



AKADEMİK M.Ə.MİRQASIMOV ADINA  
RESPUBLİKA KLİNİK XƏSTƏXANASI



## Ürək çatışmazlığında süni intellekt gərəkirmi?

**Dr. Mehriban İsgəndər**

**Akademik M.Ə.Mirqasimov adına Respublika Klinik Xəstəxanası Kardiologiya Şöbəsi  
Azərbaycan Tibb Universiteti Tədris-Terapevtik Klinikası Ailə Təbabəti Kafedrası**

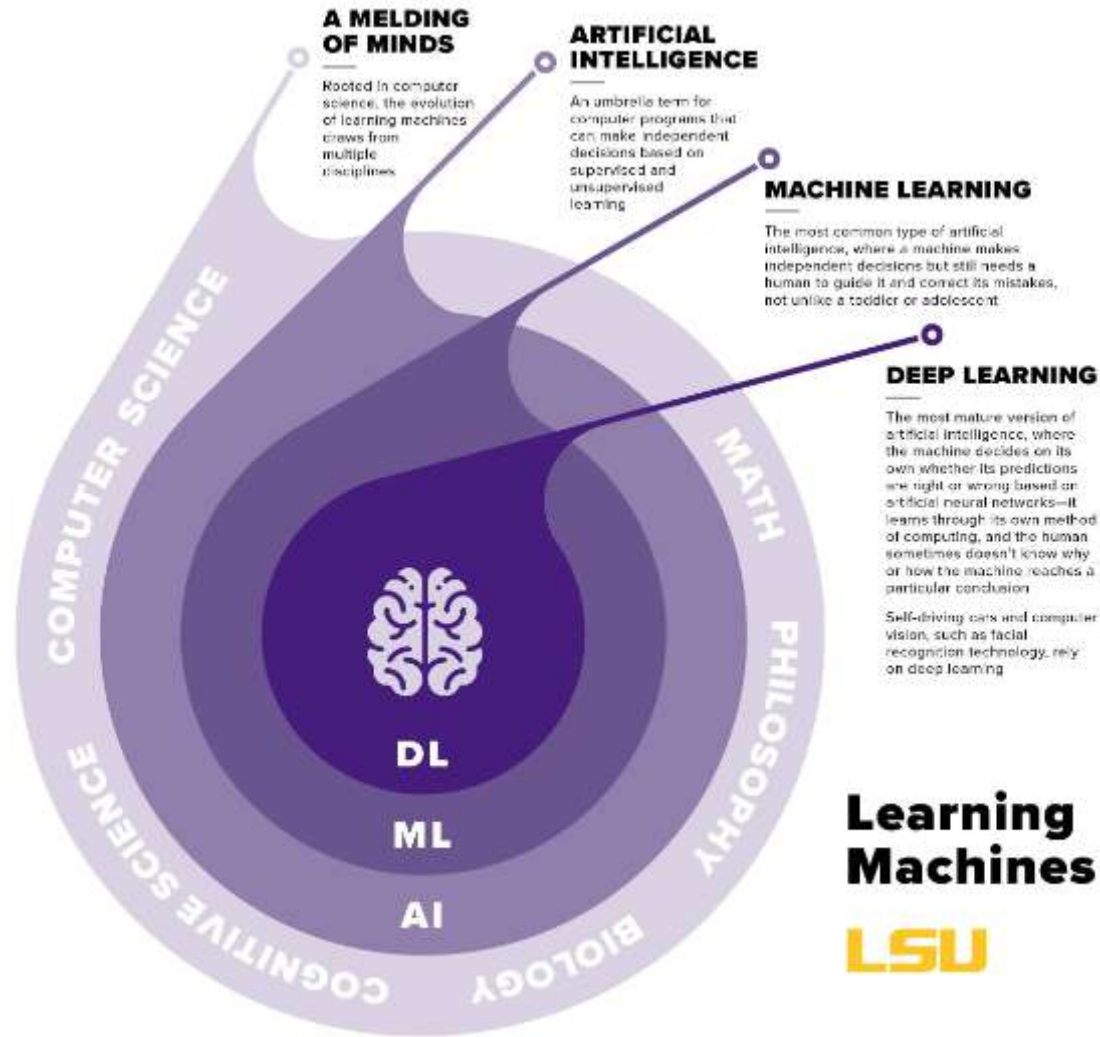
**Bakı - 2024**

**Açıqlamam yoxdur**

# Süni intellekt nədir?

- Süni intellekt kompüterlərə və maşınlara insan intellektini təqlid edən və problem həll etmə qabiliyyətlərini simulyasiya etməyə imkan verən texnologiyadır.



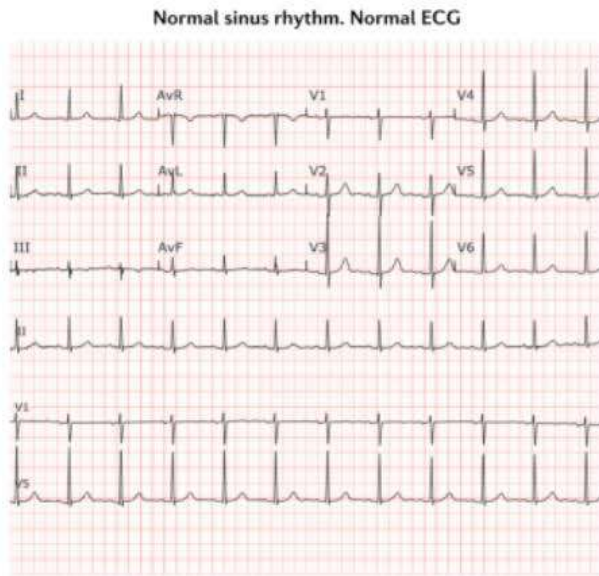
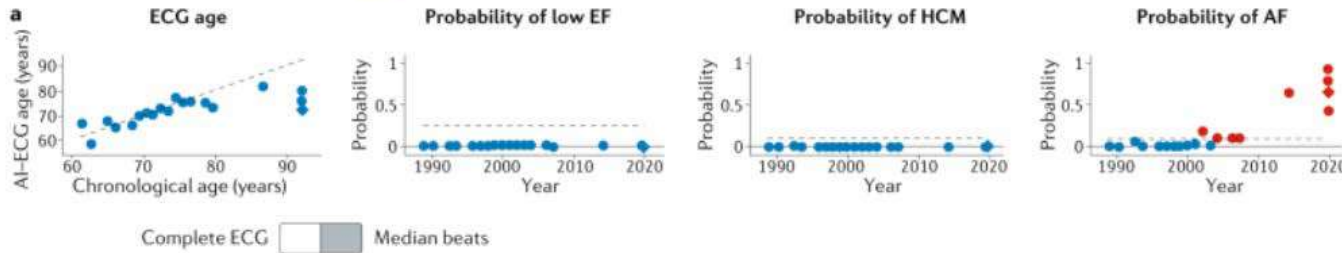


- ✓ Kökləri kompüter elmi ilə bağlı olan öyrənmə maşınlarının təkamülü bir çox fənlərdən qaynaqlanır
- ✓ Nəzarət olunan (supervised) və nəzarətsiz (unsupervised) öyrənmə əsasında müstəqil qərarlar qəbul edə bilən kompüter proqramları üçün ümumi termindir (rəqəmsal şəxsi assistent, chat və ya virtual müştəri xidməti)
- ✓ müstəqil qərar versə də, insan köməyinə ehtiyac var (idarə etmək və səhvləri korreksiya etmək üçün)
- ✓ Maşın özü proqnoz edir, sərbəst qərar verir (üz tanıma, self-driving cars)

# Artificial intelligence-enhanced electrocardiography in cardiovascular disease management

Konstantinos C. Siontis, Peter A. Noseworthy, Zachi I. Attia & Paul A. Friedman 

*Nature Reviews Cardiology* **18**, 465–478 (2021) | [Cite this article](#)



Results (screenshot from AI-ECG Dashboard)

ECG Date	Main Rhythm	Heart Rate	QT/QTc	Real Age	ECG Age	P of Male (%)	P of Low EF (%)	P of AF (%)	P of HCM (%)
XX/XX/2019	Atrial flutter	116	326/433	92.2	72.0	17.42%	0.59%	65.63%	0.01%
XX/XX/2019	Sinus tachycardia	109	356/477	92.2	79.7	16.35%	0.93%	43.52%	0.01%
XX/XX/2019	Normal sinus rhythm	79	426/488	92.1	79.7	7.77%	0.39%	92.94%	0.03%
XX/XX/2019	Sinus rhythm	92	396/492	92.1	75.7	7.55%	1.87%	78.84%	0.22%
XX/XX/2014	Normal sinus rhythm	69	434/465	86.7	81.5	1.04%	1.11%	65.15%	0.10%
XX/XX/2007	Normal sinus rhythm	63	456/466	79.7	72.9	0.57%	0.73%	18.84%	0.18%
XX/XX/2006	Normal sinus rhythm	69	436/463	78.6	74.9	2.94%	1.77%	16.28%	0.08%
XX/XX/2004	Normal sinus rhythm	63	448/454	76.6	75.3	2.99%	0.63%	18.71%	0.18%
XX/XX/2003	Normal sinus rhythm	68	436/460	75.5	75.0	0.13%	0.57%	1.79%	0.35%
XX/XX/2002	Normal sinus rhythm	65	436/449	74.5	76.9	2.19%	0.59%	18.86%	0.04%
XX/XX/2000	Normal sinus rhythm	74	404/445	73.4	71.5	0.59%	1.05%	2.61%	0.10%
XX/XX/1999	Normal sinus rhythm	85	388/461	72.4	72.5	1.66%	0.53%	1.48%	0.01%
XX/XX/1998	Normal sinus rhythm	71	420/456	71.3	70.1	1.91%	0.70%	0.42%	0.10%
XX/XX/1997	Normal sinus rhythm	85	388/461	70.4	70.9	0.39%	0.53%	0.45%	0.10%
XX/XX/1996	Normal sinus rhythm	68	416/442	69.4	69.6	0.46%	1.21%	0.24%	0.15%
XX/XX/1995	Normal sinus rhythm	68	444/472	68.4	65.8	0.99%	0.71%	0.50%	0.17%

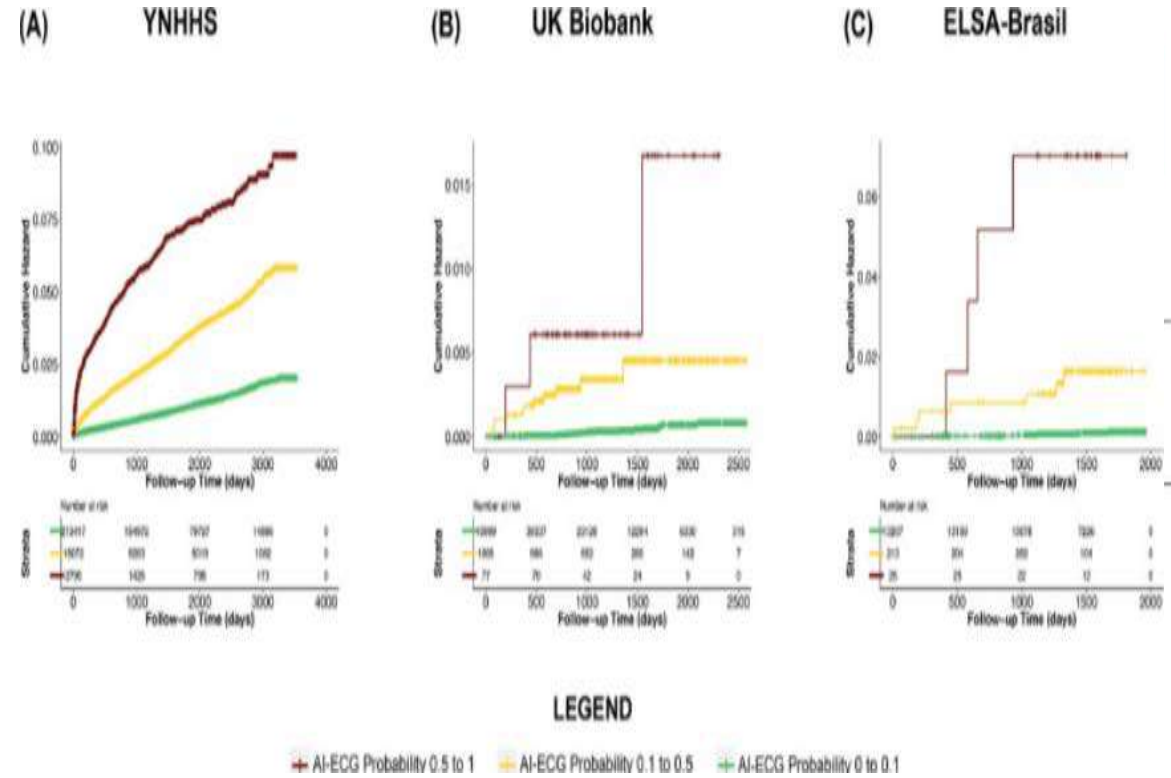
- Deep learning ilə EKQ-nin sürətli, insana bənzər interpretasiyasına imkan verən, hətta insan tərəfindən böyük ölçüdə tanınmayan siqnallar və ya nümunələri çox təbəqəli Sİ şəbəkələri tərəfindən dəqiqliklə aşkar edə bilər.
- Sİ-lə gücləndirilmiş EKQ ilə risk altında olan populyasiyalarda ürək-damar xəstəliklərinin aşkarlanmasında və ürək-damar xəstəliyi olan xəstələrdə klinik qərarların verilməsi məqsədi ilə də istifadə oluna bilər

