CARDIO SCOPIE

iCANN LIFE SCIENCES

Intelligence artificielle: dès la clinique à l'éthique

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Hopital Erasme

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SUMMARY

- Introduction: the AI powered medical technology
- AI-powered technology in cardiovascular medicine
- AI, Machine Learning and Deep Neural Network
- Doctors versus Artificial Neural Network
- AI-based healthcare: the 4P model of medicine
- Ethical concerns and legal challenges
- Conclusions

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HISTORY

The conception of ***AI*** can be tracked back in the mid-20th century, after the World War II, when the Allies Forces managed to break the Encryption Machine Enigma used by the Nazi German Army [1].

"Can machines think?" (Alan Turing 1912 – 1954): a-machine (abstract machine) settled the basis of modern ***AI*** -based machine [2].

Machine Enigma

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AI TIMELINE

1950 Machine enigma

1970 AI winter

1997 IBM PC wins chess match

2005 Big Data

2006 Cloud Compute

2010 The app revolution

2014 FDA approved app in medicine

2015
2016
2017
…

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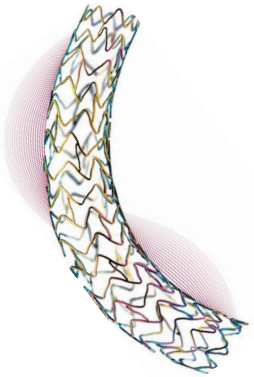
AI-POWERED MEDICAL TECHNOLOGIES

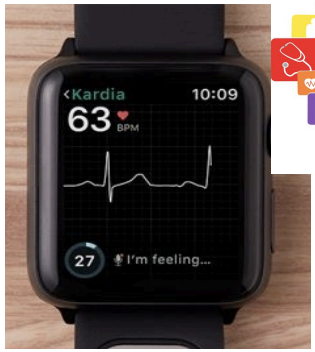
Medical Technology = tools that can enable health professionals to provide patients and society with a better quality of life by:

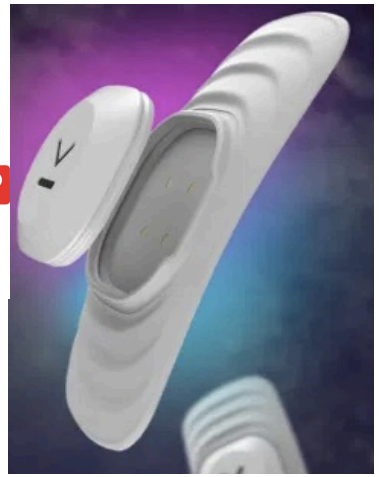
- performing early diagnosis
- reducing complications
- optimizing treatment
- providing less invasive options
- reducing the length of hospitalization [3]

BEFORE MOBILE ERA



AFTER MOBILE ERA





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CURRENT APPLICATIONS OF AI IN MEDICINE

FDA approval for artificial intelligence applied to the practice of medicine [4].		
Company	**FDA approval**	**Indication**
AliveCor	2014	AF detection
Apple	September 2018	AF detection
Zebra Medical	July 2018	Coronary Calcium Scoring
Bab Labs	June 2018	Echocardiogram EF determination
Neural Analytic	May 2018	Device for paramedic stroke diagnosis
Arteris	January 2017	Cardiac MRI interpretation

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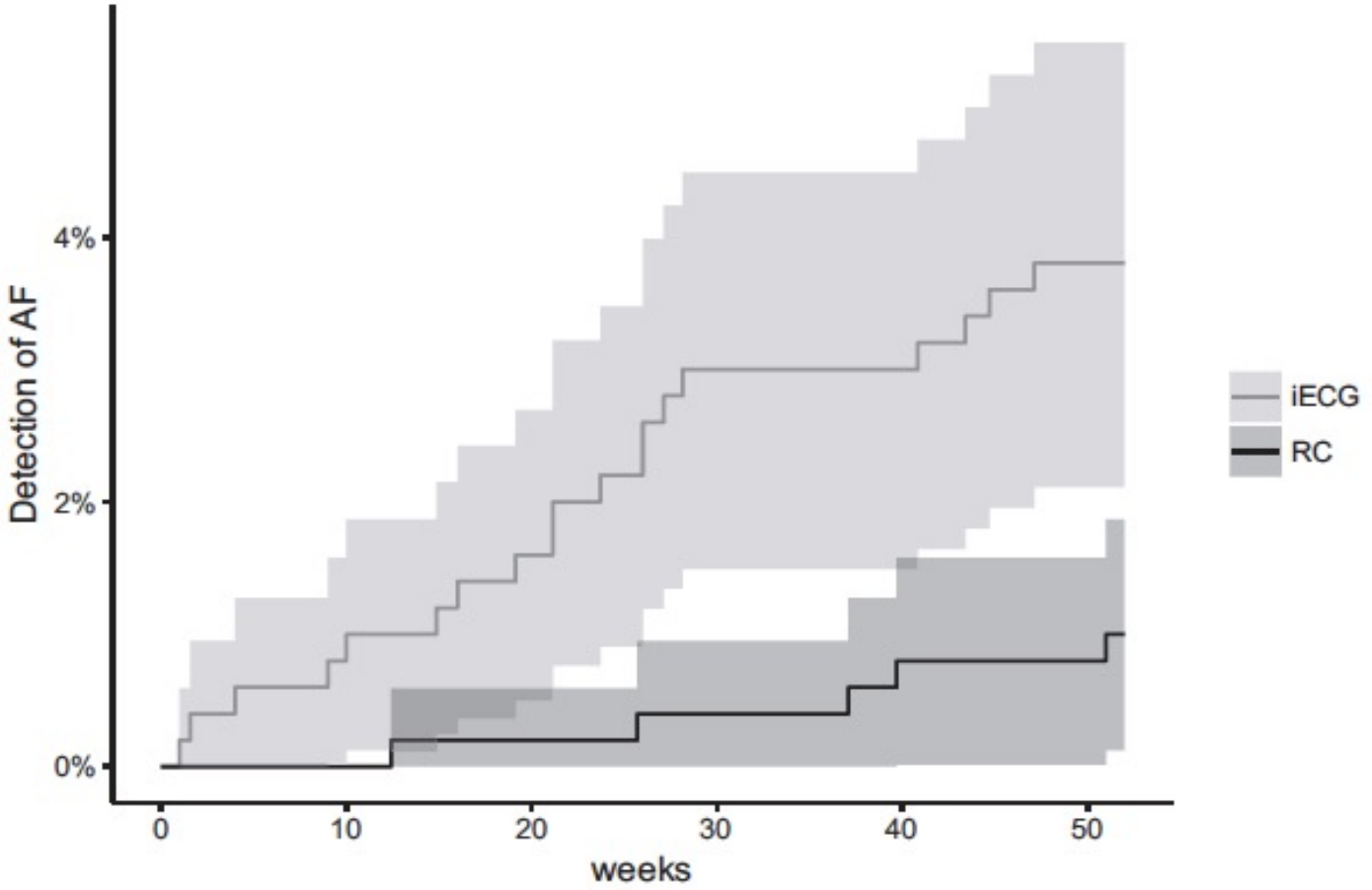
ORIGINAL RESEARCH ARTICLE

