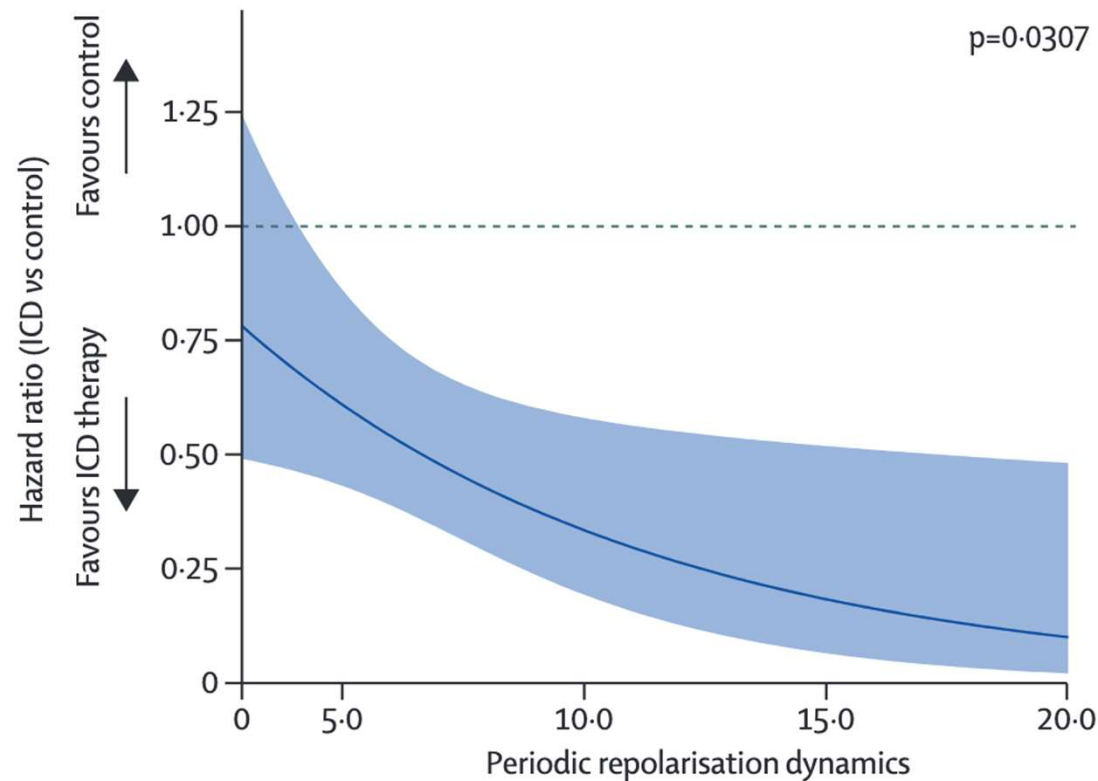


	0	60	120	180	240	300	360	420	480	540	600	660	720
Numbers at risk	275	246	227	205	186								
	592	543	525	481	452								
	1844	1784	1754	1641	1505								