# Scalable Risk Stratification for Heart Failure Using Artificial Intelligence applied to 12-lead Electrocardiographic Images: A Multinational Study

Lovedeep S Dhingra<sup>1</sup>, Arya Aminorroaya<sup>1</sup>, Veer Sangha<sup>1,2</sup>, Aline Pedroso Camargos<sup>1</sup>, Folkert W Asselbergs<sup>3,4,5</sup>, Luisa Cc Brant<sup>6,7</sup>, Sandhi M Barreto<sup>8</sup>, Antonio Luiz P Ribeiro<sup>6,7</sup>, Harlan M Krumholz<sup>1,9,10</sup>, Evangelos K Oikonomou<sup>1</sup>, Rohan Khera<sup>1,9,11,12</sup>

Affiliations + expand

PMID: 38633808 PMCID: PMC11023679 DOI: 10.1101/2024.04.02.24305232



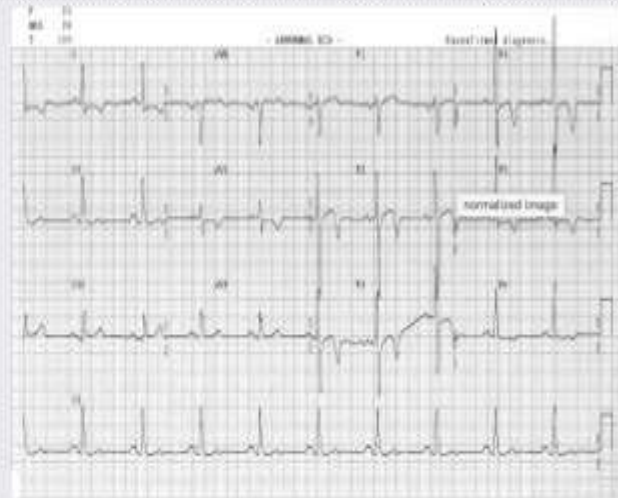
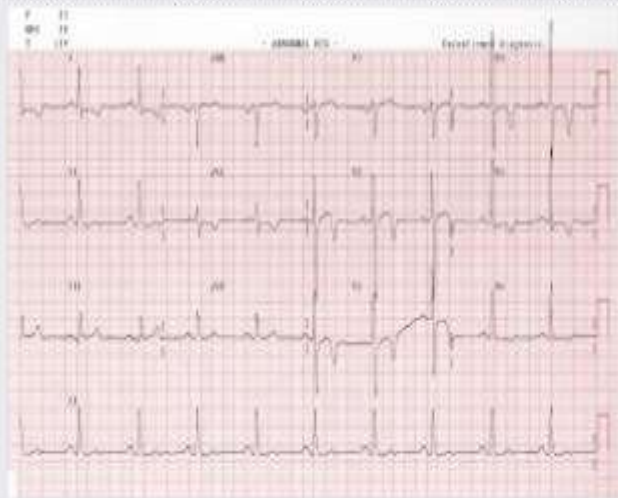
**Noticə:** 231,285 YNHHS, 4472 ilk ÜÇH 4.5 il ərzində (IQR 2.5-6.6),UKB və ELSA-Brasil, 42,741 və 13,454 şəxsə, 46 və 31 nəfərdə ilk ÜÇH 3.1 (2.1-4.5) və 4.2 (3.7-4.5) il ərzində izləndi.

## Identification of Hypertrophic Cardiomyopathy on Electrocardiographic Images with Deep Learning

● Veer Sangha, ● Lovdeep Singh Dhingra, ● Evangelos Oikonomou, ● Arya Aminorroaya, Nikhil V Sikand, ● Sounok Sen, ● Harlan M Krumholz, ● Rohan Khara

doi: <https://doi.org/10.1101/2023.12.23.23300490>

Drag and Drop or Select Files



### Prediction result:

The ECG image suggests a high probability of Hypertrophic Cardiomyopathy - Screen positive.  
Predicted probability: 56.31%.





# Patented motion sensor technology

## Method

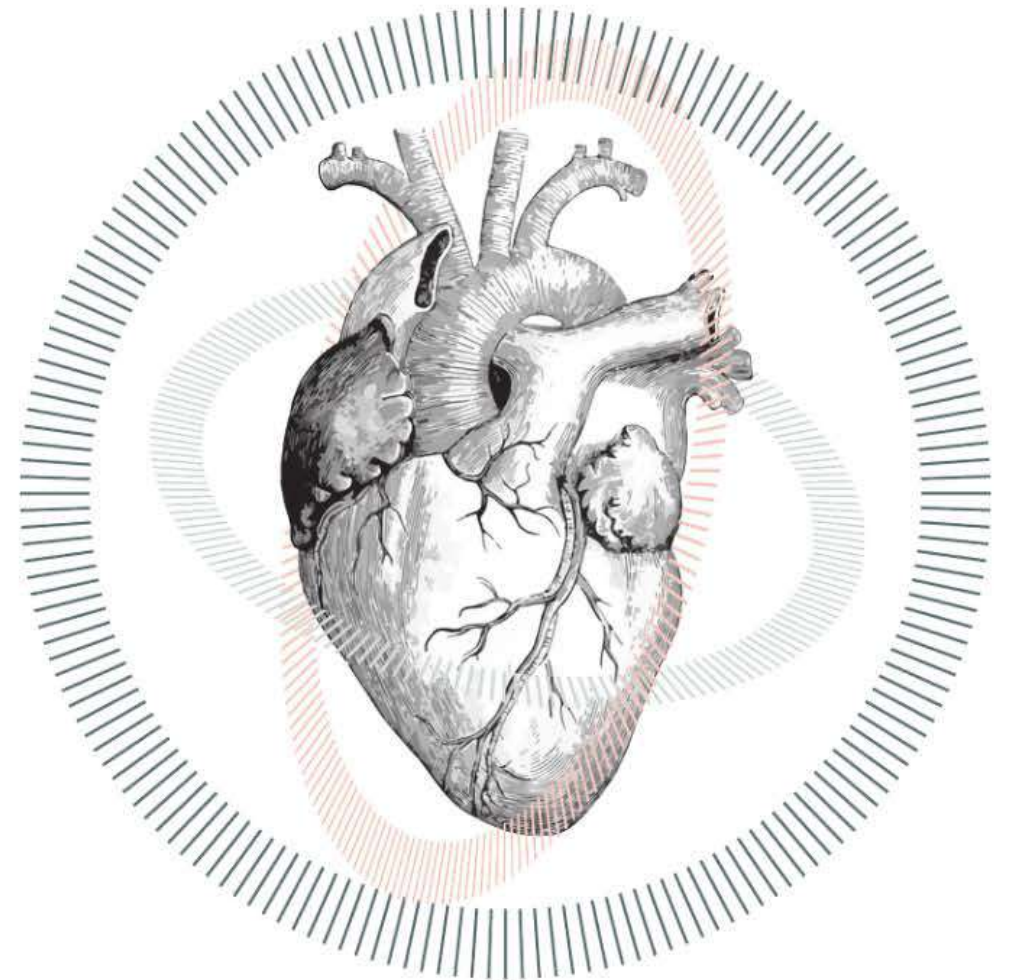
Gyrocardiography, a non-invasive technique for measuring heart motion with a gyroscope and accelerometer

## Scientific basis

Technology based on 10+ years of academic research and 20+ peer-reviewed publications

## Clinical studies

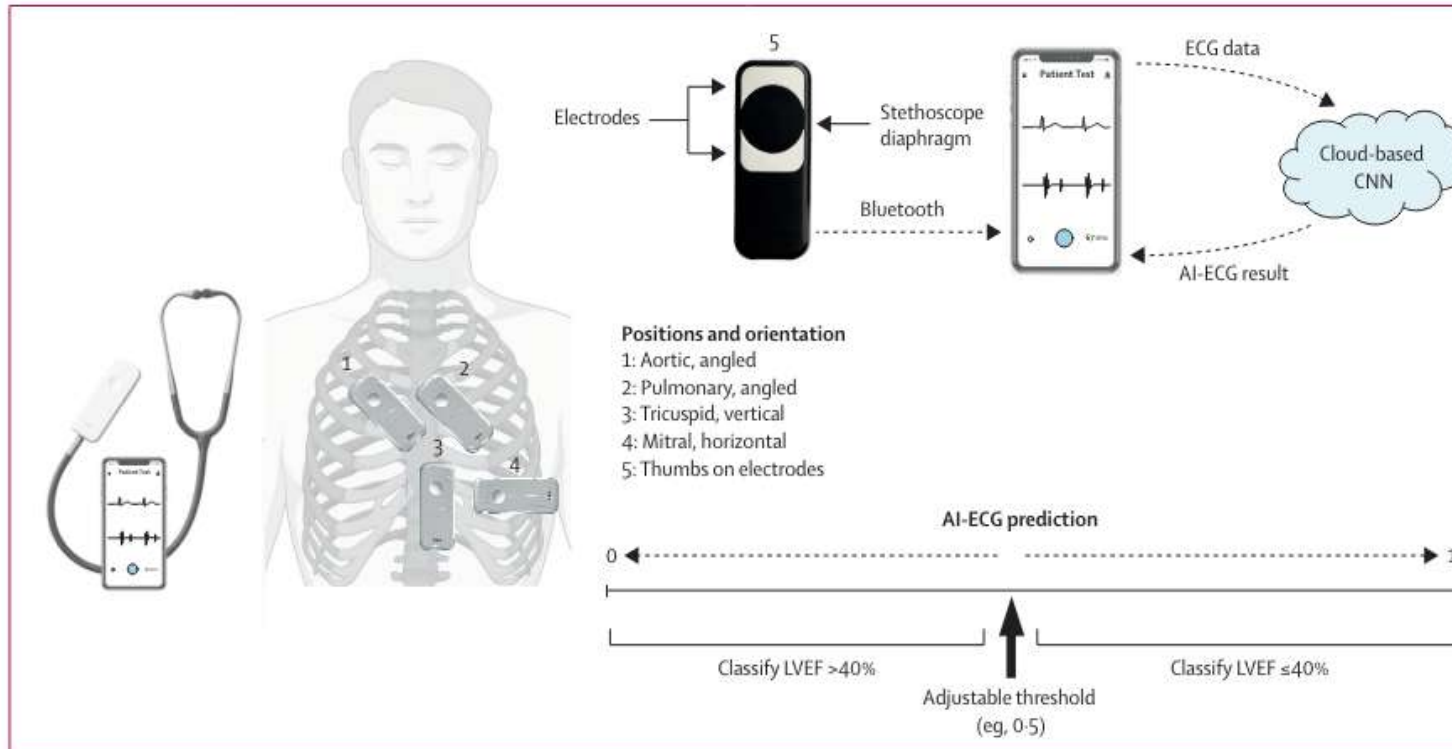
Validated in clinical studies, with continuous focus on academic collaboration