Assessment of Remote Heart Rhythm Sampling Using the AliveCor Heart Monitor to Screen for Atrial Fibrillation

The REHEARSE-AF Study



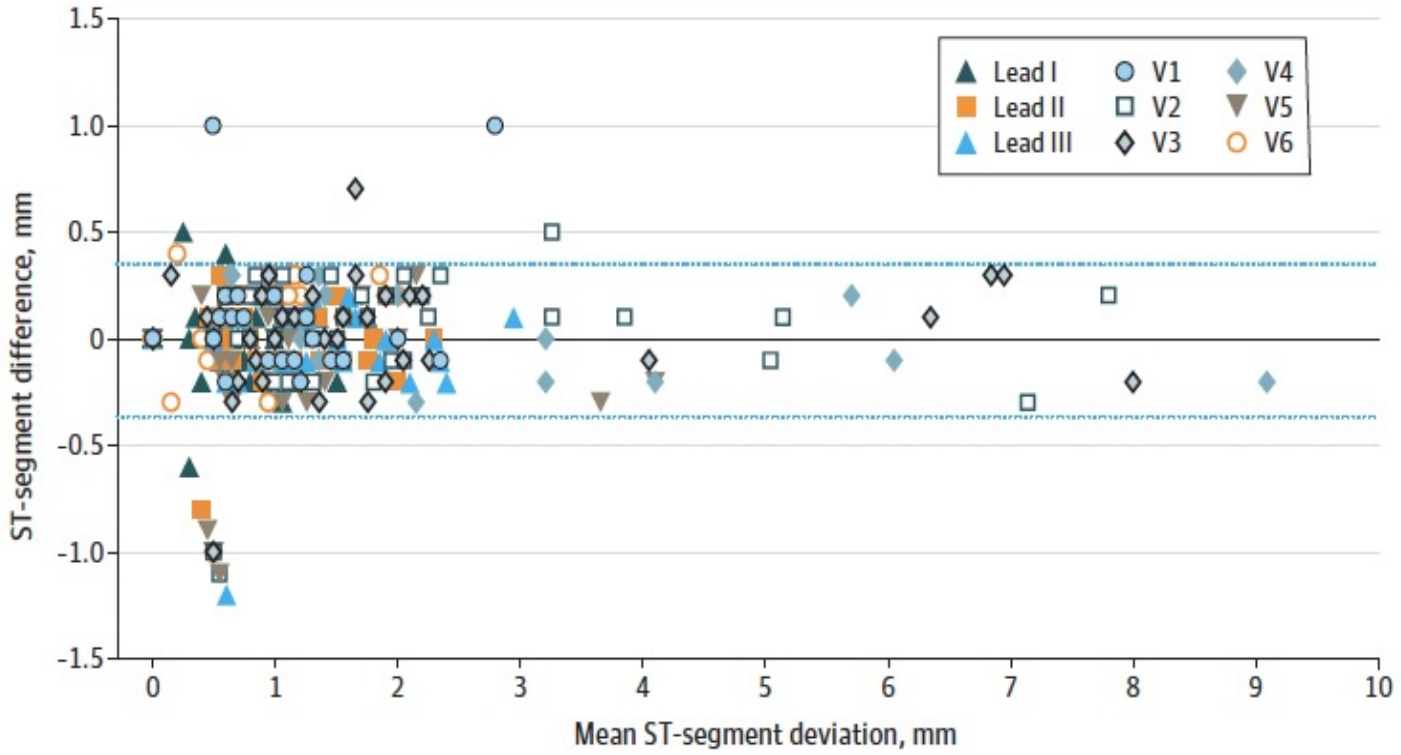
Almost 4-fold increase in the likelihood of a diagnosis of AF with remote ECG compared to routine care [5].

