



# Intelligenza artificiale: il futuro è ora!

*Paolo CANOVA, MD*

*Interventional Cardiology Unit*

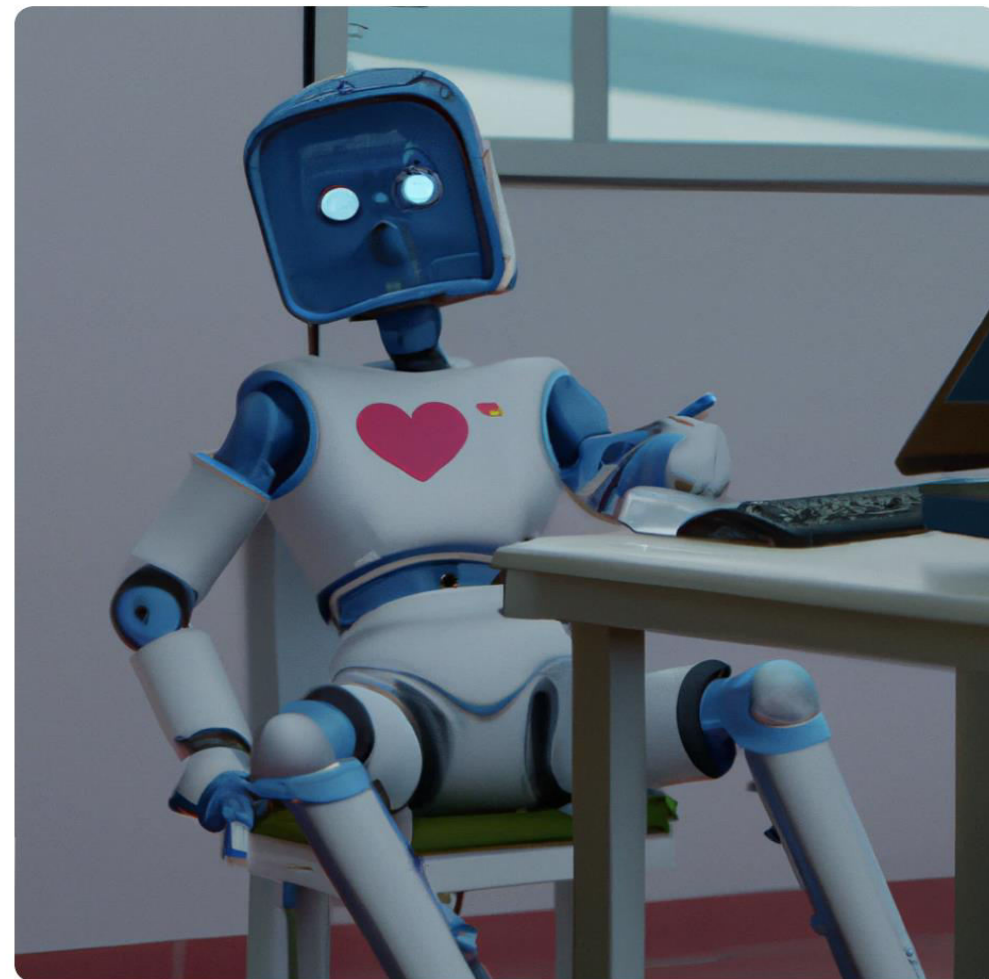
*Cardiovascular Department - Papa Giovanni XXIII Hospital – Bergamo*

*Genova, 14 Aprile 2023.*

## How AI is Used in Cardiology

AI can be used to analyze electrocardiograms (ECGs) to detect anomalies or predict the risk of cardiovascular diseases. AI can also be used to diagnose heart conditions and recommend treatments.