# Point-of-care screening for heart failure with reduced ejection fraction using artificial intelligence during ECG-enabled stethoscope examination in London, UK: a prospective, observational, multicentre study

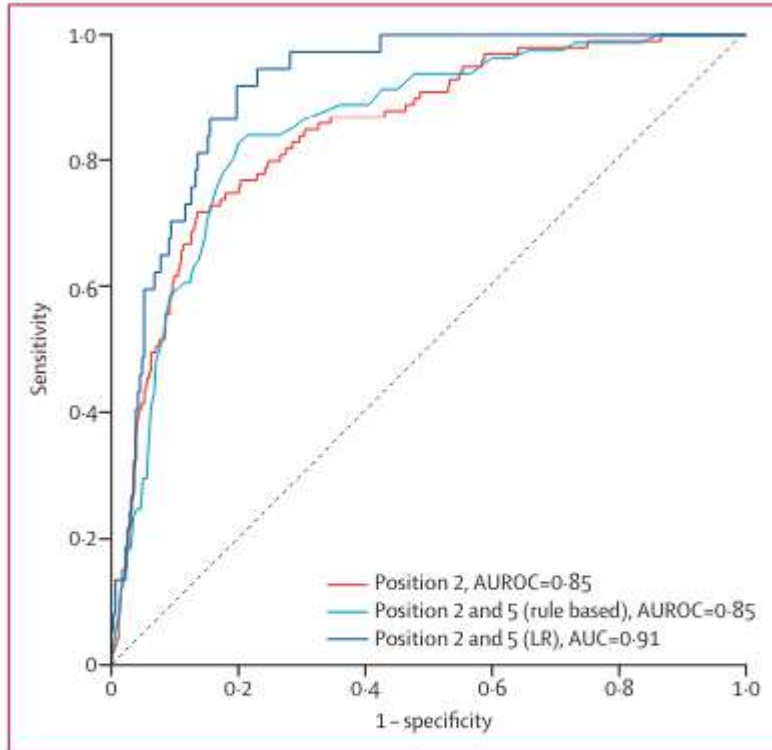
Patrik Bachtiger, Camille F Petri, Francesca E Scott, Se Ri Park, Mihir A Kelshiker, Harpreet K Sahemey, Bianca Dumea, Regine Alquero, Pritpal S Padam, Isobel R Hatrick, Alfa Ali, Maria Ribeiro, Wing-See Cheung, Nina Bual, Bushra Rana, Matthew Shun-Shin, Daniel B Kramer, Alex Fragoyannis, Daniel Keene, Carla M Plymen, Nicholas S Peters



	All participants (n=1050)	LVEF >40 group (n=945)	LVEF ≤40 group (n=105)	p value
Age, years				
18-69	636 (61%)	583 (62%)	53 (50%)	0.034
≥70	414 (39%)	362 (38%)	52 (50%)	..
Mean (SD)	62 (17.4)	62 (17.5)	67 (15.3)	0.0014
Sex				
Male	535 (51%)	466 (49%)	69 (66%)	0.0015
Female	..	..	..	..
Mean TTE LVEF (SD), %	54% (10.3)	57% (5.8)	30% (8.2)	<0.0001
Ethnicity	..	..	..	0.4
Asian	199 (19%)	176 (19%)	23 (22%)	..
Black	95 (9%)	84 (9%)	11 (10%)	..
Mixed	22 (2%)	18 (12%)	<5	..
Other	116 (11%)	102 (11%)	14 (13%)	..
White	618 (59%)	565 (60%)	53 (50%)	..
Medical history				
Hypertension	395 (38%)	338 (36%)	57 (54%)	<0.0001
Myocardial infarction	102 (10%)	62 (6%)	40 (38%)	<0.0001
Atrial fibrillation	173 (16%)	146 (15%)	27 (26%)	0.011
Pacemaker	59 (6%)	43 (5%)	16 (15%)	<0.0001
Diabetes	224 (21%)	181 (19%)	43 (41%)	<0.0001
Stroke or transient ischaemic attack	100 (10%)	85 (9%)	15 (14%)	0.11
Chronic kidney disease	98 (9%)	74 (8%)	24 (23%)	<0.001
Smoking	148 (14%)	132 (14%)	16 (15%)	0.78
Excessive alcohol intake	26 (2%)	25 (2.6%)	<5	0.48
Hypercholesterolaemia	188 (18%)	159 (17%)	29 (28%)	0.0098
Pregnancy (current)	21 (2%)	21 (2%)	0	0.24
Chronic obstructive pulmonary disease	57 (5%)	48 (5%)	9 (8%)	0.20

Data are n (%) unless otherwise stated. Characteristics reported in fewer than five participants are shown as <5. p values were calculated via Student's t test or Pearson's  $\chi^2$  test. Ethnicity was self-reported from a list of 18 options drawn from the UK Office of National Statistics Census for England.<sup>15</sup> Full ethnicity breakdown is available in the appendix (p 2). TTE LVEF=transthoracic echocardiogram-derived left ventricular ejection fraction.

**Table 1: Baseline characteristics of study participants**



**Figure 3: Receiver operating characteristic curves detection of reduced LVEF**  
Data are shown for the single-best performing position (pulmonary), rule-based optimal combination of two positions (pulmonary and handheld), and exploratory logistic regression model with l2 regularisation using AI-enabled ECG outputs from optimal combination of two positions. AUROC=area under the receiver operating characteristic curve. LR=logistic regression. LVEF=left ventricular ejection fraction.

Group	Sensitivity	Specificity	Diagnostic OR (95% CI)
Female, 18–69 years	87.5% (14/16)	84.0% (242/288)	22.8 (6.2–83.2)
Female, ≥70 years	73.3% (11/15)	84.0% (136/162)	10.5 (3.3–33.1)
Male, 18–69 years	88.9% (32/36)	67.9% (188/277)	13.1 (4.9–34.8)
Male, ≥70 years	80.6% (25/31)	75.0% (114/152)	10.3 (4.1–25.8)
Non-White	68.0% (34/50)	84.9% (304/358)	10.9 (5.7–21.0)
<b>Overall</b>	<b>71.7% (84/99)</b>	<b>86.4% (612/880)</b>	<b>12.4 (7.5–20.5)</b>

	Adequate ECG, n/N (%)	AUC	Maximising Se and Sp equally (Youden index)					Maximising Se and Sp with rule Se >81, Sp >67, Se >81, or maximising Sp						
			Threshold	Se	Sp	PPV	NPV	F1 score	Threshold	Se	Sp	PPV	NPV	F1 score
1	846/1050 (80.6%)	0.75	0.370	77.1	60.7	17.3	95.9	0.282	0.345	81.9	53.3	15.8	96.2	0.264
2	979/1050 (93.2%)	0.85	0.443	71.7	86.5	37.0	96.3	0.486	0.341	84.8	69.5	23.6	97.4	0.369
3	946/1050 (90.1%)	0.78	0.489	68.1	77.4	24.7	95.5	0.361	0.280	81.9	55.2	16.6	96.3	0.275
4	968/1050 (92.2%)	0.78	0.420	62.9	80.6	26.2	95.0	0.368	0.312	81.4	58.4	17.7	96.4	0.290
5	916/1050 (87.2%)	0.79	0.427	62.8	83.4	27.7	95.5	0.383	0.304	81.4	60.1	17.5	96.8	0.287
2 and 5	864/1050 (82.3%)*	0.85	0.450	82.7	79.9	29.9	87.8	0.439	0.450	82.7	79.9	29.9	87.8	0.439
2 and 5, LR	346/864 (40%) <sup>†</sup>	0.91	0.497	91.9	80.2	35.1	98.4	0.503	0.497	91.9	80.2	35.1	98.4	0.503

AUC=area under the curve. 1=aortic. 2=pulmonary. 3=tricuspid. 4=mitral. 5=handheld. AI=artificial intelligence. LR=logistic regression. Se=sensitivity. Sp=specificity. PPV=positive predictive value. NPV=negative predictive value. \*Number of patients who had adequate recordings at both position 2 and 5, where a positive AI-ECG result as per threshold was considered a positive test. †Representing 40% testing dataset from the original 864 participants with both position 2 and 5 recordings.

**Table 2: Performance characteristics of AI-ECG, by position**

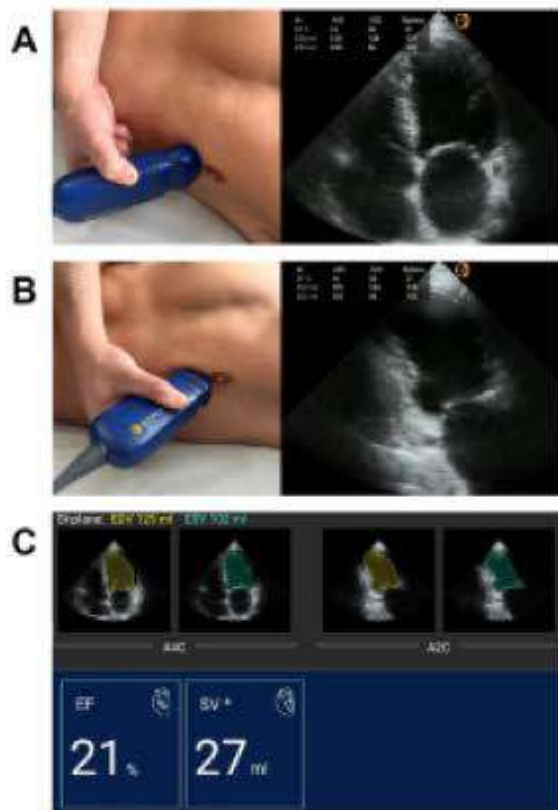
# Diagnostic accuracy of point-of-care ultrasound with artificial intelligence-assisted assessment of left ventricular ejection fraction