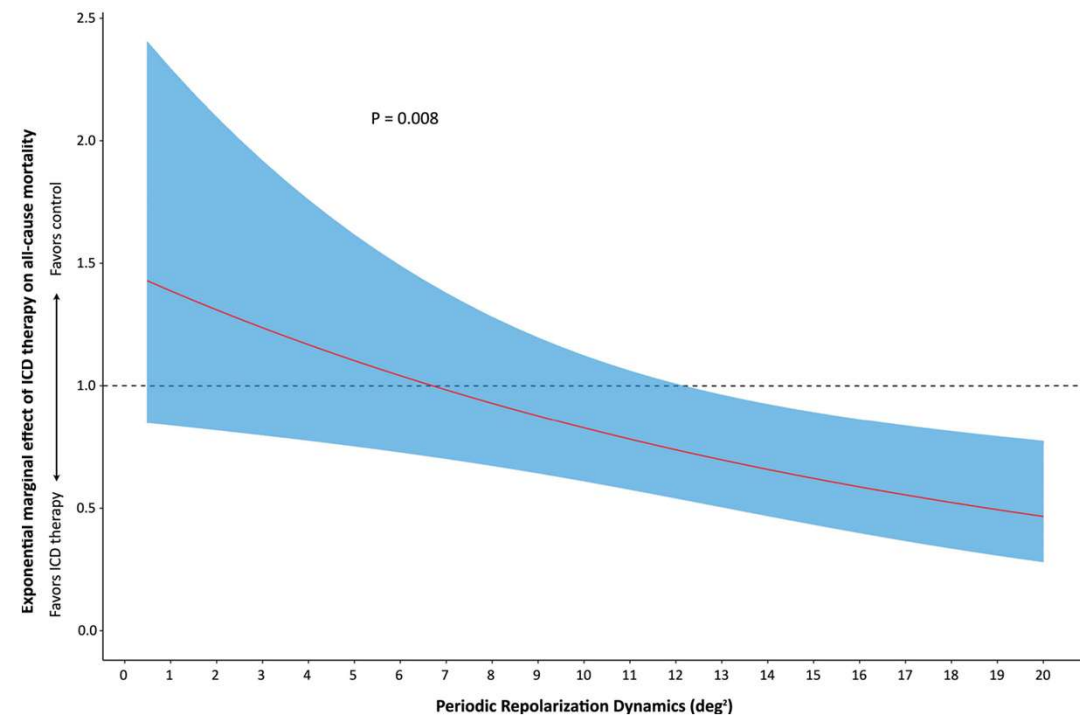
# Biosignals to personalize therapy

Use case: Prediction of therapy response in HrEF patients

EU-CERT ICD trial (ICM>DCM)

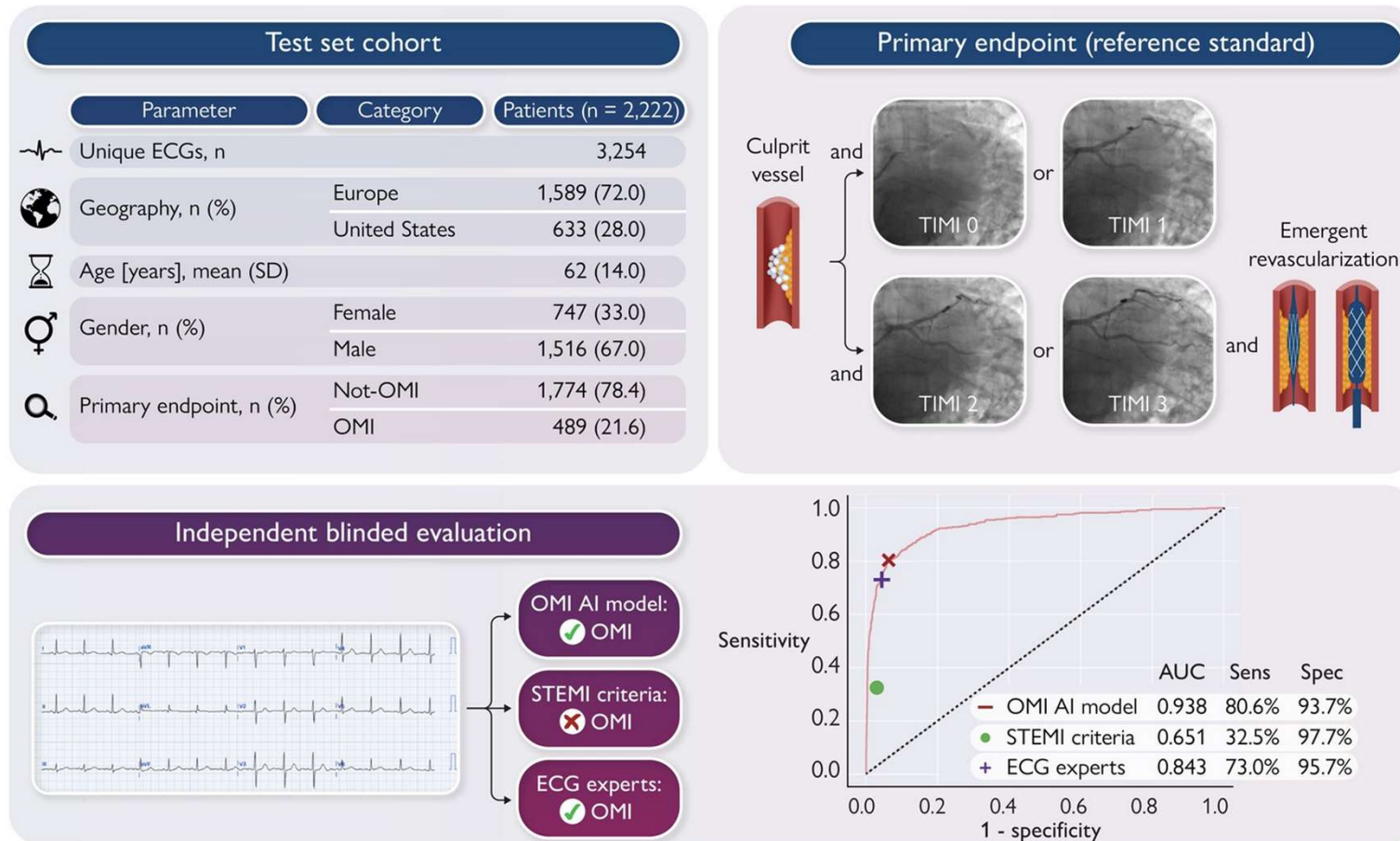


DANISH RCT trial (DCM)