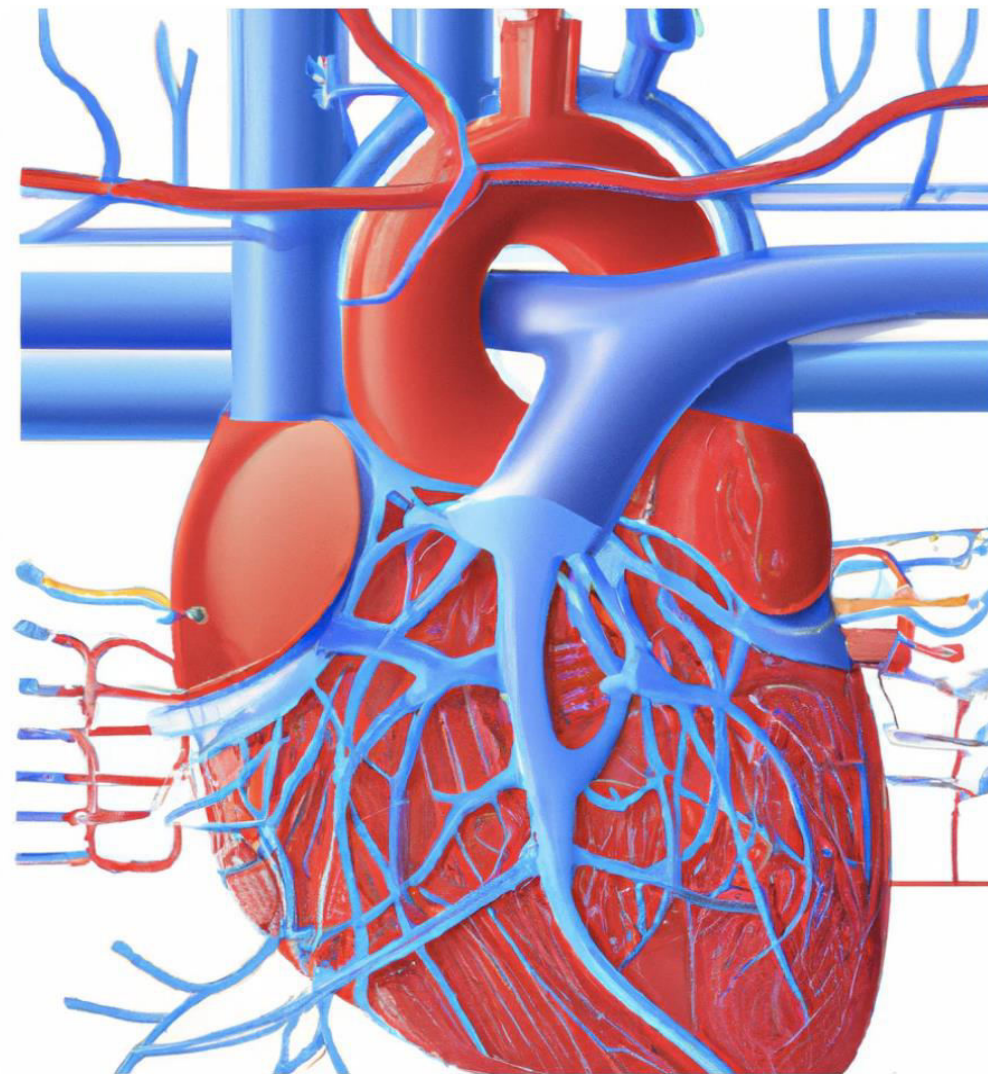
AI can also be used to monitor patients remotely. AI-enabled devices can track vital signs and detect changes that could indicate a problem. This can help doctors provide more timely care.



## **Coronary Arteries and Artificial Intelligence**

Artificial intelligence is being explored to help identify, diagnose, and treat coronary artery diseases.

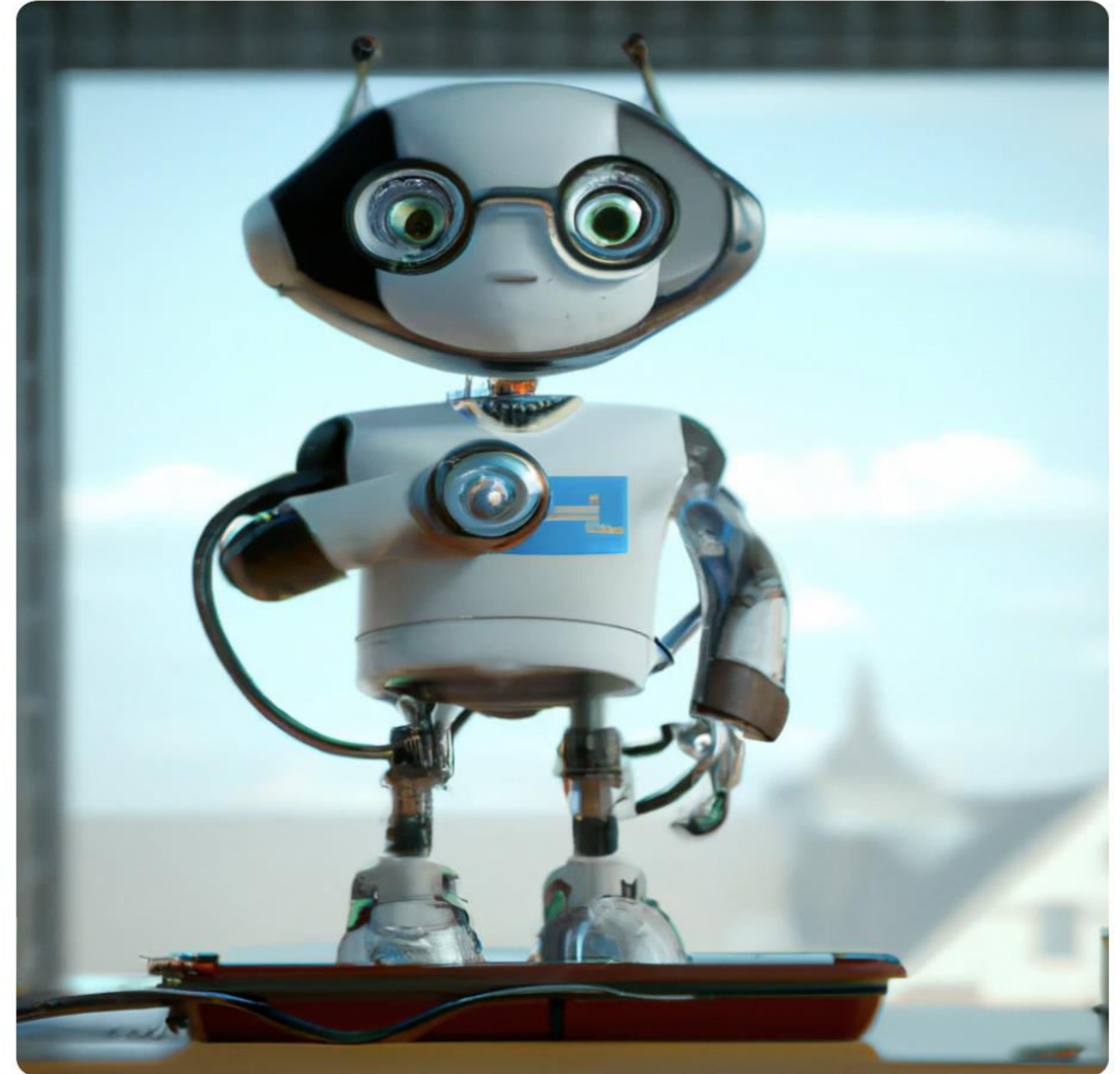
The use of AI algorithms can help improve the accuracy and reliability of coronary artery imaging.