JAMA Cardiology | Brief Report

Multichannel Electrocardiograms Obtained by a Smartwatch for the Diagnosis of ST-Segment Changes

Spaccarotella C et. Al [6]

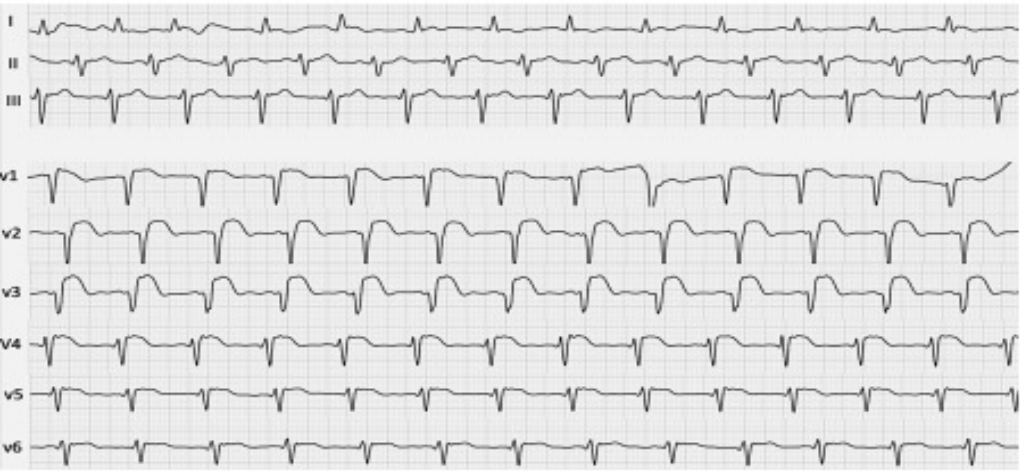
Figure 2. Comparison of the Amplitude of ST-Segment Deviations Between Smartwatch and Standard Electrocardiogram (ECG)