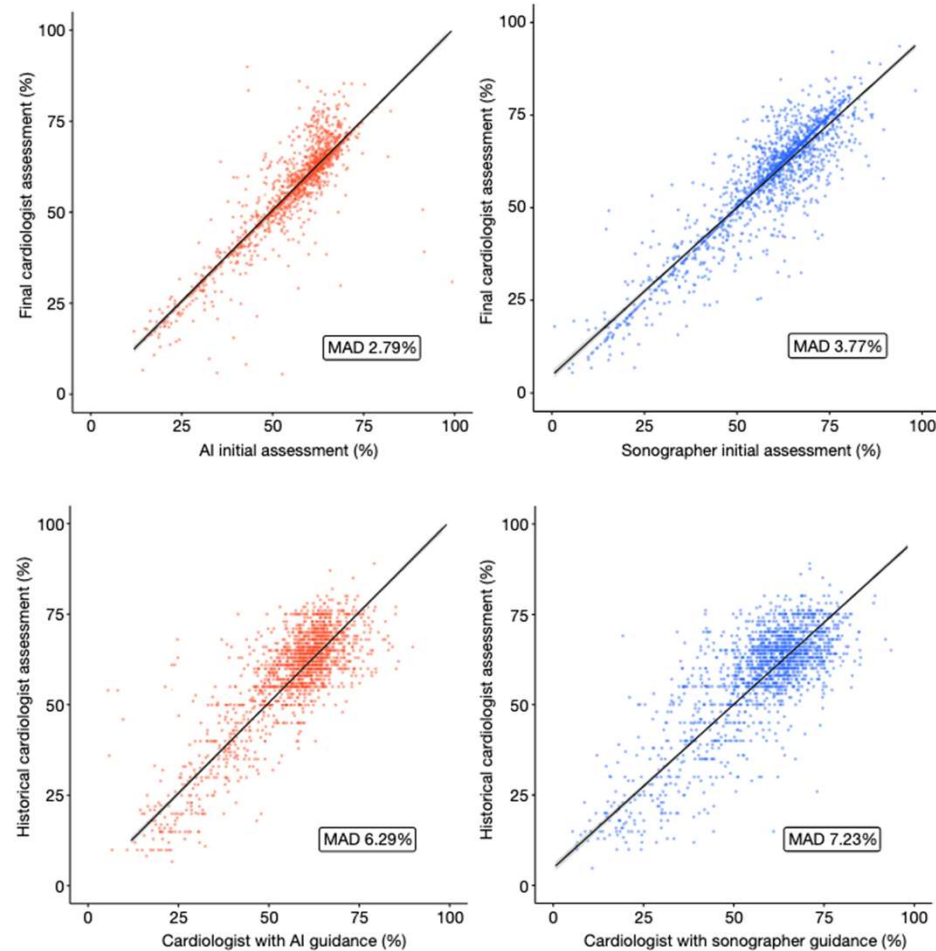
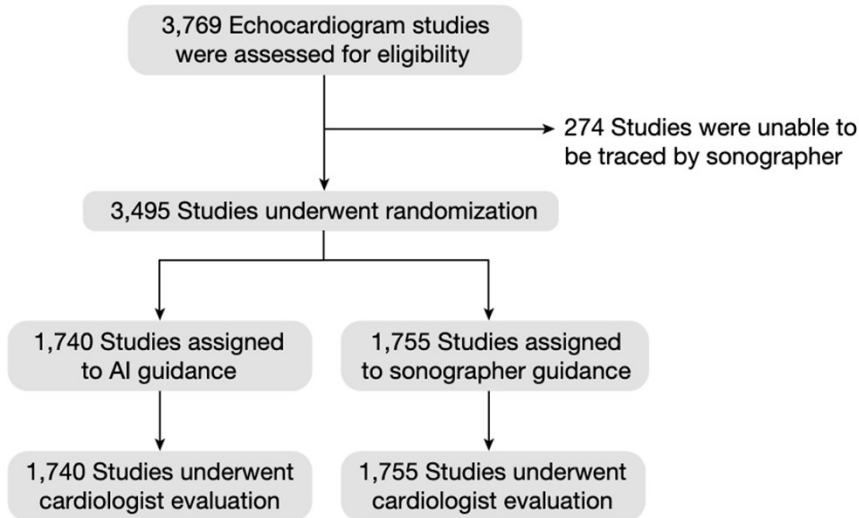
# Artificial Intelligence-powered ECG evaluation