## **The Future of AI in Cardiology**

AI is still in its early stages in cardiology, but the potential is huge. AI can help improve care and reduce costs, while also freeing up medical staff to focus on more complex tasks.

AI is also becoming more accessible, with more affordable and user-friendly systems. This could help make AI more widely available and increase its impact on healthcare.




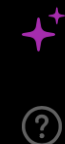
# Exploring the Possibilities of Artificial Intelligence in Cardiology

## Outline generating...

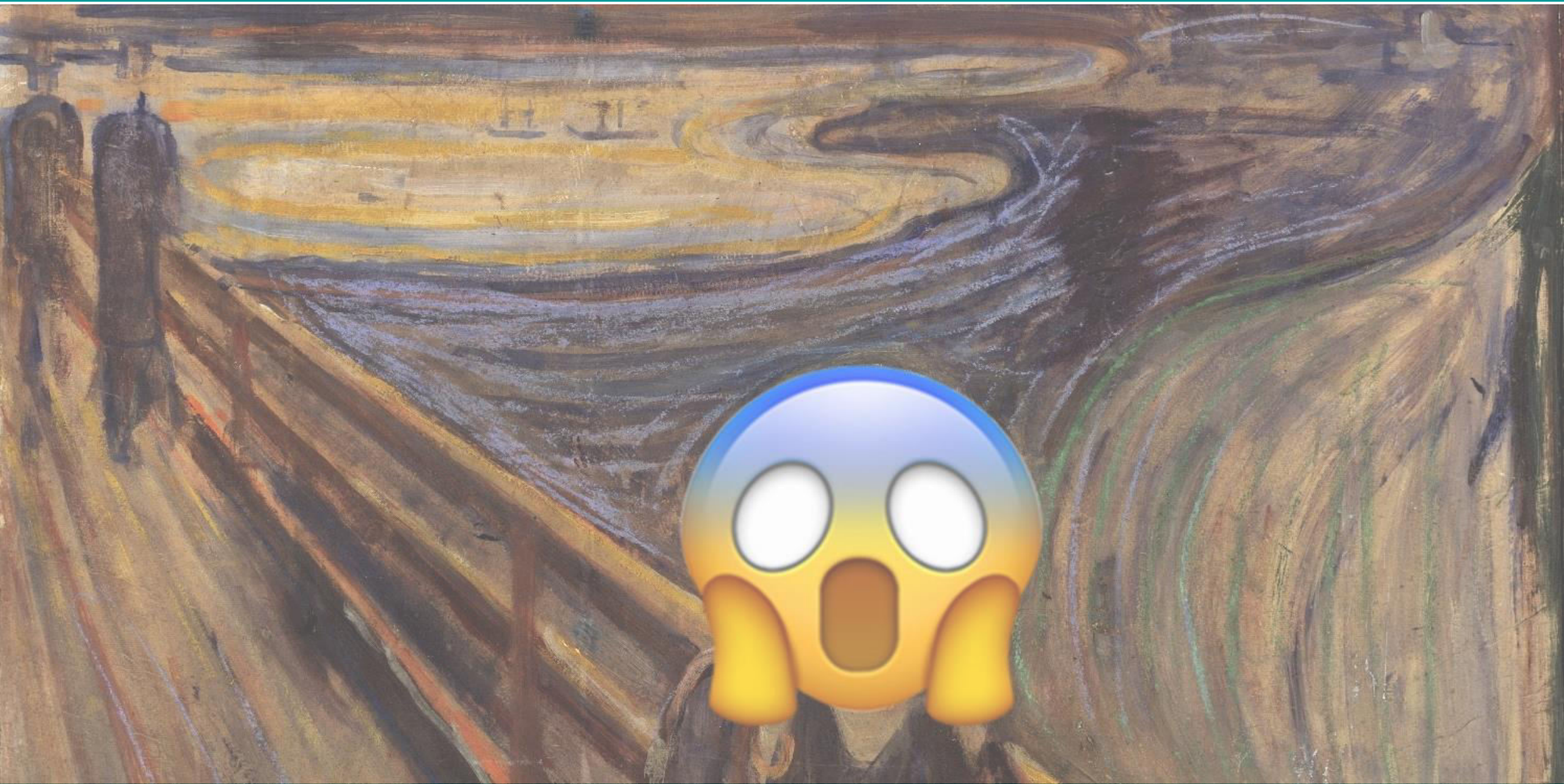
- 1 Exploring the Possibilities of Artificial Intelligence in Cardiology
- 2 Outline generating... P
- + (Add new slide)