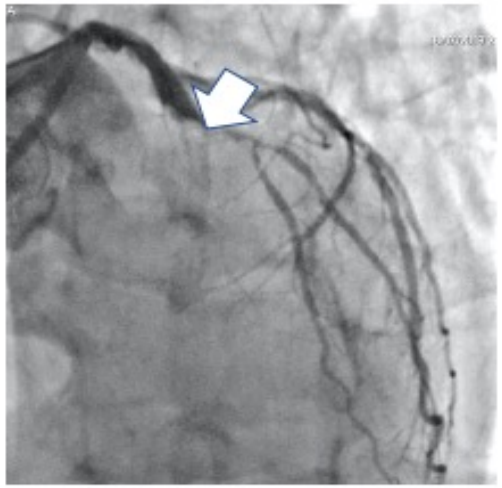


	Se (%)	Sp (%)
Normal ECG	84	100
STEMI	93	95
NSTEMI	94	92

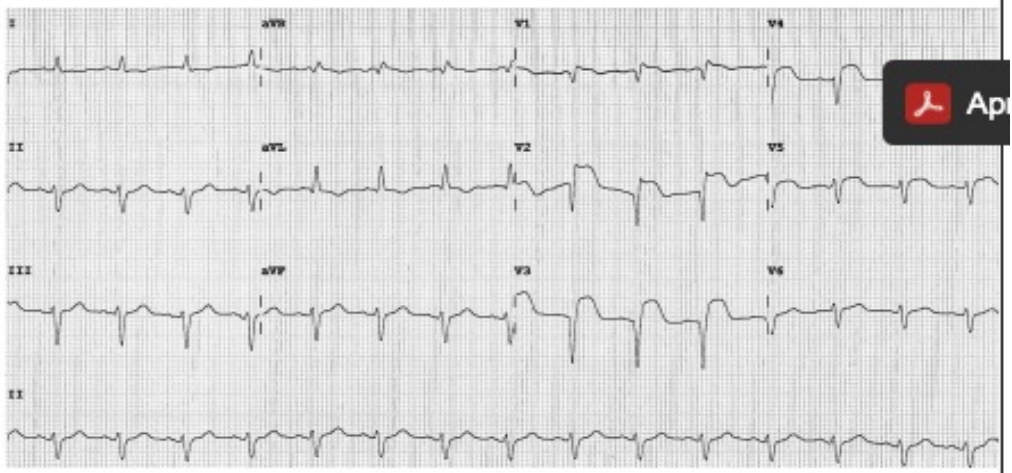
STEMI

SMARTWATCH ECG



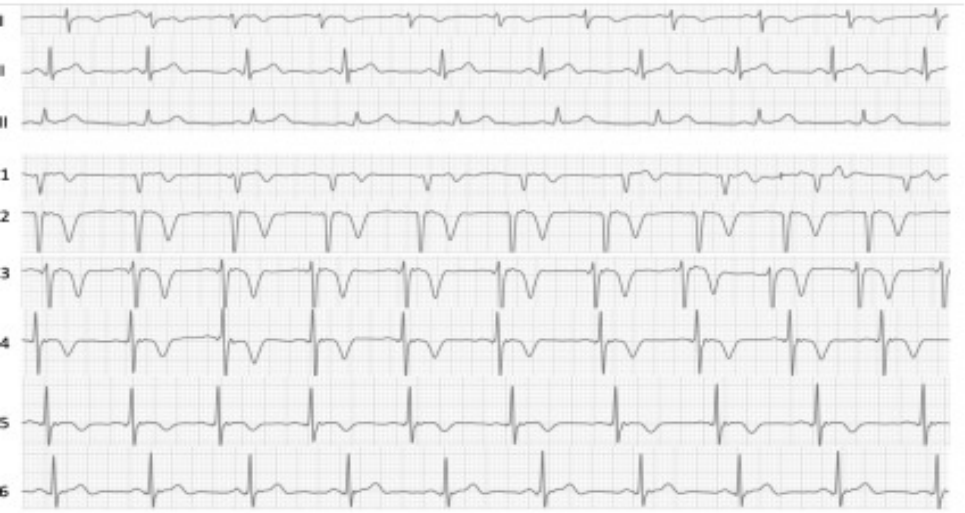


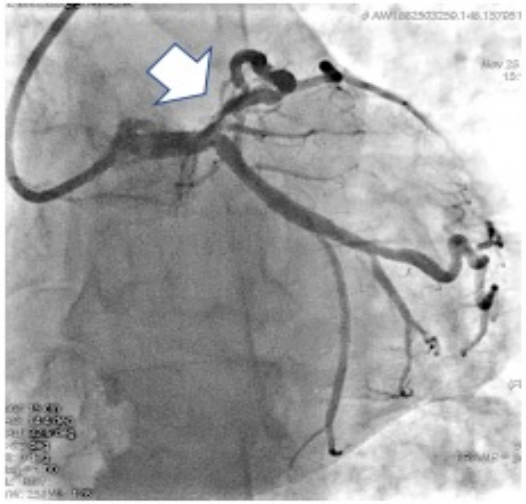
STANDARD 12-LEAD ECG



NSTEMI

SMARTWATCH ECG





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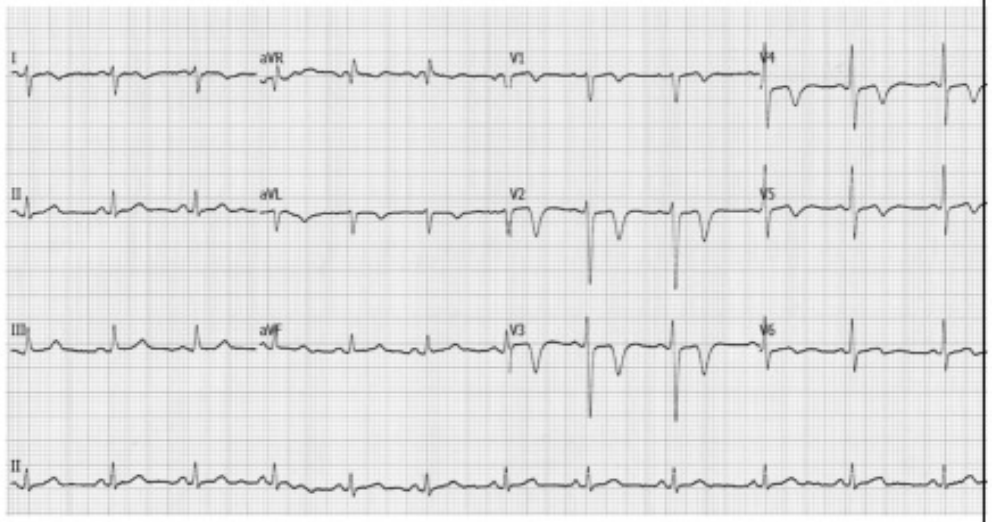
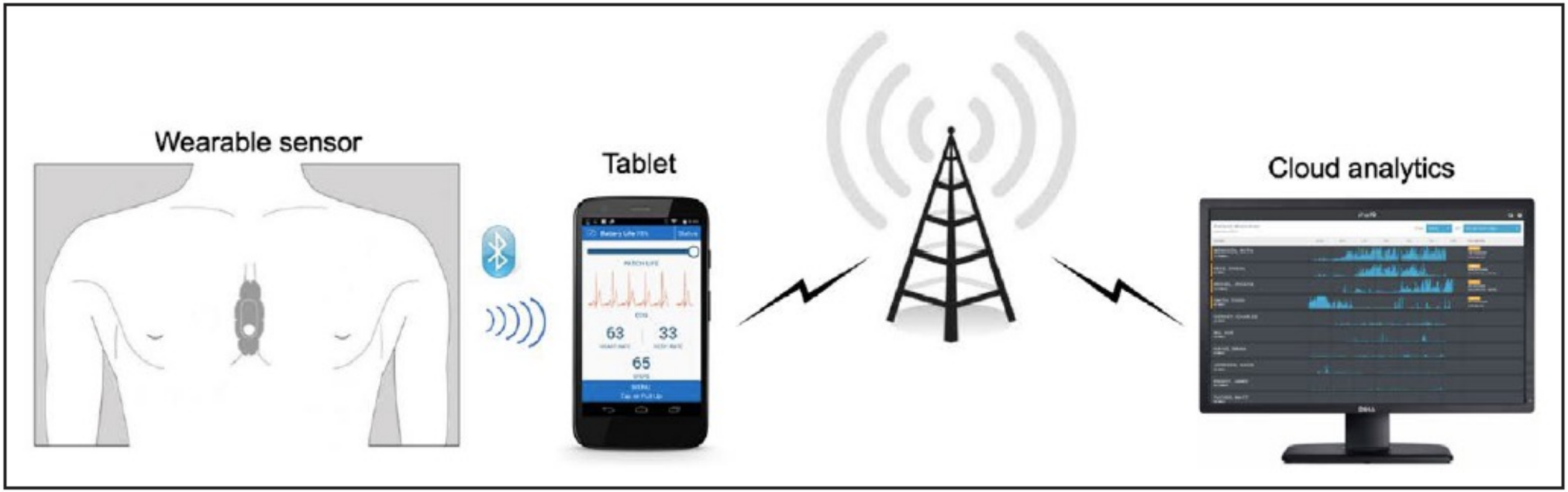


Continuous Wearable Monitoring Analytics Predict Heart Failure Hospitalization

The LINK-HF Multicenter Study [7]