JAMA Cardiology | **Original Investigation**

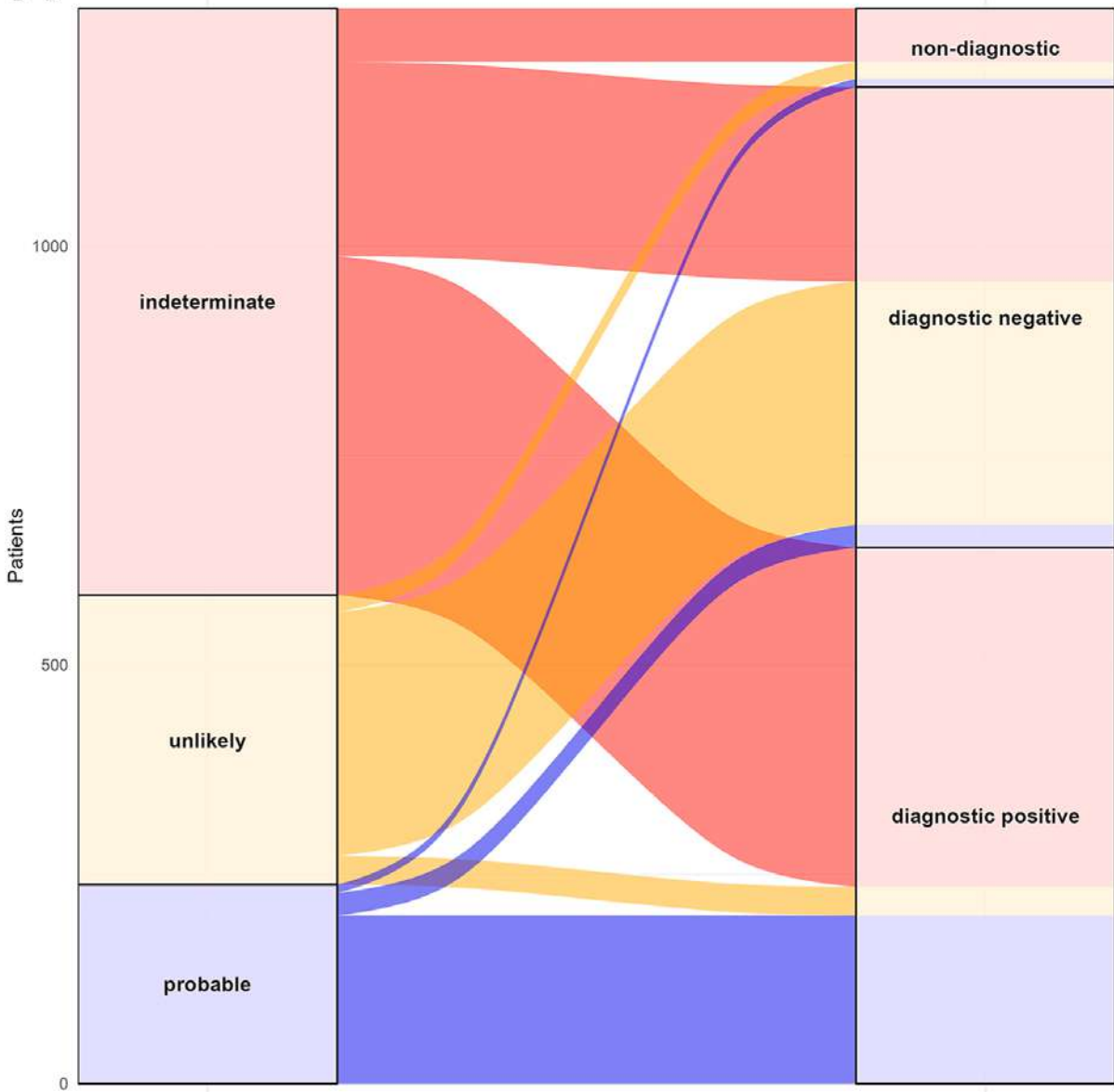
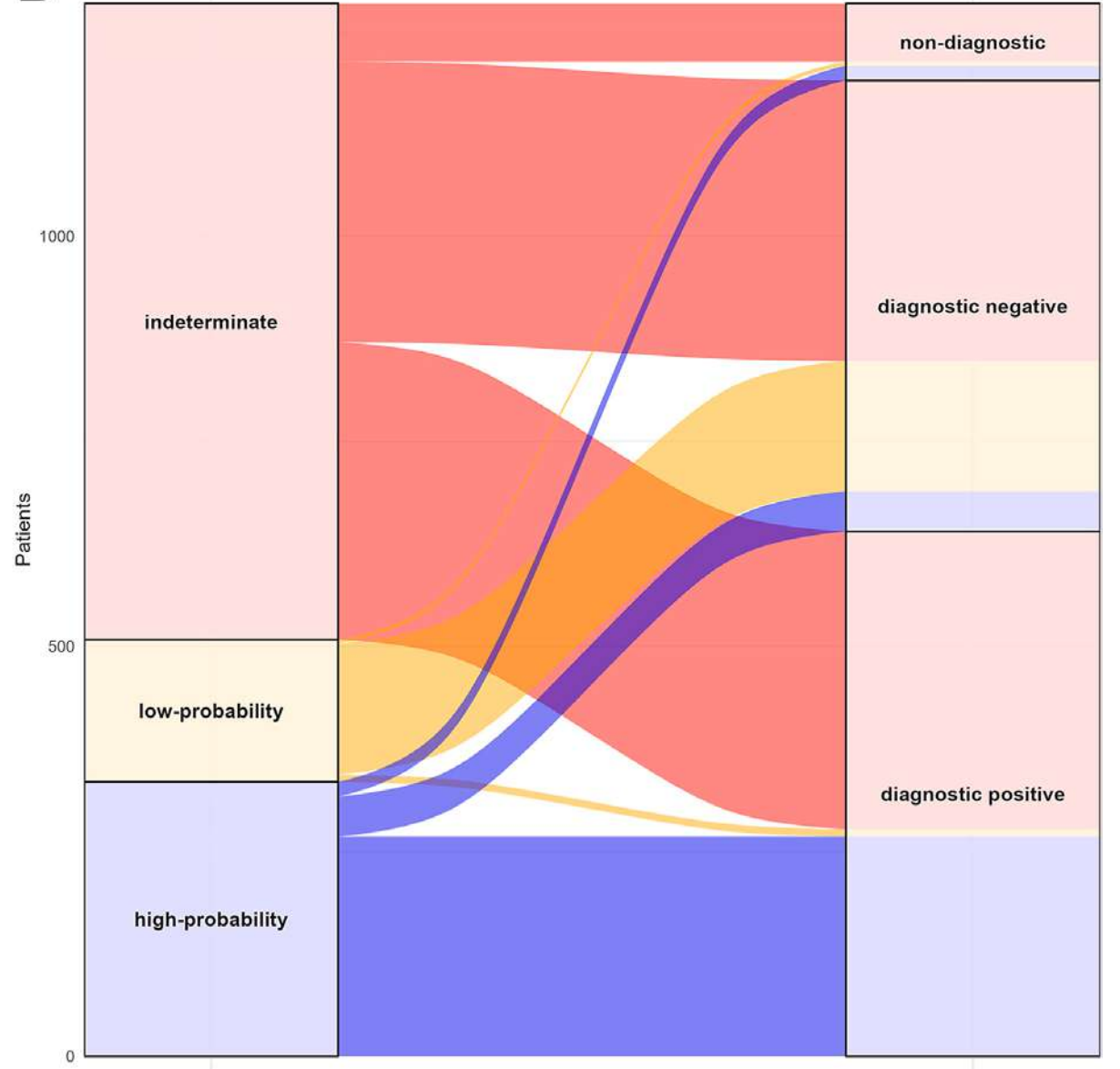
## Utility of a Deep-Learning Algorithm to Guide Novices to Acquire Echocardiograms for Limited Diagnostic Use

Akhil Narang, MD; Richard Bae, MD; Ha Hong, PhD; Yngvil Thomas, MS; Samuel Surette, BS; Charles Cadieu, PhD; Ali Chaudhry, MBA; Randolph P. Martin, MD; Patrick M. McCarthy, MD; David S. Rubenson, MD; Steven Goldstein, MD; Stephen H. Little, MD; Roberto M. Lang, MD; Neil J. Weissman, MD; James D. Thomas, MD

*JAMA Cardiol.* 2021;6(6):624-632.



**Findings** In this diagnostic study, 8 nurses without prior ultrasonography experience used artificial intelligence guidance to scan 30 patients each with a 10-view echocardiographic protocol (240 total patients). Five expert echocardiographers blindly reviewed these scans and felt they were of diagnostic quality for left ventricular size and function in 98.8% of patients, right ventricular size in 92.5%, and presence of pericardial effusion in 98.8%.

**A****B**

HFA-PEFF patients with VS without HFrEF, more often than clinical scores, and included patients with higher mortality. AI HFpEF H2FPEF AI HFpEF


Artificial intelligence [+ Add to myFT](#)

## Hippocratic hits \$500mn valuation as tech investors seek new bets in AI

One-year-old healthcare start-up gains investment from venture groups including General Catalyst and Andreessen Horowitz

 <p><b>Keisha</b> CHF Discharge Rating by Nurses: 82% Style: Direct Estimated Cost: &lt;\$9/hr*</p>	 <p><b>Diane</b> CKD Chronic Care Rating by Nurses: 80% Style: Engaging Estimated Cost: &lt;\$9/hr*</p>	 <p><b>Wyatt</b> CKD Chronic Care Rating by Nurses: 80% Style: Engaging Estimated Cost: &lt;\$9/hr*</p>	 <p><b>Nancy</b> Pre-Op Colonoscopy Rating by Nurses: 88% Style: Direct Estimated Cost: &lt;\$9/hr*</p>
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Hippocratic AI [Foundation Model](#) [Safety](#) [Research](#) [Company](#) [Test our AI](#)

Read about our new financing and partnership with NVIDIA. Check out Jensen's video where he talks about us. 

### Safety Focused Generative AI for Healthcare

Choose a Role to Get Started

- All
- Pre-op
- Discharge
- Chronic Care
- Nutritionist
- Payor
- VBC/At Risk
- Pharma
- Pharmacy



### Linda

CHF Discharge

Linda is designed to follow up with a patient admitted and discharged for Congestive Heart Failure. She focuses on their follow up care for 30 days or more post discharge. She checks in on a number of things such as symptoms, medication adherence and lifestyle adjustments. See the detailed list below.

Style: Direct

Estimated Cost: <\$9/hr\*

[Test our AI](#)

(a) Dialogue example



Hello, I am a primary care physician and this is a chest x-ray for a patient of mine. The formal radiology report is still pending and I would like some help to understand the x-ray. Please write a radiology report for me:

**FINDINGS:** The heart is at the upper limits of normal size. The mediastinal and hilar contours appear within normal limits. The lungs appear clear. There are no pleural effusions or pneumothorax. Mild degenerative changes are noted along the lower thoracic spine. **IMPRESSION:** No evidence of acute disease.

What evidence do you see for degenerative changes?

Mild degenerative changes are noted along the lower thoracic spine. This can be seen by the slight narrowing of the intervertebral disc spaces and the presence of small osteophytes (bone spurs) along the anterior margins of the vertebral bodies.

My patient has a history of back pain. Might this explain the back pain?

While the degenerative changes seen on the x-ray could potentially contribute to your patient's back pain, it's important to note that correlation doesn't equal causation. Many people have degenerative changes in their spine without experiencing pain, and conversely, back pain can have numerous causes beyond just degenerative changes.

Therefore, while the x-ray findings are worth noting, they don't definitively explain your patient's back pain. A comprehensive evaluation, including a detailed history, physical examination, and potentially additional imaging or tests, would be necessary to determine the exact cause of their pain.

Please let me know if you have any other questions.

To help me communicate all of this to my patient, please rewrite the report without medical terminology:

**Chest X-ray Results:**

- **Heart:** Normal size.
- **Lungs:** Clear, no signs of infection or fluid buildup.
- **Bones:** Minor wear and tear in the lower spine, common with age.

**Overall:** No signs of serious problems in the chest. The wear and tear in the lower spine might be related to your back pain, but other factors could also be involved. We'll need to do more tests to figure out the exact cause of your pain.

Thank you. That is useful while I wait for the radiologists report.

You're welcome! I'm glad I could help. If you have any further questions, feel free to ask.

**Ground truth report (not provided to model)**

**FINDINGS:** The cardiomeastinal and hilar contours are normal. The lungs are well expanded and clear, without focal consolidation, pleural effusion or pneumothorax. Mild degenerative changes are seen in the thoracic spine. **IMPRESSION:** No acute cardiopulmonary pathology.



# Disease management guidelines are all analogue...



ESC

European Society  
of Cardiology

European Heart Journal (2021) 42, 3599–3726  
doi:10.1093/eurheartj/ehab368

ESC GUIDELINES

## 2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure

**Developed by the Task Force for the diagnosis and treatment of acute and chronic heart failure of the European Society of Cardiology (ESC)**

**With the special contribution of the Heart Failure Association (HFA) of the ESC**

# There is a need for computable guidelines

The HDR UK Phenotype Library is a comprehensive, open access resource providing the research community with information, tools and phenotyping algorithms for UK electronic health records.