Use case: Detection of acute coronary occlusion myocardial infarction



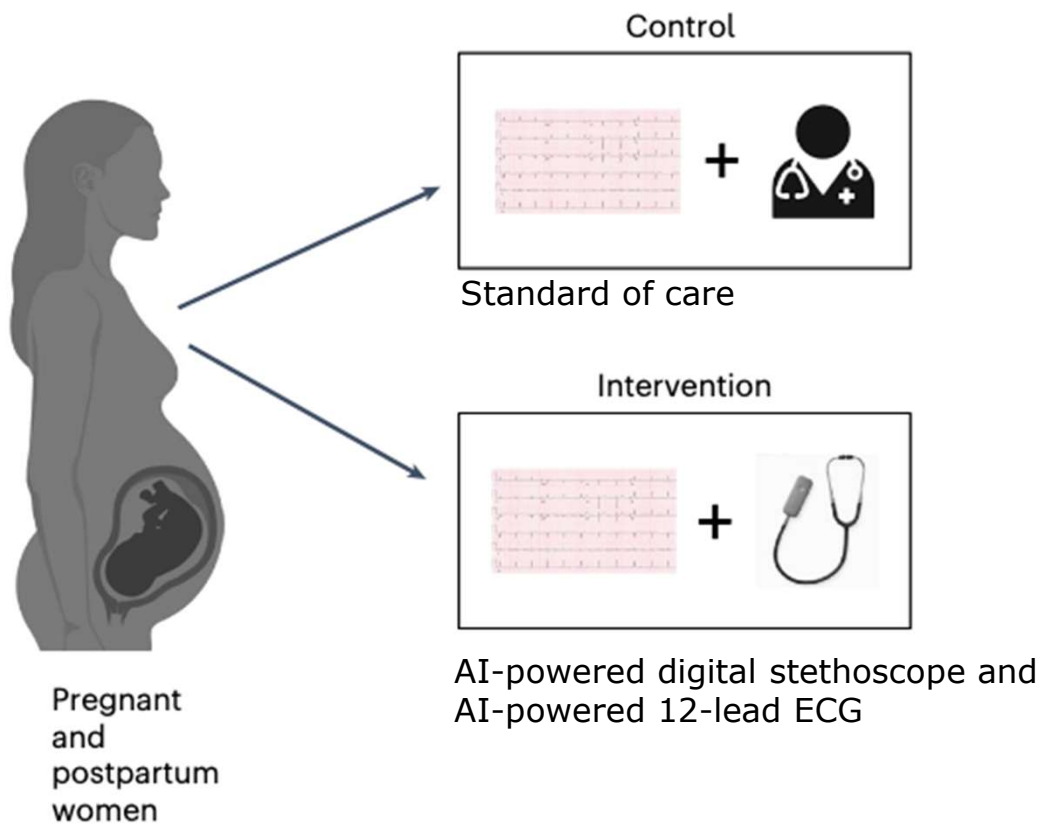
# AI-powered echocardiography

Use case: assessment of left ventricular ejection fraction (LVEF)



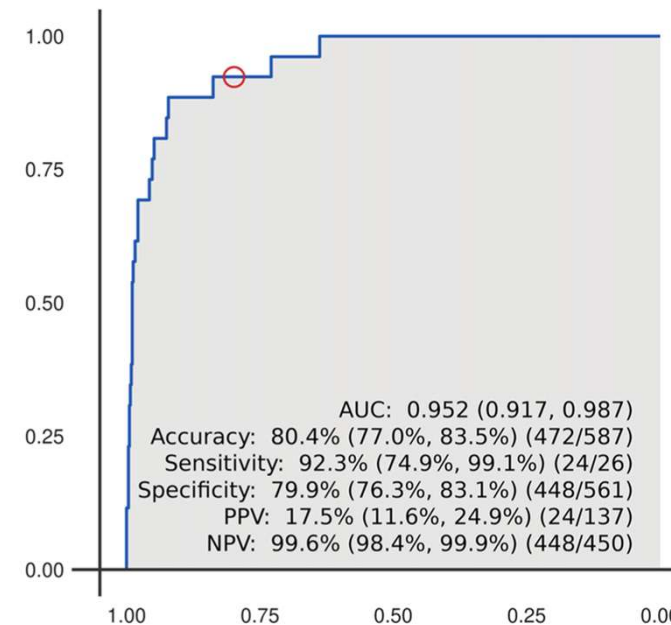
# AI-powered stethoscope

Use case: AI-guided screening for peripartum cardiomyopathies in Nigeria



LVEF < 50% detected:

- 4,1% in intervention arm
- 1,8% in control arm  
(OR 2.3; p=0.019)