Creating page 3... 



# *The (R)evolution of AI*



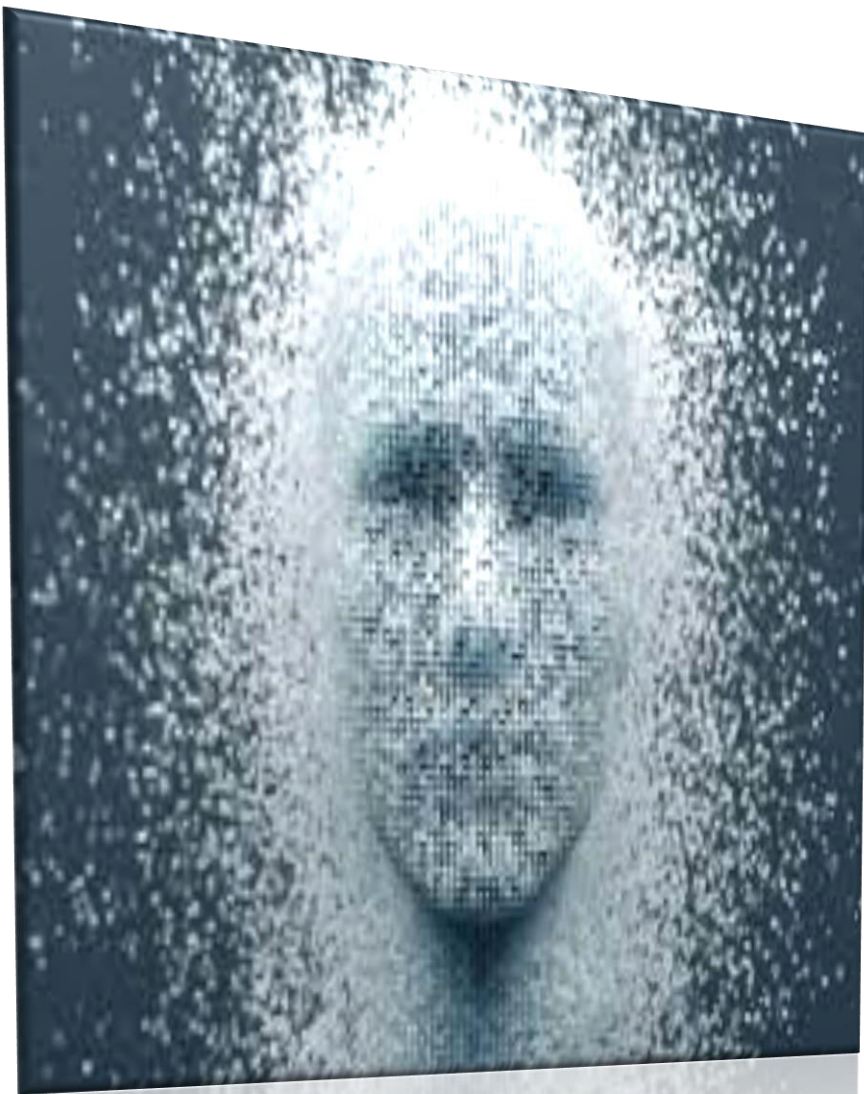


PRECEDENCE  
RESEARCH

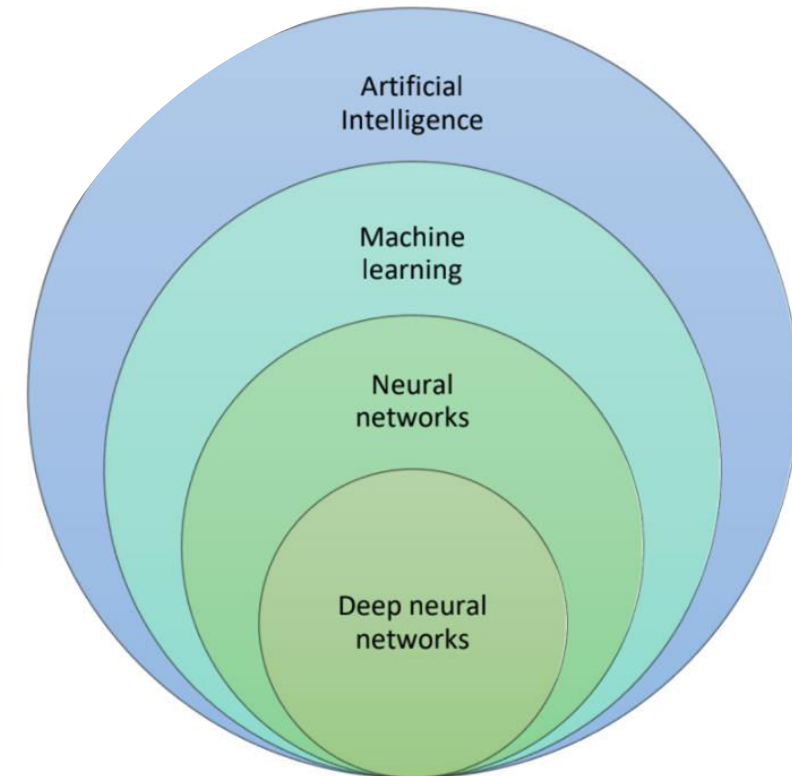
## ARTIFICIAL INTELLIGENCE MARKET SIZE, 2021 TO 2030 (USD BILLION)







**ARTIFICIAL