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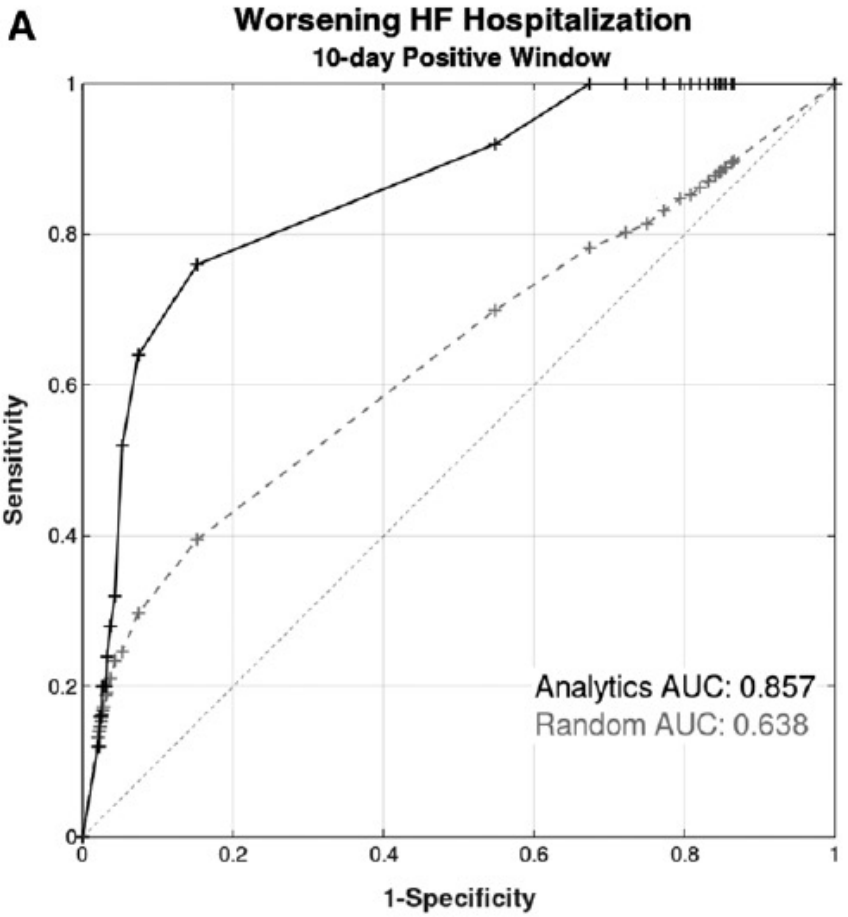