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## Precision medicine

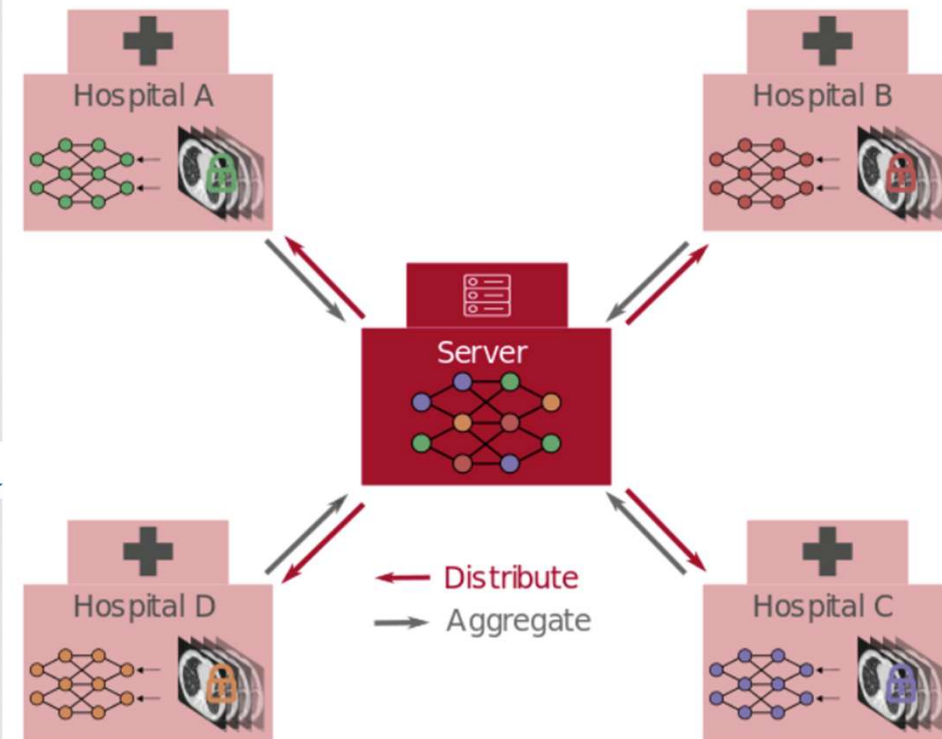
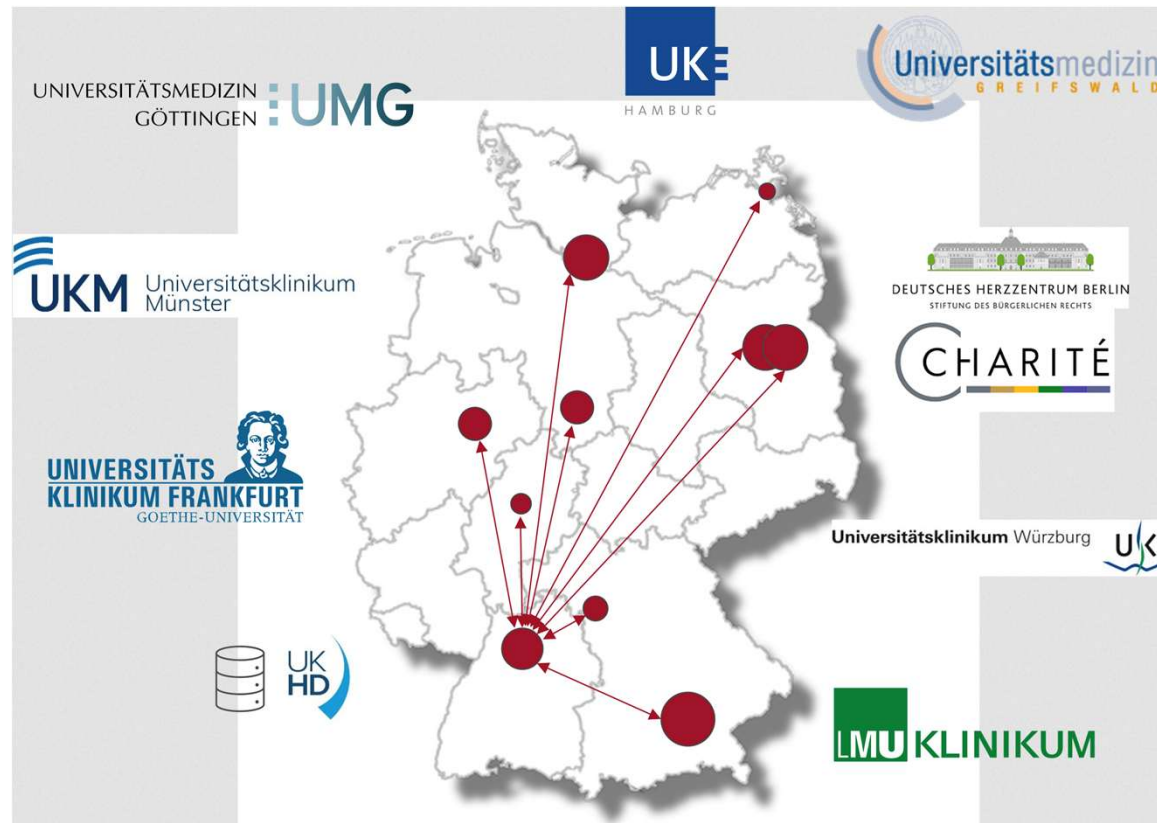
- Personalized treatment
- AI-powered Clinical Decision Support

## Contemporary platforms

- Federated Learning
- FAIR principle / FHIR

# Federated Learning

Use case: Federated deep learning of TAVI Outcomes (FLOTO)





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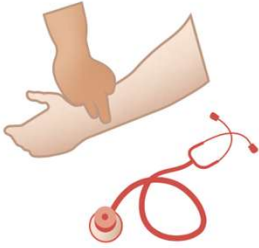