INTELLIGENCE** is a field of computer science that aims to mimic human thought processes, learning capacity and knowledge storage.



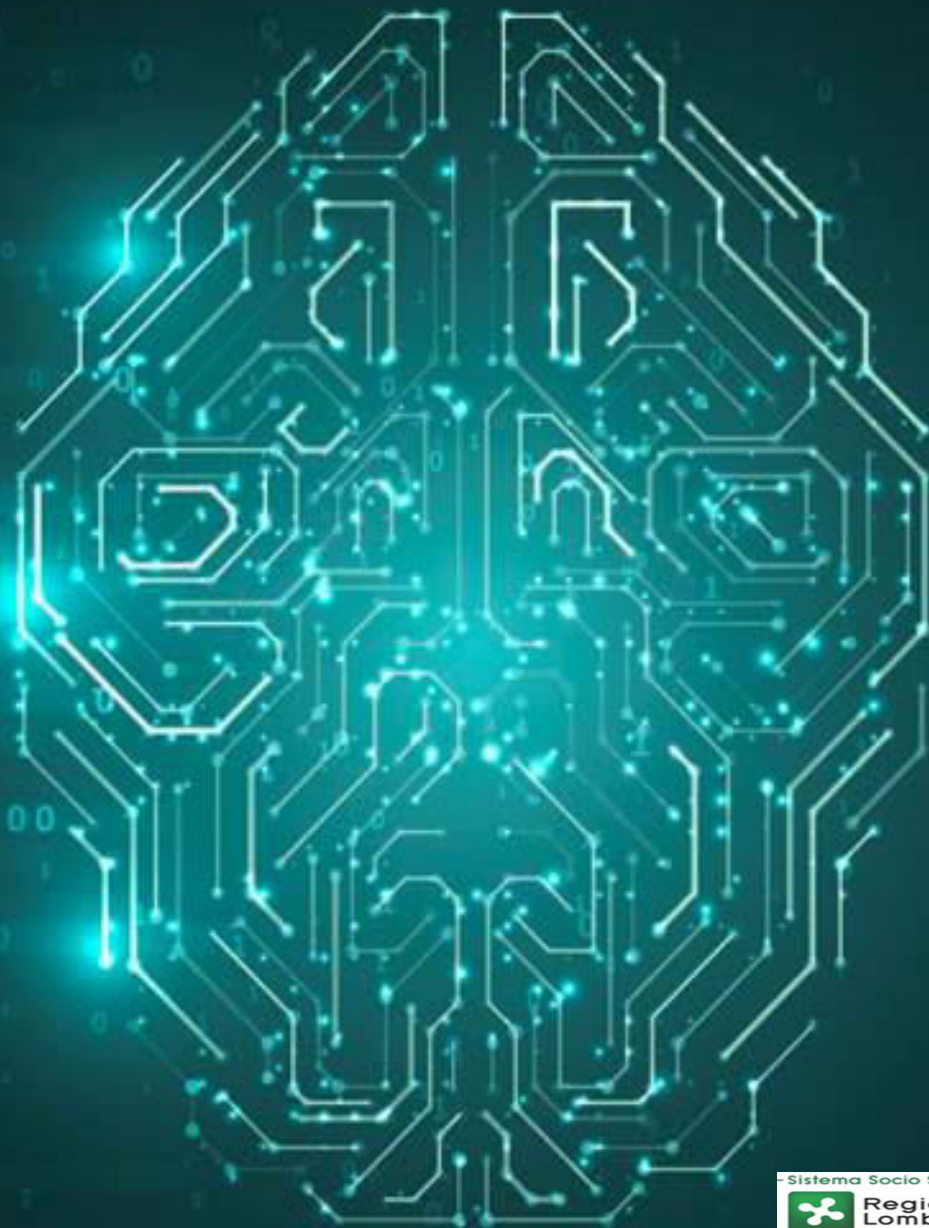
**BIG DATA:** large datasets that are unable to be analysed, searched and interpreted.