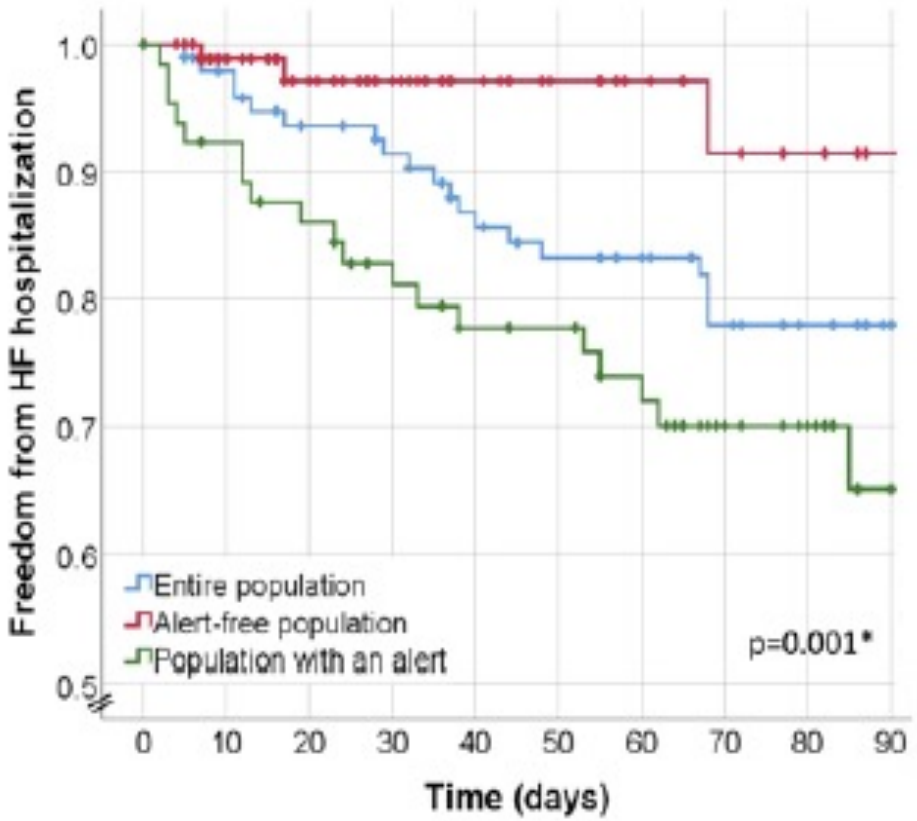

	Se (%)	Sp (%)
HF admission	88	86

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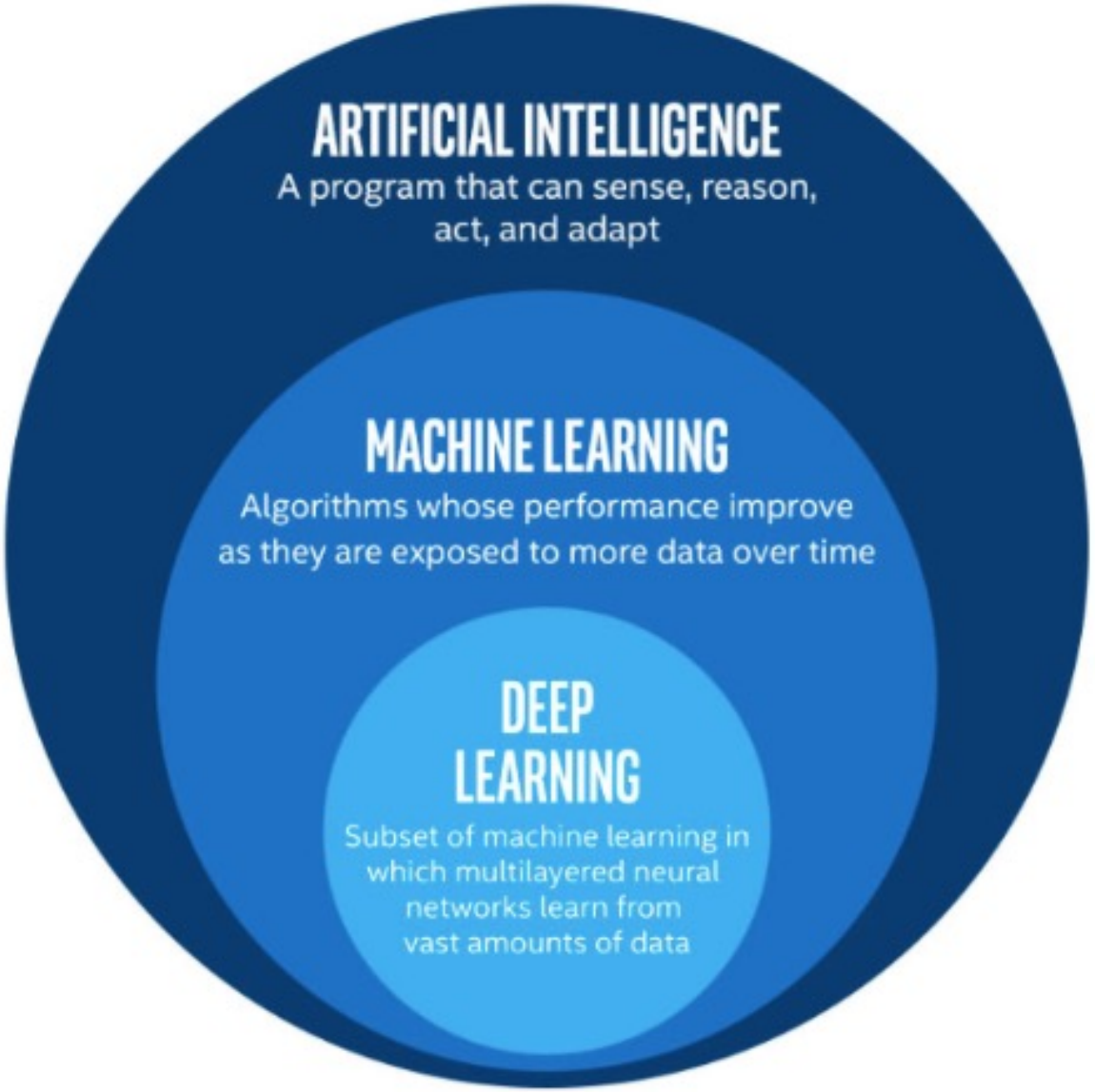
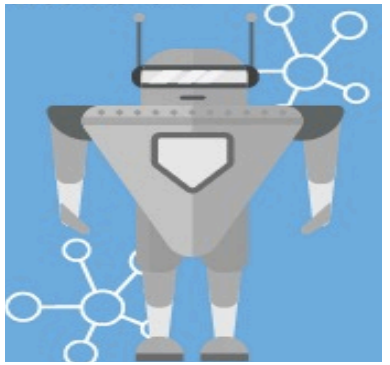
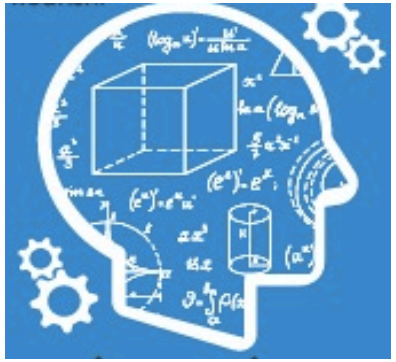
AI, ML and DNN







https://towardsdatascience.com/artificial-intelligence-vs-machine-learning-vs-deep-learning-2210ba8cc4ac