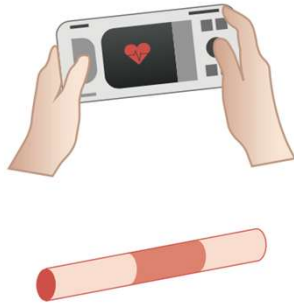
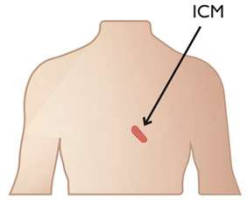
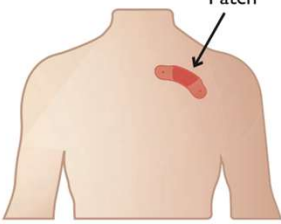


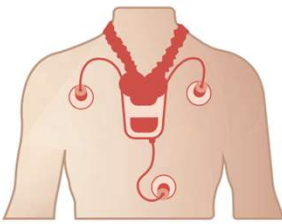
## Contemporary platforms

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## Next generation wearables

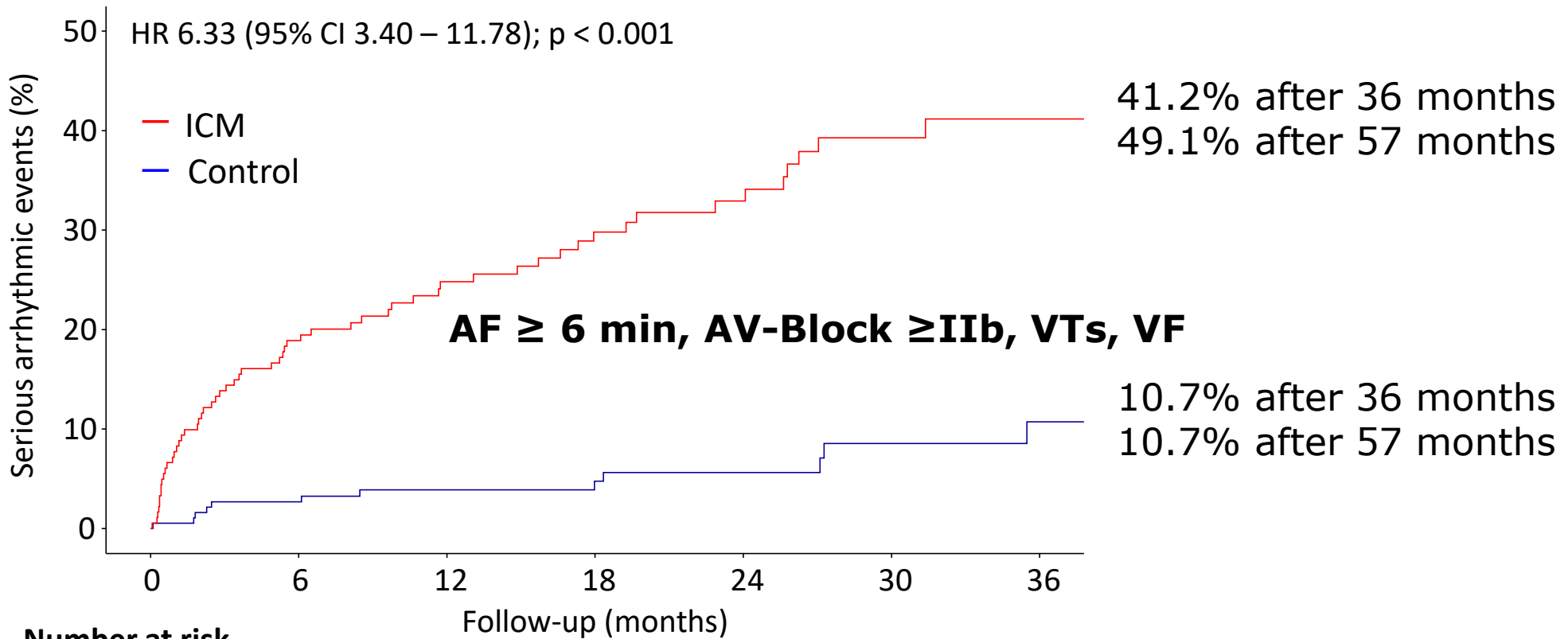
- Continuous telemonitoring
- Data Integration @ healthcare platforms

# Wearables in cardiovascular health

 <p>Patient initiated photoplethysmogram on smartphone</p>	 <p>Semi-continuous photoplethysmogram on a smartwatch or wearable</p>	 <p>Pulse palpitation, auscultation</p>	 <p>Stroke unit/in hospital telemetry monitoring</p>	 <p>Patient initiated (or medical professional) intermittent ECG rhythm strip using smartphone or dedicated connectable device</p>	 <p>Implantable cardiac monitors</p>
 <p>1-2 week continuous ECG patches</p>	 <p>Intermittent smartwatch ECG initiated by semi-continuous photoplethysmogram with prompt notification of irregular rhythm or symptoms</p>	 <p>Patient initiated (or medical professional) oscillometric blood pressure cuff</p>	 <p>Long-term Holter</p>		