994 Phenotypes    2147 Concepts    162689 Clinical Codes    39 Data Sources    16 Coding Systems

← C1208/3555 Heart failure - Secondary care - Diagnoses - ICD10 codes

Rows: 4

Show 10 entries    Search:

Code	Description	Disease	Category
I11.0	Hypertensive heart disease with (congestive) heart failure	Heart failure	Diagnosis of Heart failure
I13.0	Hypertensive heart and renal disease with (congestive) heart failure	Heart failure	Diagnosis of Heart failure
I13.2	Hypertensive heart and renal disease with both (congestive) heart failure and renal failure	Heart failure	Diagnosis of Heart failure
I50	Heart failure	Heart failure	Diagnosis of Heart failure

Showing 1 to 4 of 4 entries

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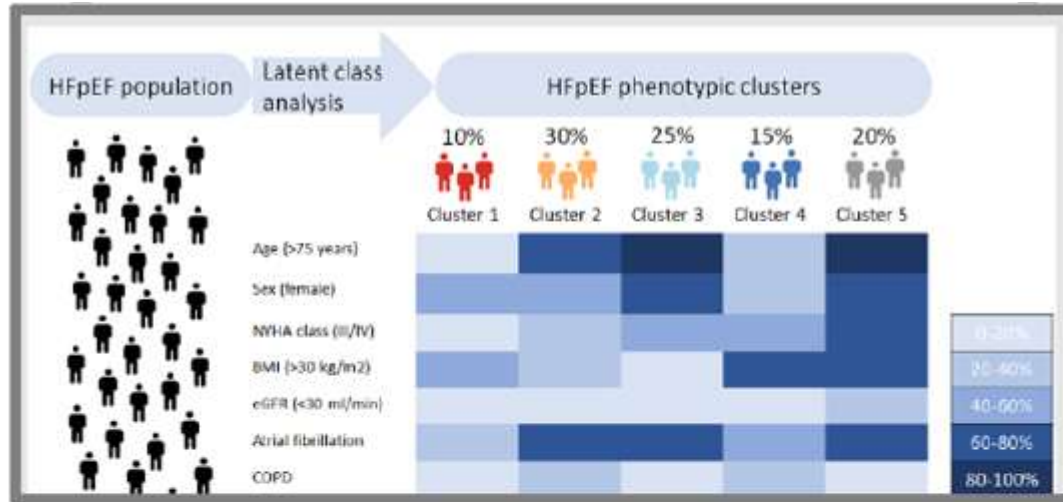
## Heart failure

Kuan V, Denaxas S, Gonzalez-Izquierdo A, Direk K, Bhatti O, Husain S, Sutaria S, Hingorani M, Nitsch D, P Casas JP, Wong I, Hemingway H, Hingorani A

Type	Disease or Syndrome
ID	PH182
Version ID	364
Data Sources	<a href="#">CPRD GOLD</a> , <a href="#">HES Admitted Patient Care data for CPRD GOLD</a>
Valid event data range	01/01/1999 - 01/07/2016
Sex	Female, Male
Agreement Date	2019-05-20
Coding system	<a href="#">Read codes v2</a> <a href="#">ICD10 codes</a> <a href="#">Med codes</a>
Tags /Collections	<a href="#">CALIBER</a> <a href="#">Phenotype Library</a>

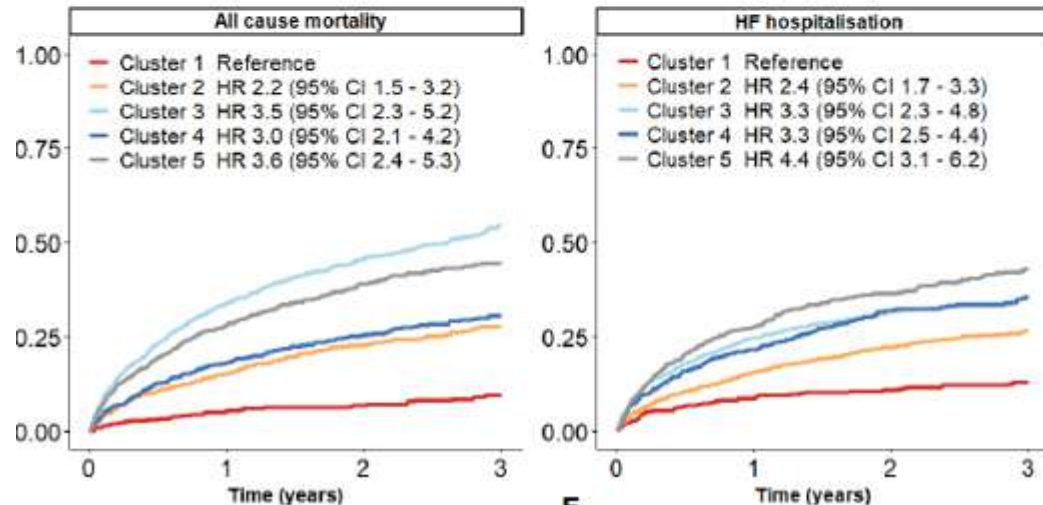


# Identification of distinct phenotypic clusters in heart failure with preserved ejection fraction





□ Qrup modeli Swedish Heart Failure Registry (SwedeHF) 6909 HFpEF pasiyentlər və Chronic Heart Failure ESC-guideline based Cardiology practice Quality project (CHECK-HF) registry 2153 olan pasiyentlərin məlumatlarından əldə olunub

□ Bu 5 qrupda olan pasiyentlər klinik xüsusiyyətlərinə və proqnozuna görə bir birindən fərqlənib (fərdi müalicə yanaşması konsepti qəbul olunub)



# Efficacy of $\beta$ blockers in patients with heart failure plus atrial fibrillation: an individual-patient data meta-analysis

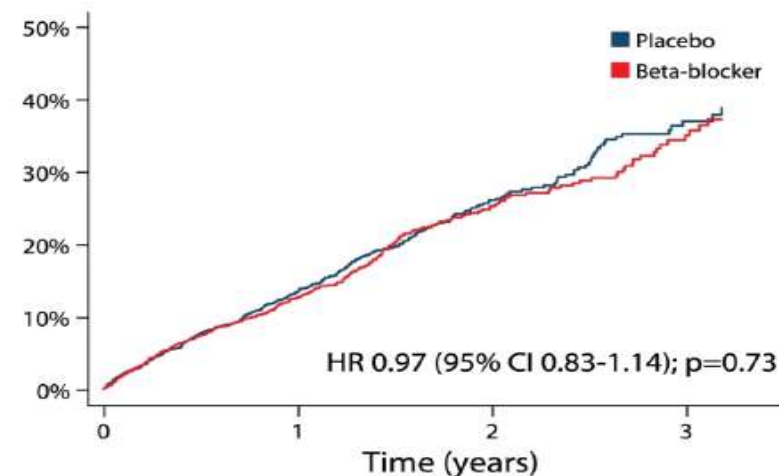
Dr Dipak Kotecha, PhD   • Jane Holmes, PhD • Prof Henry Krum, PhD • Prof Douglas G Altman, DSc • Prof Luis Manzano, MD • Prof John G F Cleland, MD • et al. [Show all authors](#)

Published: September 02, 2014 • DOI: [https://doi.org/10.1016/S0140-6736\(14\)61373-8](https://doi.org/10.1016/S0140-6736(14)61373-8) •



**Findings:** 18,254 patients were assessed, and of these 13,946 (76%) had sinus rhythm and 3066 (17%) had atrial fibrillation at baseline. Crude death rates over a mean follow-up of 1.5 years (SD 1.1) were 16% (2237 of 13,945) in patients with sinus rhythm and 21% (633 of 3064) in patients with atrial fibrillation.  $\beta$ -blocker therapy led to a significant reduction in all-cause mortality in patients with sinus rhythm (hazard ratio 0.73, 0.67-0.80;  $p < 0.001$ ), but not in patients with atrial fibrillation (0.97, 0.83-1.14;  $p = 0.73$ ), with a significant  $p$  value for interaction of baseline rhythm ( $p = 0.002$ ). The lack of efficacy for the primary outcome was noted in all subgroups of atrial fibrillation, including age, sex, left ventricular ejection fraction, New York Heart Association class, heart rate, and baseline medical therapy.

## All-cause mortality in patients with heart failure, reduced ejection fraction and atrial fibrillation



Kotecha et al: Lancet 2014;384:2235-43

# Redefining $\beta$ -blocker response in heart failure patients with sinus rhythm and atrial fibrillation: a machine learning cluster analysis

Andreas Karwath, PhD • Karina V Bunting, PhD • Simrat K Gill, MD • Otilia Tica, PhD • Samantha Pendleton, MSc •

Furqan Aziz, PhD • et al. [Show all authors](#) • [Show footnotes](#)

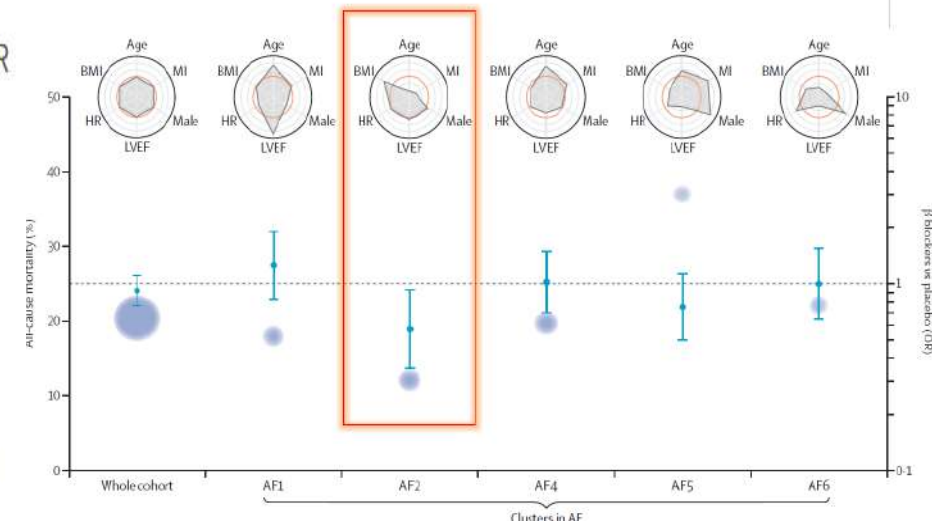
[Open Access](#) • Published: August 30, 2021 • DOI: [https://doi.org/10.1016/S0140-6736\(21\)01638-X](https://doi.org/10.1016/S0140-6736(21)01638-X) •