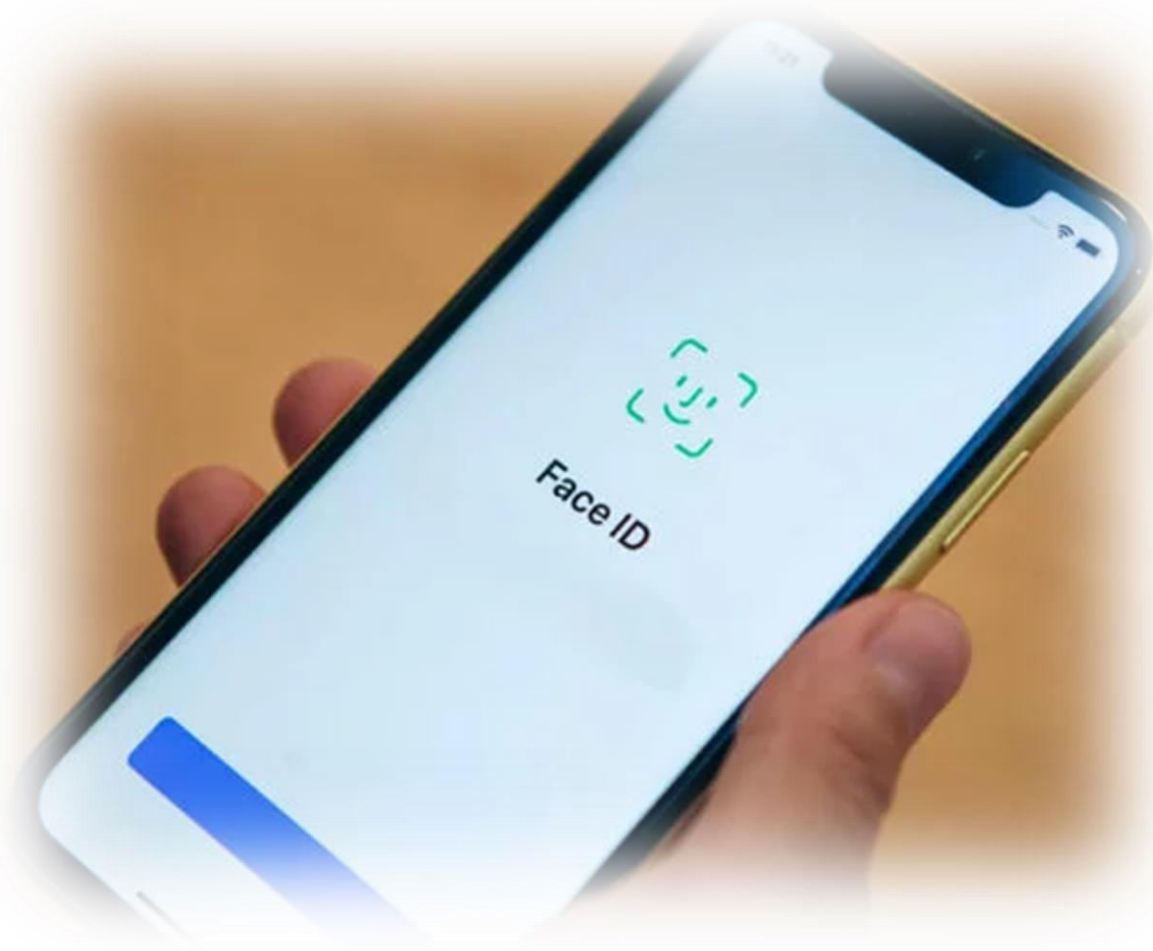
## ***MACHINE LEARNING:***

*set of techniques for solving complex problems in an automated manner through identification of interaction patterns among variables.*



**DEEP LEARNING:** process that mimics human thought with the use of multiple layers of artificial **NEURAL NETWORKS** which can learn, automatically generate predictions based on input data and output result (training sets).