# Implantable monitors in cardiovascular health

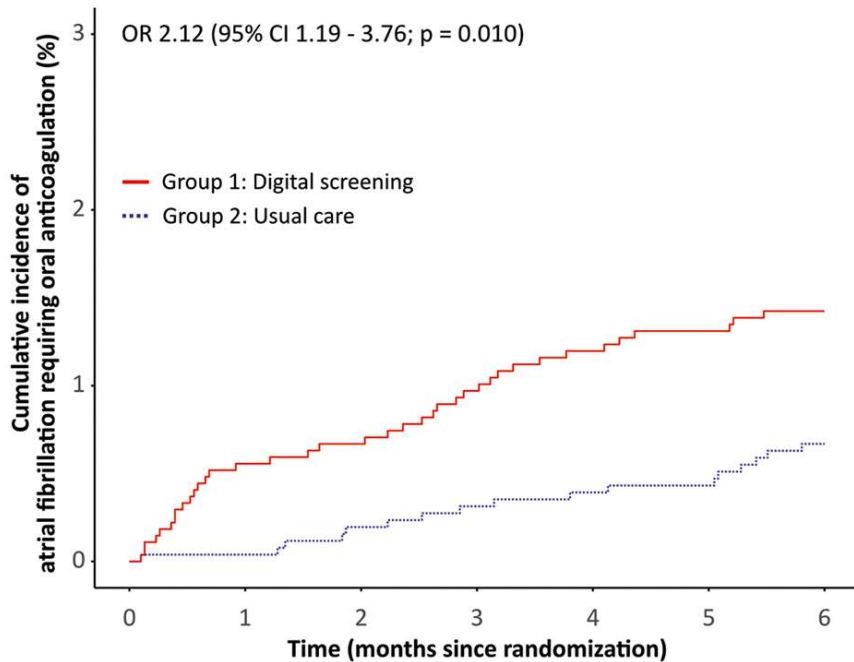
Use case: SMART-MI RCT – telemedicine detection of arrhythmias post-MI



Number at risk		Follow-up (months)						
	0	6	12	18	24	30	36	
ICM	201	144	105	76	57	36	24	
Control	199	177	139	109	83	56	41	

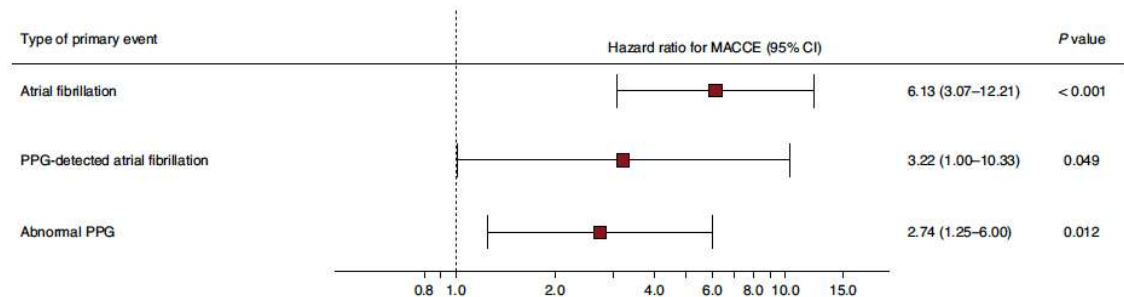
# Wearables in cardiovascular health

Use case: eBRAVE RCT – telemedicine screening for atrial fibrillation



Patients at risk

Group 1:	2860	2659	2640	2623	2614	2607	2603
Group 2:	2691	2557	2538	2531	2527	2521	2514



## → What is new?

- A strategy of digital screening using smartphones provides substantial benefits in detecting AF compared to usual care.
- **Novel site-less pragmatic study design**