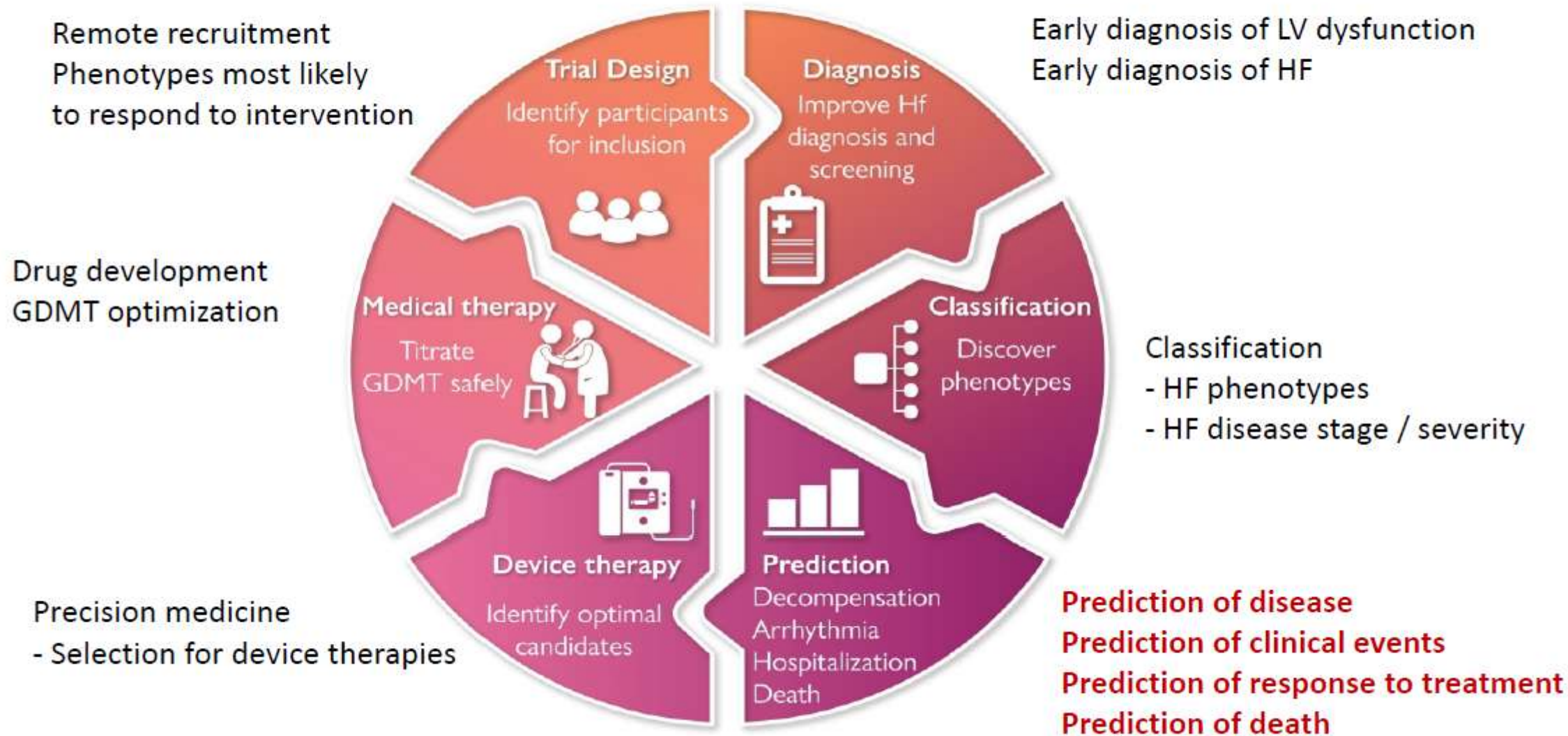
## Findings

15 659 patients with heart failure and LVEF of less than 50% were included, with median age 65 years (IQR 56–72) and LVEF 27% (IQR 21–33). 3708 (24%) patients were women. In sinus rhythm (n=12 822), most clusters demonstrated a consistent overall mortality benefit from  $\beta$  blockers, with odds ratios (ORs) ranging from 0.54 to 0.74. One cluster in sinus rhythm of older patients with less severe symptoms showed no significant efficacy (OR 0.86, 95% CI 0.67–1.10; p=0.22). In atrial fibrillation (n=2837), four of five clusters were consistent with the overall neutral effect of  $\beta$  blockers versus placebo (OR 0.92, 0.77–1.10; p=0.37). One cluster of younger atrial fibrillation patients at lower mortality risk but similar LVEF to average had a statistically significant reduction in mortality with  $\beta$  blockers (OR 0.57, 0.35–0.93; p=0.023). The robustness and consistency of clustering was confirmed for all models (p<0.0001 vs random), and cluster membership was externally validated across the nine independent trials.

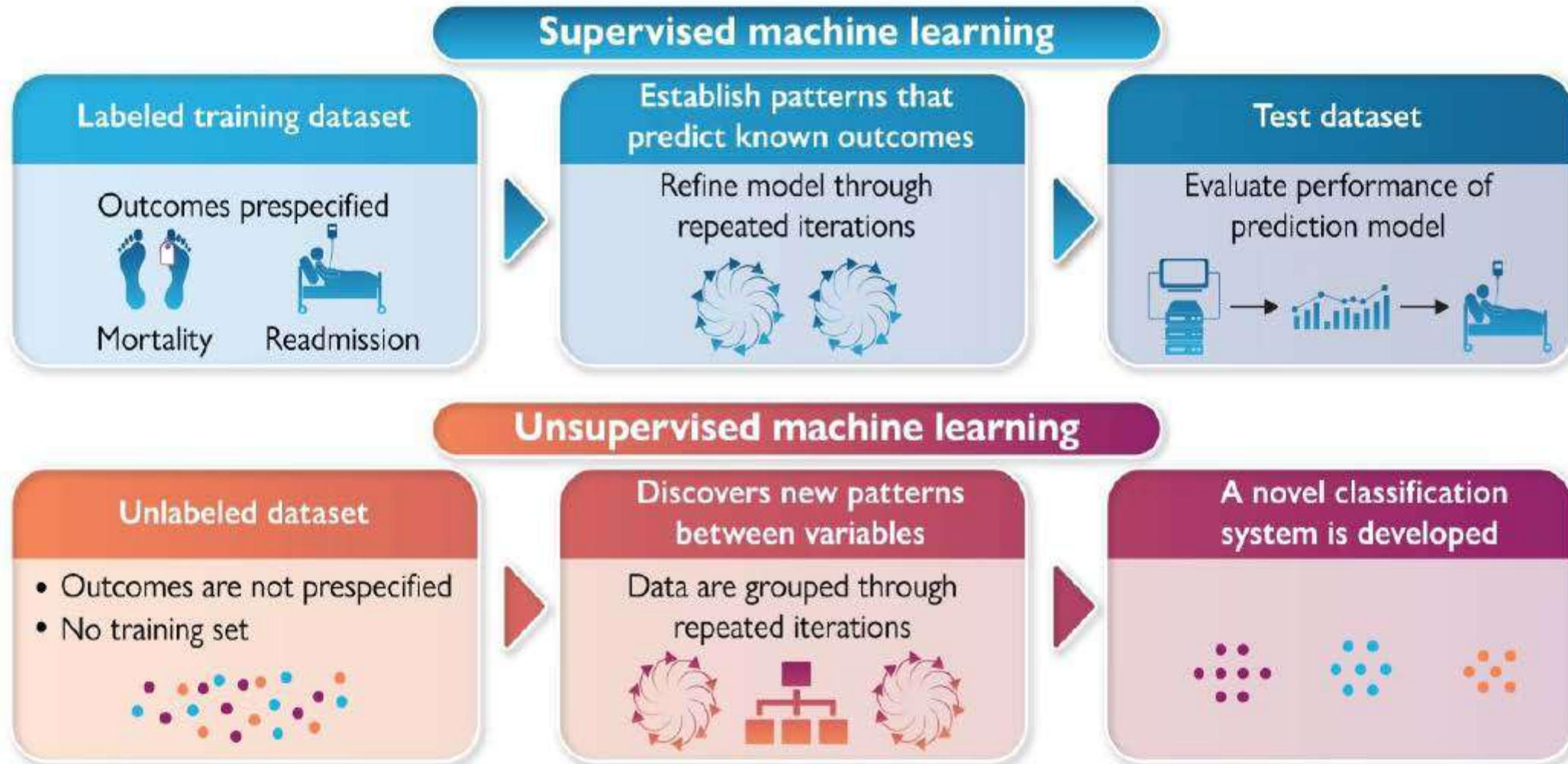
## ... finding patients with atrial fibrillation where beta-blockers still prevent death...



# Machine Learning (ML): Applications in HF



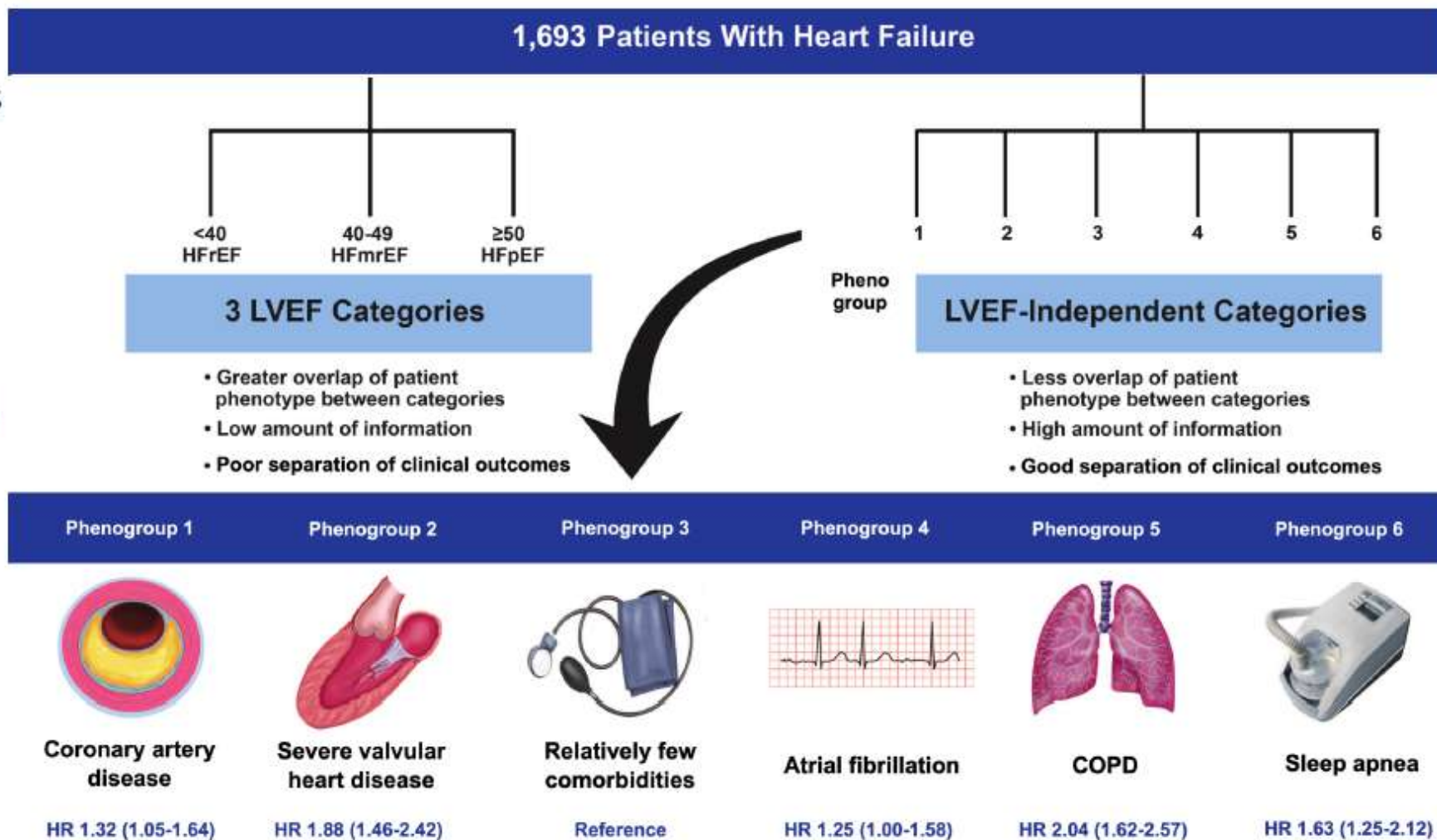
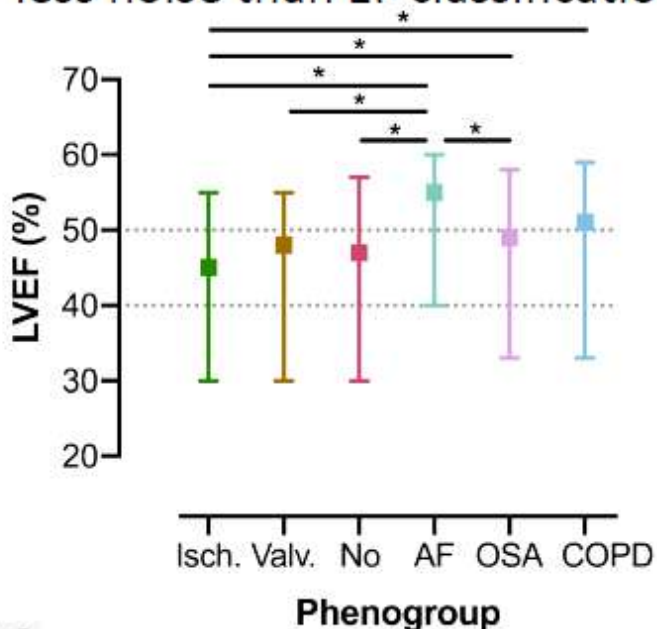
# Types of Machine Learning (ML) Algorithms



# Phenotyping: ML in patients hospitalized for HF (n=1693)

## Unsupervised ML

- Demographics, labs, co-morbidities
- Agglomerative hierarchical clustering
- 6 phenogroups by predominant comorbidity
- Better separation, less uncertainty, less noise than EF classification



Original Research Article

 Open Access



## Clinical phenogroups are more effective than left ventricular ejection fraction categories in stratifying heart failure outcomes