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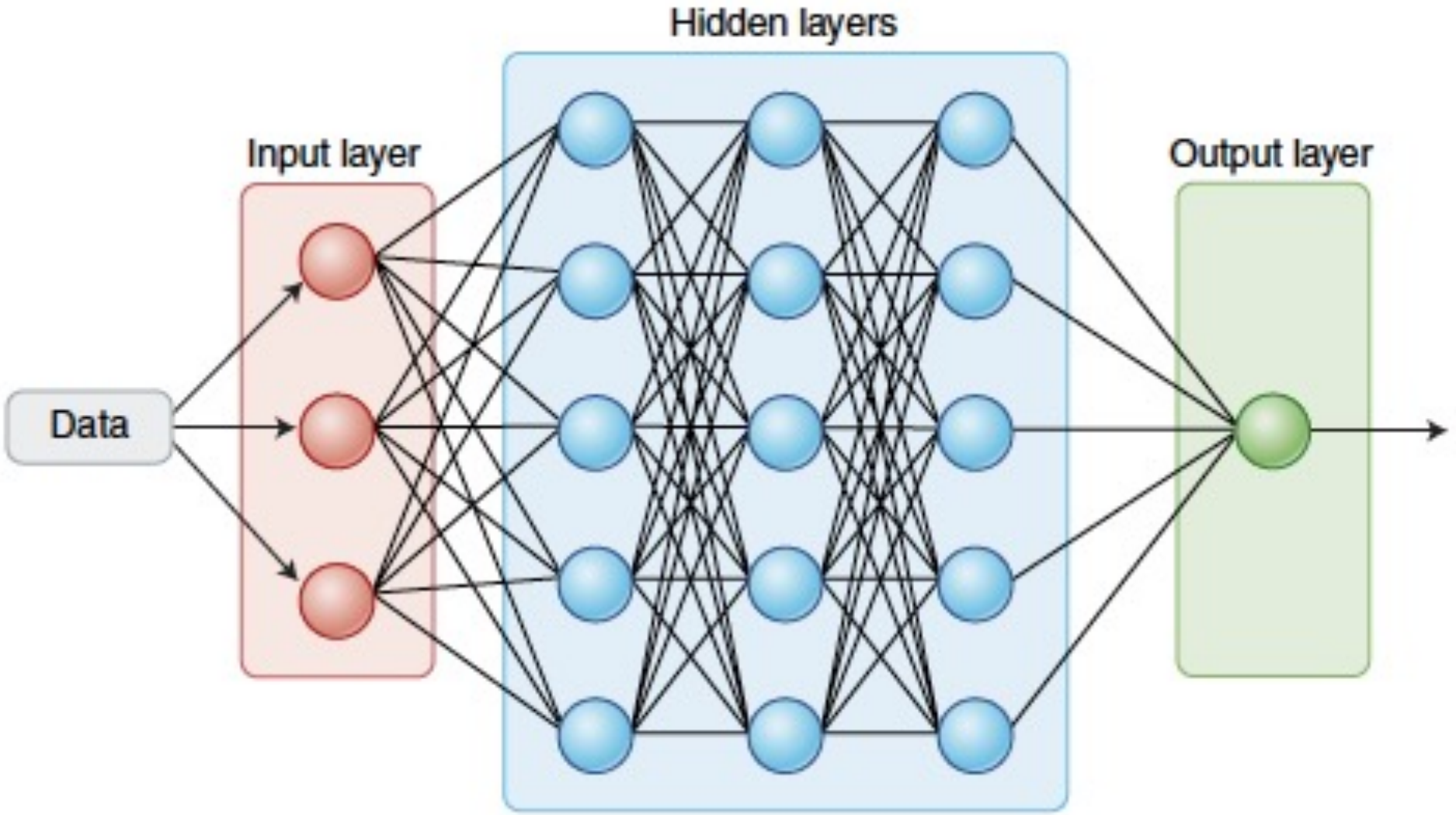
DNN : DEEP NEURAL NETWORK



https://blogs.nvidia.com/blog/2016/07/29/whats-difference-artificial-intelligence-machine-learning-deep-learning-ai/

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nature medicine

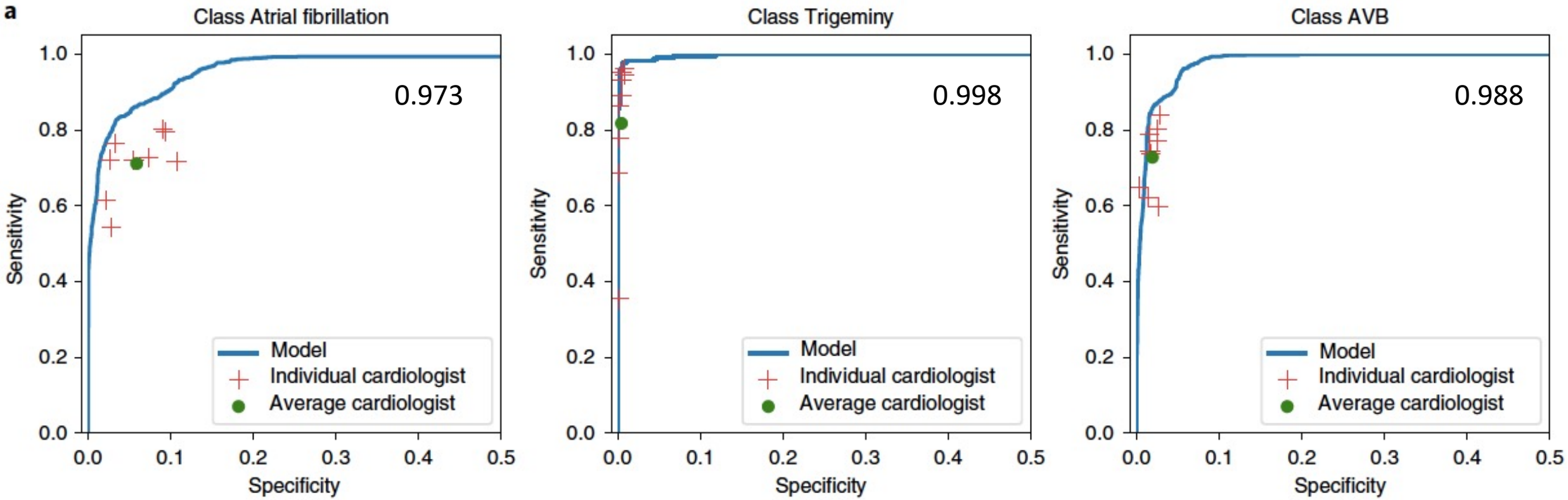
Cardiologist-level arrhythmia detection and classification in ambulatory electrocardiograms using a deep neural network

Awni Y. Hannun[1,6*], Pranav Rajpurkar[1,6], Masoumeh Haghpanahi[2,6], Geoffrey H. Tison[3,6], Codie Bourn[2], Mintu P. Turakhia[4,5] and Andrew Y. Ng[1]