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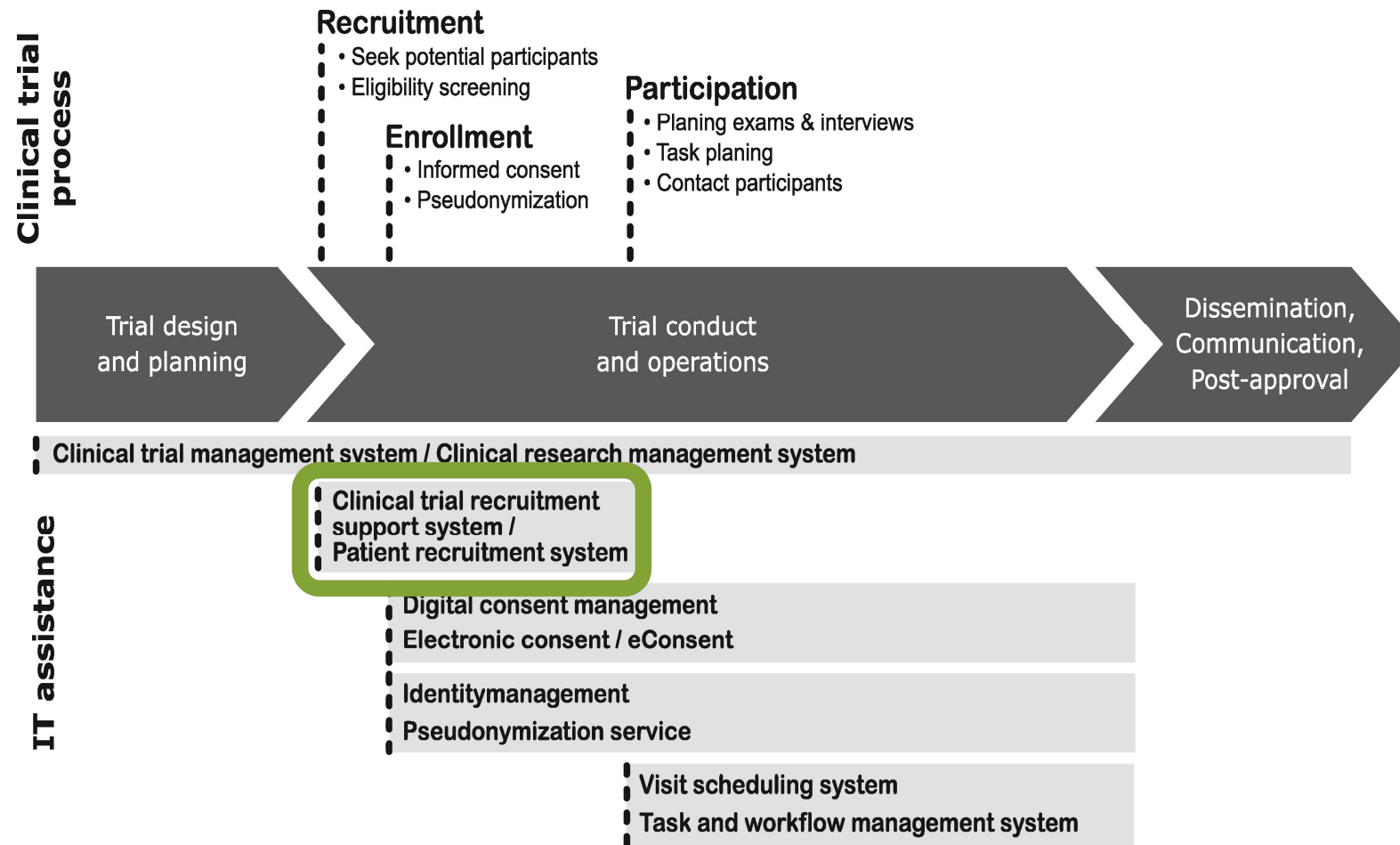
## Digital trial units

- Virtual clinical trials
- Clinical Trial Recruitment Support Systems

## Contemporary platforms





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# The digital clinical trial



# The digital clinical trial

Use case: **LMU** clinical trial recruitment tool

<u>Vorname</u> <u>Nachname</u>	XX.XX.XXXX	19.11.2021	MIGPM1hf	19.11.2021		Kandidat für Screening 
Name 2			MIGF4	19.11.2021		Kandidat für Screening 
Name 3			MIGF4	17.11.2021		Kandidat für Screening 
<u>Vorname</u> <u>Nachname</u>	<div style="background-color: #f0f0f0; padding: 5px;"> <p><b>PatientAge:</b> 46</p> <p><b>HIV:</b> No (19.11.2021)</p> <p><b>Ischämische Kardiomyopathie:</b> No (19.11.2021)</p> <p><b>Dilatative Kardiomyopathie:</b> Dilatative Kardiomyopathie ED 2013, 1 Bruder bereits verstorben, progredient im Verlauf, bei hochgradig dilatiertem LV mit hochgradig reduzierter LV-Pumpfunktion (19.11.2021)</p> <p><b>Left ventricular Ejection fraction by US:</b> 26.2 (19.11.2021) 21.154 (19.11.2021) 28.763 (19.11.2021) 29 (19.11.2021)</p> </div>					
Name 2						
Name 3						
<u>Vorname</u> <u>Nachname</u>	XX.XX.XXXX	19.11.2021	MIGPM1hf	19.11.2021		Kandidat für Screening  Kandidat für Screening Screening läuft E/A-Kriterien passend E/A-Kriterien nicht passend in Studie lehnt Studie ab
Name 2			MIGF4	19.11.2021		
Name 3			MIGF4	17.11.2021		

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## Digital trial units

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→ Optimized patient care



## Conclusions

- Digitalisation provides benefits for patients and healthcare providers.
- Balanced approach to innovation, addressing both technical and ethical considerations.
- Critical challenges (data privacy, security, and the need for robust interoperability across systems).
- Continued collaboration among stakeholders of utmost importance.