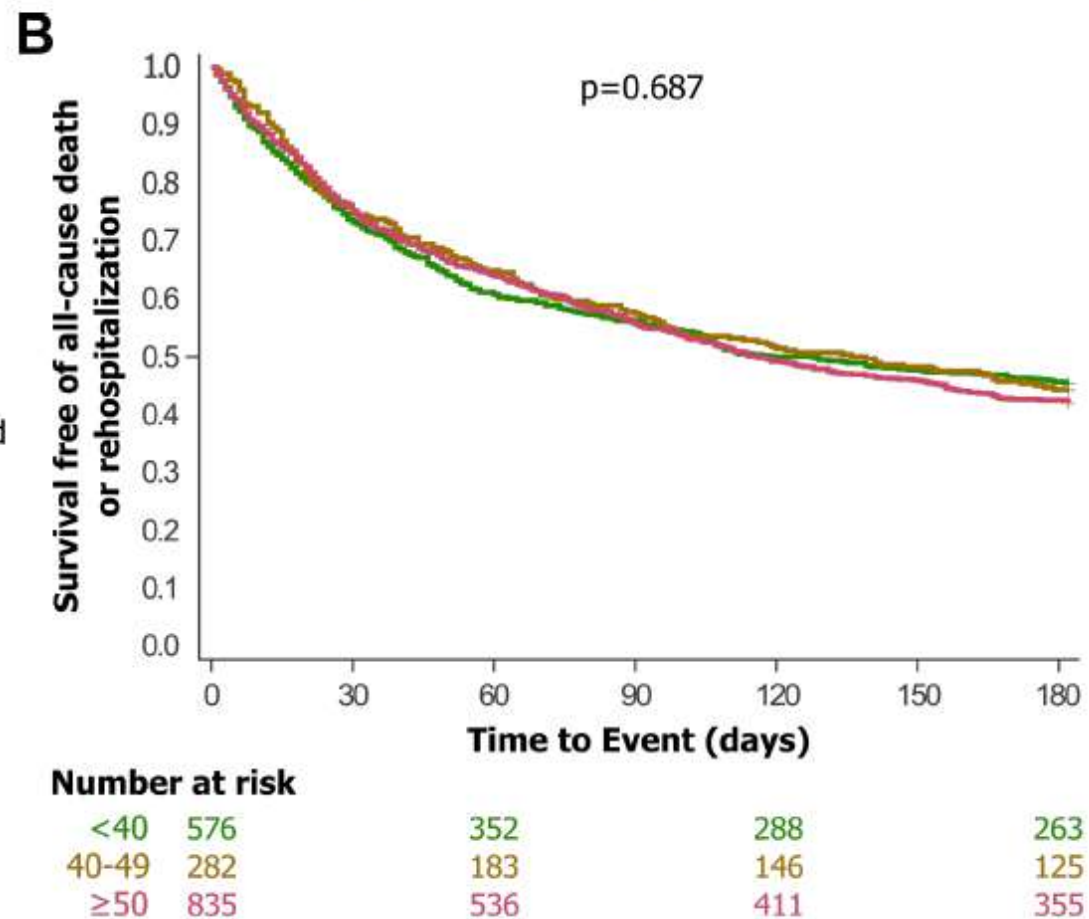
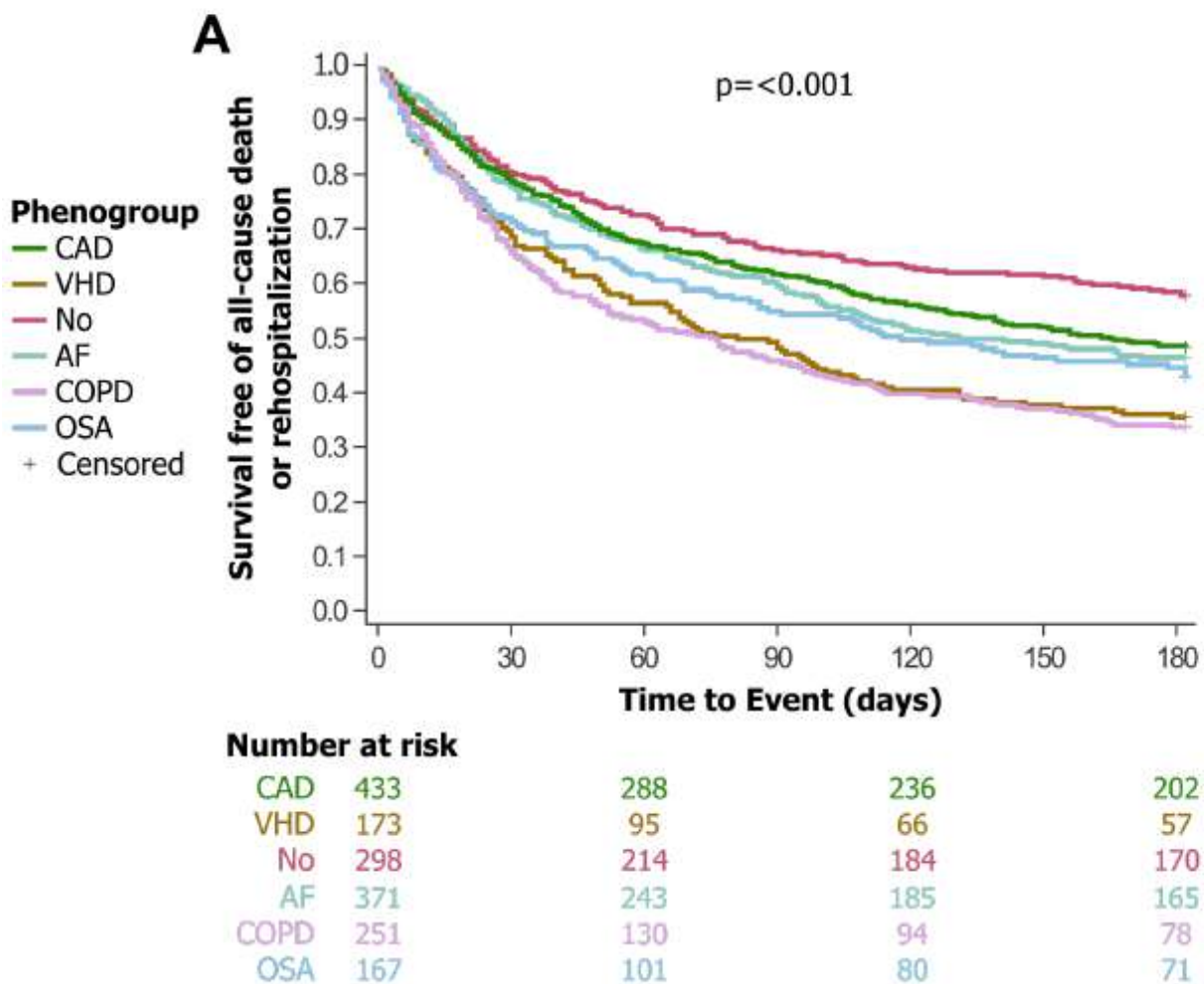
Andreas B. Gevaert, Semra Tibebe, Mamas A. Mamas, Neal G. Ravindra, Shun Fu Lee, Tariq Ahmad, Dennis T. Ko, James L. Januzzi Jr, Harriette G.C. Van Spall 

First published: 02 May 2021 | <https://doi.org/10.1002/ehf2.13344> | Citations: 21

### Conclusion

Among patients hospitalized for HF, clinical phenotypes generated by unsupervised machine learning provided greater prognostic information for a composite of clinical endpoints at 6 and 12 months compared with LVEF-based categories.

# Clinical phenogroups vs LVEF categories in predicting risk following hospitalization for HF (n=1693)





# Predictive Analytics

- To predict the risk of heart failure exacerbations or complications. By identifying high-risk patients early, **clinicians can intervene proactively to prevent adverse events.**
- AI-based image analysis tools can detect subtle abnormalities, quantify cardiac function parameters, and track changes in cardiac structure and function over time, **aiding in treatment planning and disease**



## AI4HF

Trustworthy Artificial Intelligence  
for Personalised Risk Assessment  
in Chronic Heart Failure

**4-year project that will co-design, develop and evaluate the first trustworthy artificial intelligence (AI) tool for personalising the care and management of patients with heart failure**

## **Evaluating Efficacy of Digital Health Technology in the Treatment of Congestive Heart Failure**

NCT04394754 is a RCT evaluating the efficacy of AI-based technology in the treatment of congestive HF.

A “smart” scale (Bodyport), an automated conversational platform (Conversa), and a coaching application (Noom) using an AI algorithm are used to determine fluid status noninvasively and assess HF Risk.

In total 182 participants are expected to enroll in this study.

## **Artificial Intelligence Mobile Health Trial Of A Digital Platform To Optimize GDMT Using Wearable Sensors**

NCT04191330 is a RCT where digital AI-powered algorithms using a cloud-based platform (BiovitalsHF) combined with wearable sensors are used to aid management of optimization of GDMT prescriptions outside of normal or traditional clinical encounters.

In total 228 participants are expected to enroll in this study

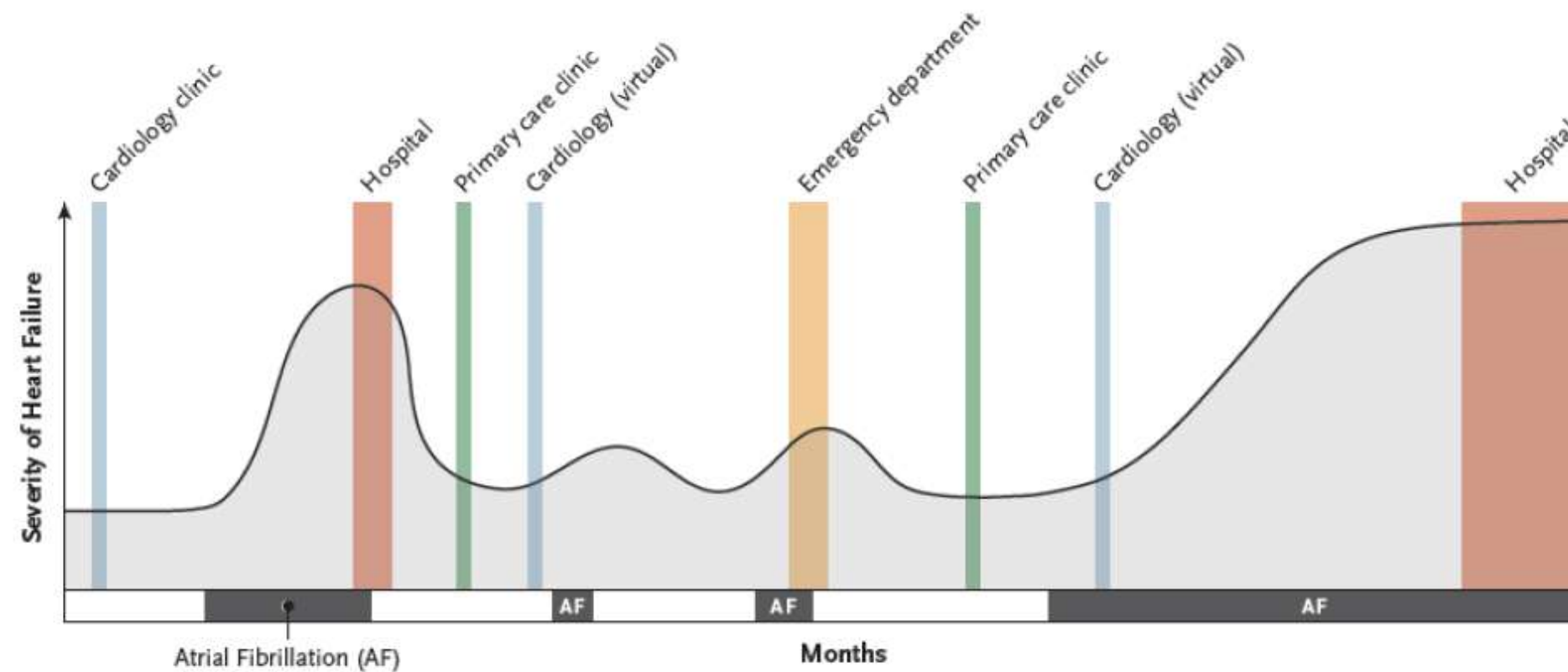
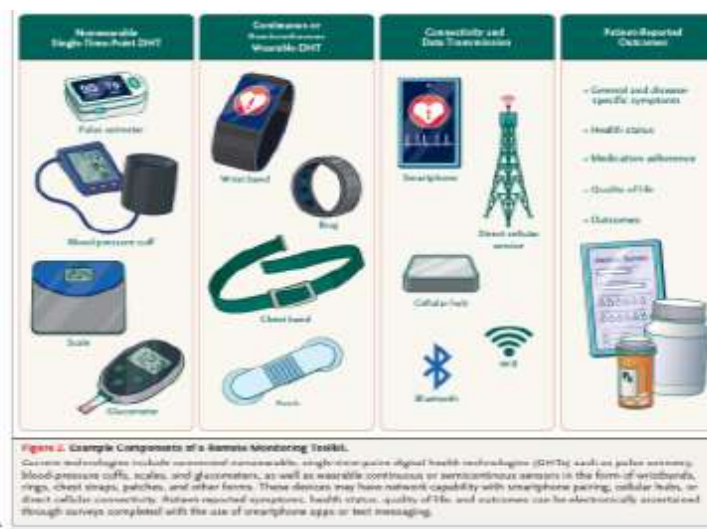
REVIEW ARTICLE

WEARABLE DIGITAL HEALTH TECHNOLOGIES IN MEDICINE

Stephen H. Friend, M.D., Ph.D., Geoffrey S. Ginsburg, M.D., Ph.D., Rosalind W. Picard, Sc.D., Guest Editors, and Jeffrey M. Drazen, M.D., Editor

Wearable Digital Health Technologies for Monitoring in Cardiovascular Medicine

Erica S. Spatz, M.D., M.H.S., Geoffrey S. Ginsburg, M.D., Ph.D., John S. Rumsfeld, M.D., Ph.D., and Mintu P. Turakhia, M.D., M.A.S.