- **DNN vs cardiologist**
- **1 lead-ECG: 91.232**
- **12 rhythm classes**

nature medicine

Hannun et al. 2019



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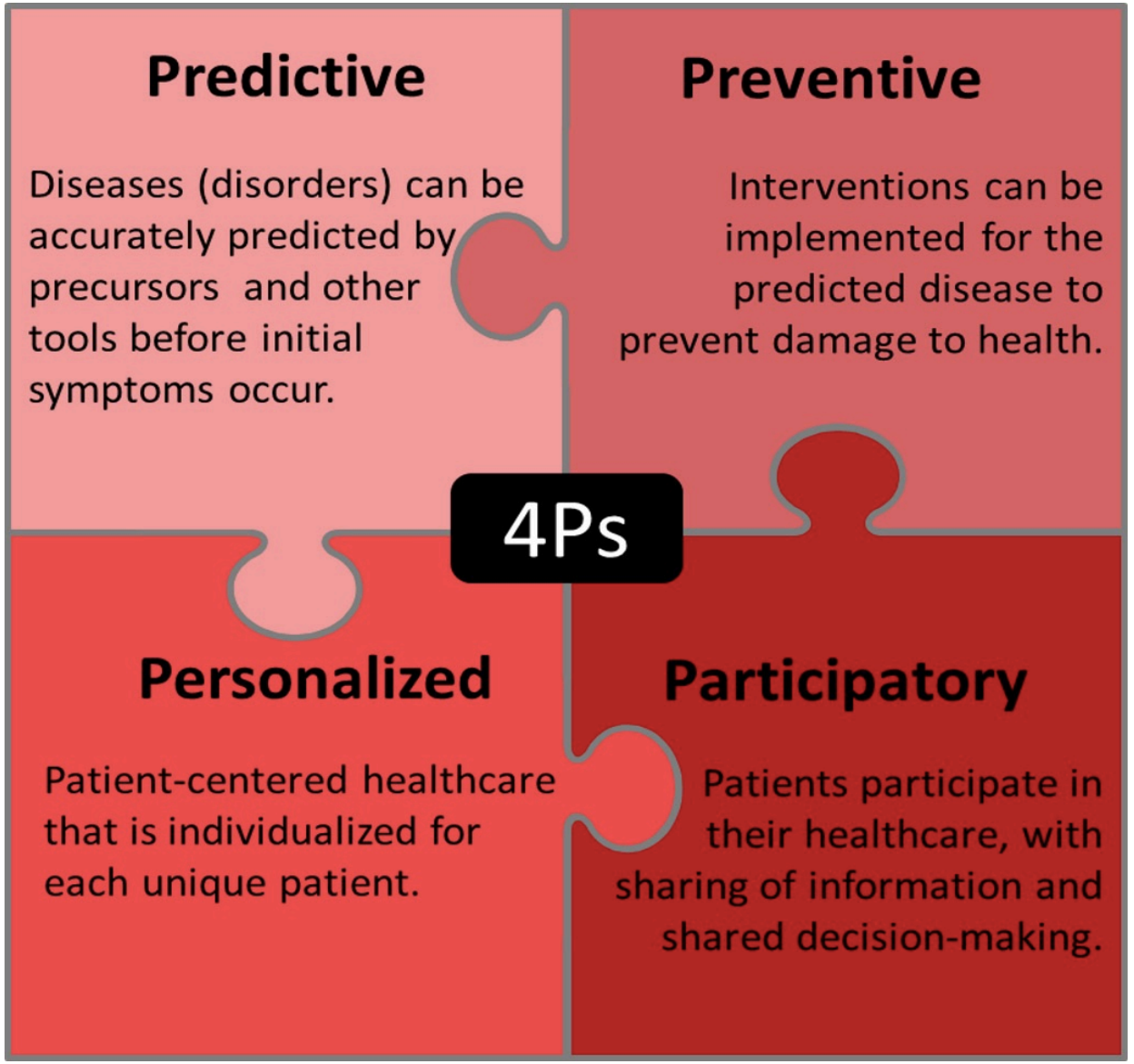
AI-EMPOWERED TECHNOLOGY AND THE 4P MODEL OF MEDICINE



WHAT IS PHYSICIAN AND PATIENT'S ATTITUDES TOWARD AI-POWERED TECHNOLOGY?

Survey items	Provider, n (%)	Consumer, n (%)	RR	RR 95% CI	*P* value[d]
Q1. Technology [a] (choose one)					<.001
Like technology, prefer professional diagnosis	819 (58.25)	490 (44.46)	1.3	1.2-1.4	
Like technology for diagnosis	194 (13.80)	437 (39.66)	0.70	0.66-0.74	
Uneasy using technology	393 (27.95)	175 (15.88)	1.2	1.1-1.2	
Q8. Access to EHR information [b] (% No)					
Could lead to feeling anxious about results	136 (9.67)	724 (65.70)	0.38	0.35-0.41	<.001
Could lead to better management of my health	375 (26.67)	80 (7.26)	1.3	1.2-1.3	<.001
Could lead to requesting unnecessary medical evaluations	257 (18.28)	831 (75.41)	0.30	0.28-0.33	<.001
Q15. Feelings about new technology [b] (choose one)					<.001
Must be mastered	806 (57.33)	405 (36.75)	1.5	1.4-1.6	
It is exciting	548 (38.98)	487 (44.19)	0.91	0.86-0.98	
It is beyond me	37 (2.63)	166 (15.06)	0.87	0.85-0.90	
It scares me	15 (1.07)	44 (3.99)	0.97	0.96-0.98	

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ETHICAL CONCERNS [12]

Under what circumstances must a clinician notify the patient that AI is being used at all.

1. Informed consent to use

2. Safety and transparency

3. Algorithmic fairness and biases

4. Data privacy

Algorithms need further refinement to generate accurate results.
AI developers should be sufficiently transparent.

A variety of algorithms are sophisticated and nontransparent.

«The price of innovation does not need to be the erosion of fundamental privacy rights»

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LEGAL CHALLENGES [12]

1. Data protection and privacy
2. Safety and effectiveness
3. Liability
4. Cybersecurity

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CONCLUSIONS

- AI powered technology opens up new horizons in the the practice of medicine
- AI powered technology provides results as accurate as physicians', with less variability and errors
- Provide robust evidence of how these technologies lead to improved clinical outcomes
- Clinical validation of tools recently developed is still lack
- Ethical concerns and legal challenges

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THANK YOU