07:24 4G 99

Bergamo

Magazzini del Cotone

2 h 56 3 h 2 g 11 h

2 h 56 min Pedaggi

4 h 50 min Nessun pedaggio

2 h 56 min (203 km)

Fa risparmiare 4% di benzina

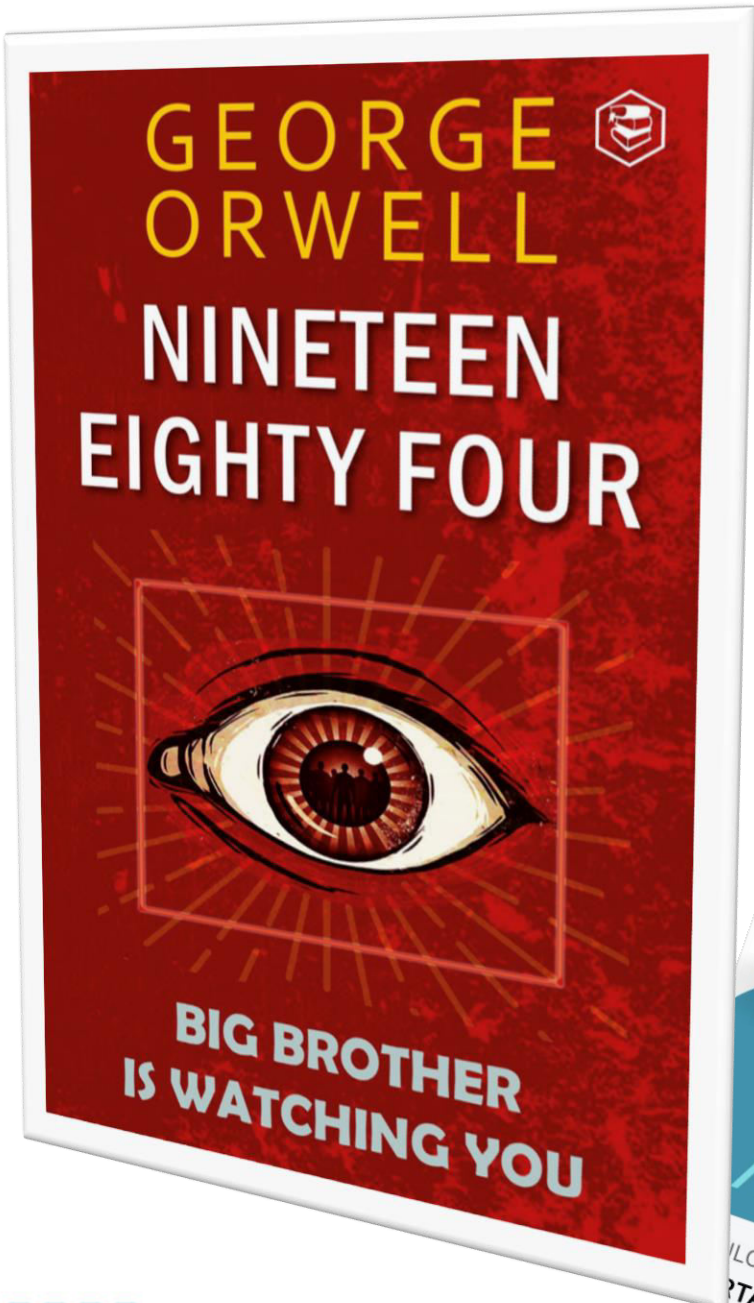
Percorso migliore adesso a causa delle condizioni del traffico

Area B lungo il percorso

Dettagli Vedi Fissa

Traffico

Detailed description: This is a screenshot of a mobile navigation app. At the top, it shows the time 07:24, signal strength, 4G network, and 99% battery. The start location is Bergamo and the destination is Magazzini del Cotone. Below the search bars, there are icons for different transport modes: car (2 h 56), train (3 h), walking (2 g), bicycle (11 h), and airplane. A map shows a blue route from Bergamo to Genova, with a callout for '2 h 56 min Pedaggi' and another for '4 h 50 min Nessun pedaggio'. Below the map, the selected route is '2 h 56 min (203 km)' with a leaf icon indicating fuel savings. It notes 'Fa risparmiare 4% di benzina' and 'Percorso migliore adesso a causa delle condizioni del traffico'. There is a button for 'Area B lungo il percorso' and buttons for 'Dettagli', 'Vedi', and 'Fissa'. At the bottom, it says 'Traffico'.



**Volkswagen Bonaldi**

Sponsorizzato · 🌐

Trova ora la tua prossima Volkswagen in Pronta  
Consegna e non lasciarti scappare le nostre... Altro...