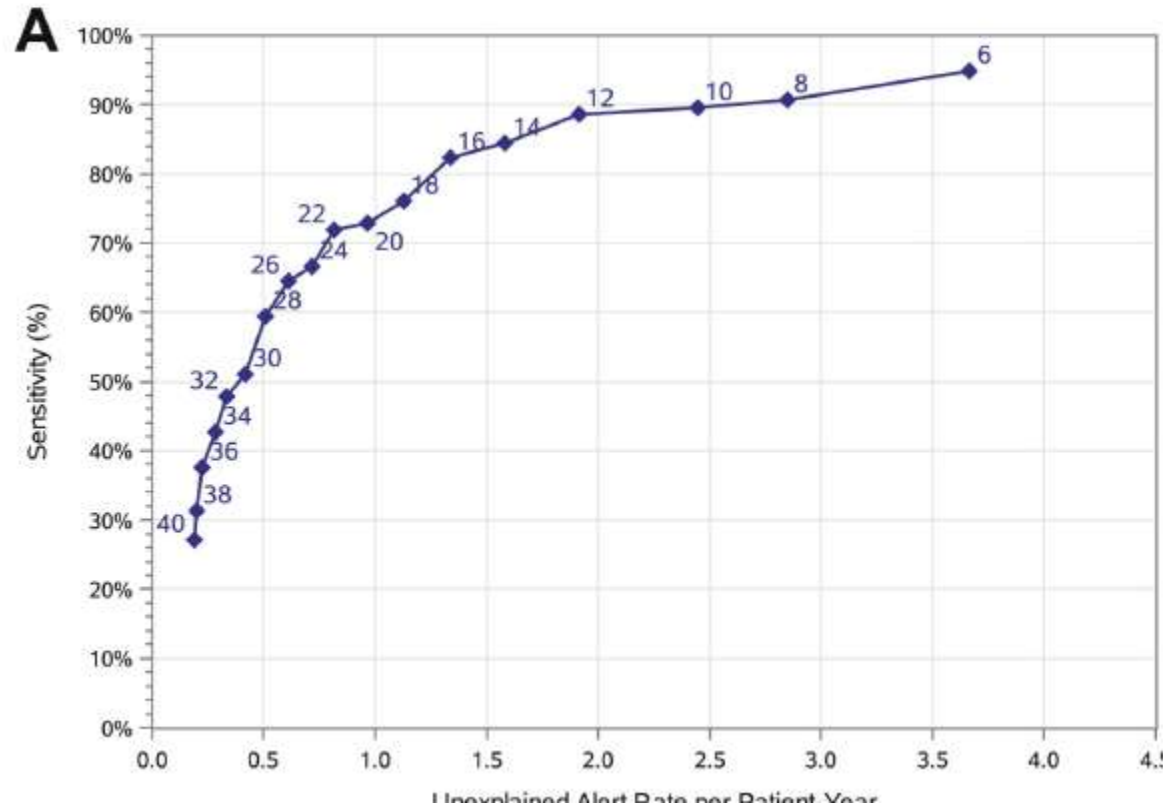
This real-time data can alert clinicians to changes in a patient's condition, enabling early intervention and preventing hospital readmissions.

Figure 1. Gaps in Care of a Patient with Paroxysmal Atrial Fibrillation and Heart Failure in a Traditional Episodic Care Model.

# A Multisensor Algorithm Predicts Heart Failure Events in Patients With Implanted Devices

## Results From the MultiSENSE Study

John P. Boehmer, MD,<sup>a</sup> Ramesh Hariharan, MD,<sup>b</sup> Fausto G. Devecchi, MD,<sup>c</sup> Andrew L. Smith, MD,<sup>d</sup>



Multisensor Chronic Evaluation in Ambulatory Heart Failure Patients study enrolled patients with CRT-D- Boston Scientific.

The 2 coprimary endpoints were sensitivity to detect HF Events >40% and unexplained alert rate <2 alerts per patient-year.

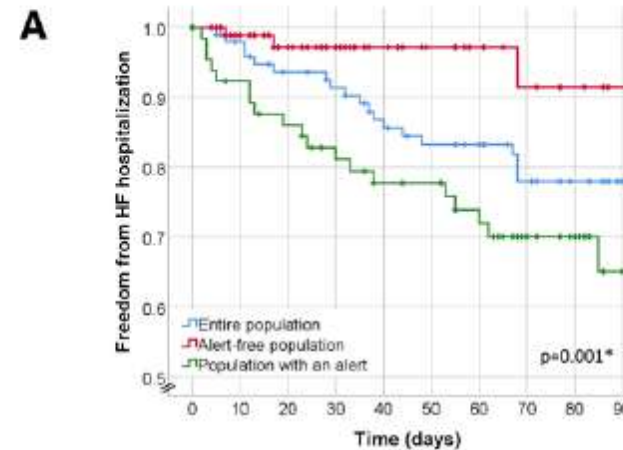
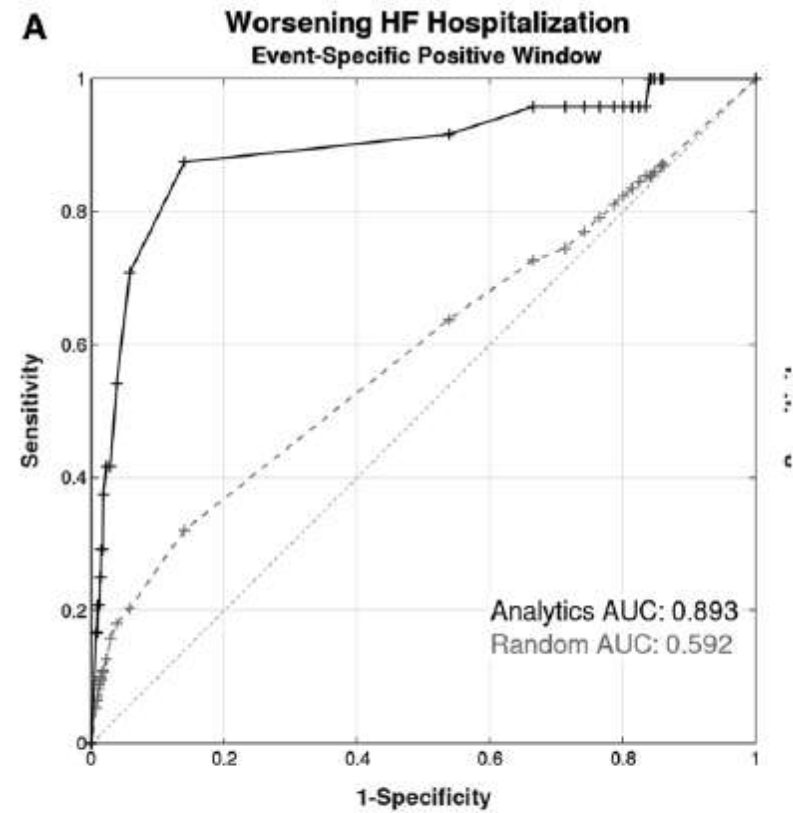
Both endpoints were significantly exceeded, with sensitivity of 70% (95% confidence interval [CI]: 55.4% to 82.1%) and an unexplained alert rate of 1.47 per patient-year (95% CI: 1.32 to 1.65).

# Circulation: Heart Failure

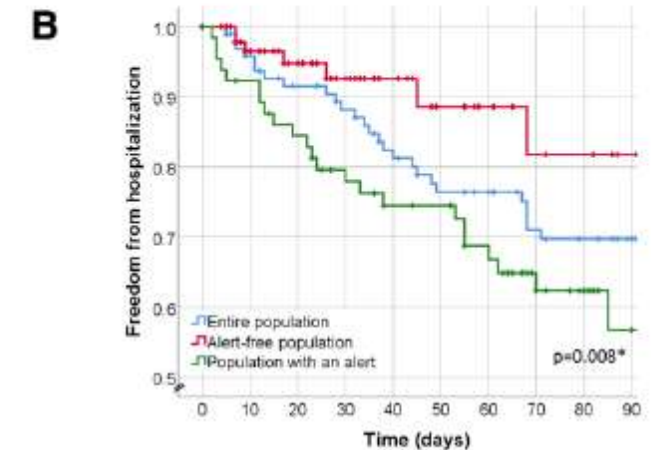
## Continuous Wearable Monitoring Analytics Predict Heart Failure Hospitalization

### The LINK-HF Multicenter Study

Josef Stehlik, MD, MPH; Carsten Schmalfluss, MD; Biykem Bozkurt, MD, PhD; Jose Nativi-Nicolau, MD;



Number at risk				
Entire population	99	81	66	48
Alert-free	99	40	19	10
With and alert	66	48	37	11



Number at risk				
Entire population	99	78	60	44
Alert-free	99	37	15	8
With and alert	66	46	34	9

The platform was able to detect precursors of hospitalization for HF exacerbation with 76% to 88% sensitivity and 85% specificity.

Management > Interventions

Cardiac resynchronization therapy is recommended for symptomatic patients with heart failure in sinus rhythm with a QRS duration  $\geq 150$  ms and left bundle branch block and with left ventricular ejection fraction  $\leq 35\%$  despite optimal medical therapy in order to improve symptoms and reduce morbidity and mortality.

REQUIRED ACTIONS Include in report High Priority Class I Level A

Triggering rule Variables Compliance Rule classifications

Clinical information

Name	Value
Complementary Tests: Heart Rhythm	Sinus
Diagnostics: Heart Failure	True
Complementary Tests: QRS duration	155 ms
Diagnostics: Symptomatic Heart Failure	True
Complementary Tests: LVEF %	29 %
Complementary Tests: Left Bundle Branch Block	True

Inferred variables

Name	Value
No data available in table	

### Demographic data

Age 67 years.  
Female.

### Symptoms

- Cardiovascular.  
Dyspnea on exertion.

### Complementary Tests

- Image Studies.  
LVEF % 29 %.

- Cardiovascular.  
Heart Rhythm Sinus.  
QRS duration 155 ms  
Left Bundle Branch B

### Diagnostics

- Cardiovascular.  
Chronic Heart Failure  
Symptomatic Heart F  
Heart Failure With Re

# Süni intellekt ÜÇ zamanı lazımdır mı?

- Bəli! İş yükünü azaldır
- Sİ ilə ÜÇ-nin inkişaf riskini, ağırlaşmalarla bağlı proqnozu vermək
- ÜÇ-nin diaqnostik və müalicə effektivliyini yüksəltmək
- ÜÇ ilə bağlı böyük randomizə tədqiqatları aparmaq və digər böyük datalardan yararlanmaq mümkündür.

**“Doctors and nurses who use AI will  
replace doctors and nurses who don’t”**

Dr. John Halamka, president of the Mayo Clinic Platform

**Dinlədiyinizə görə təşəkkürlər**