**T-Roc 2.0 tdi style  
4motion 150cv dsg**  
Nuovo, Diesel

Scopri di



...LO SU FACEBOOK  
...TA RISERVATA

TROVA AUTO



Manut  
Modul  
ANTICIPO  
O PERMUT  
15.636 EUR

**Concessionaria BMW Lario Bergauto**  
Sponsorizzato · 🌐  
Guida la Nuova **BMW X4** da 620€ al mese.  
Con Bollo, Assicurazione RCA e Manutenzione  
... Altro...



**Quattroruote**

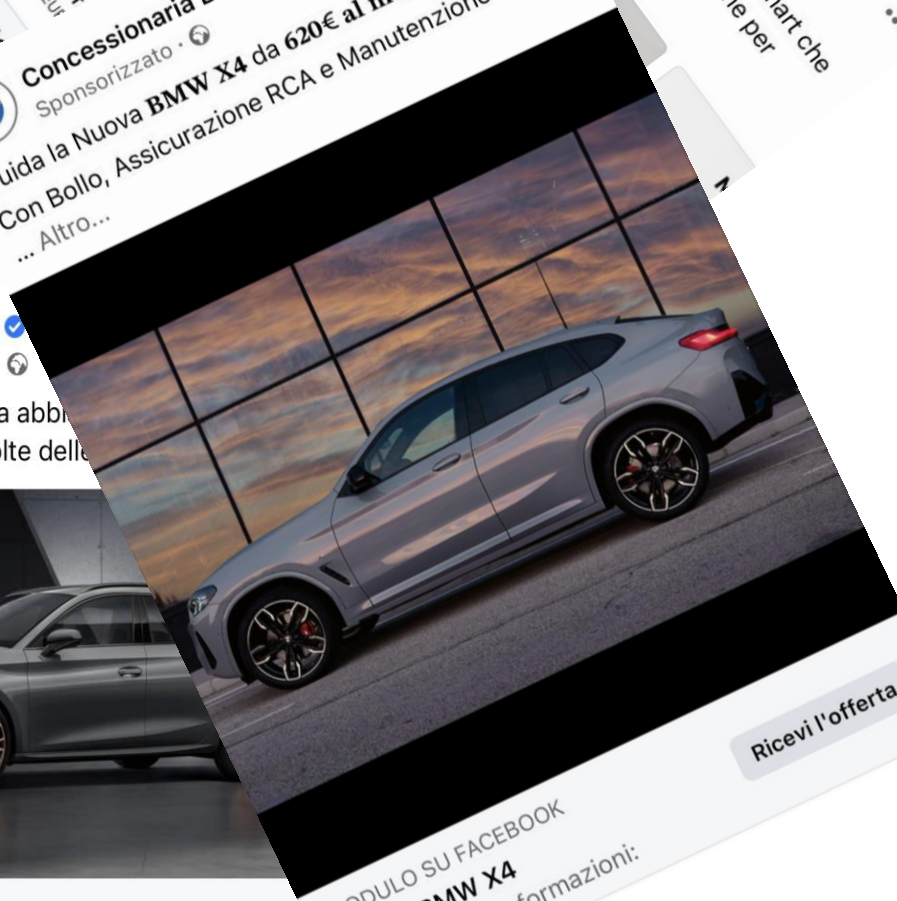
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Nella nostra rassegna abbonamento  
vendita nel 2023, molte delle



quattroruote.it

Station wagon - Familiari forever: meno richieste  
più affascinanti - FOTO GALLERY

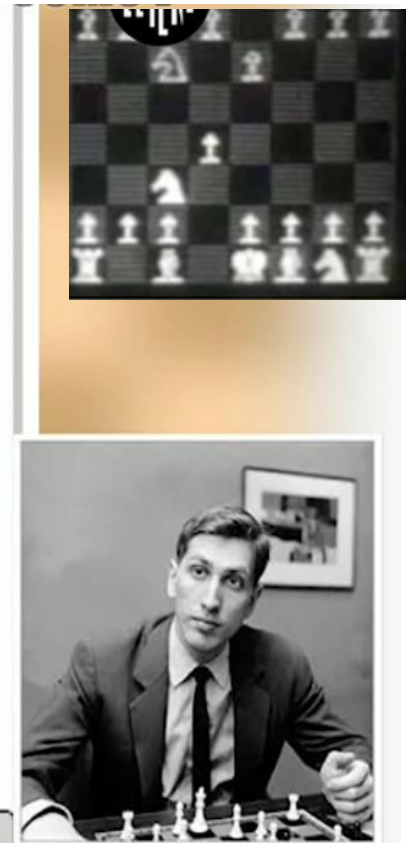
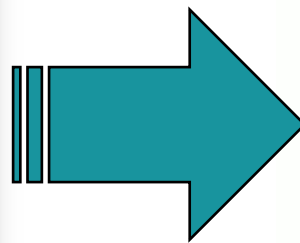
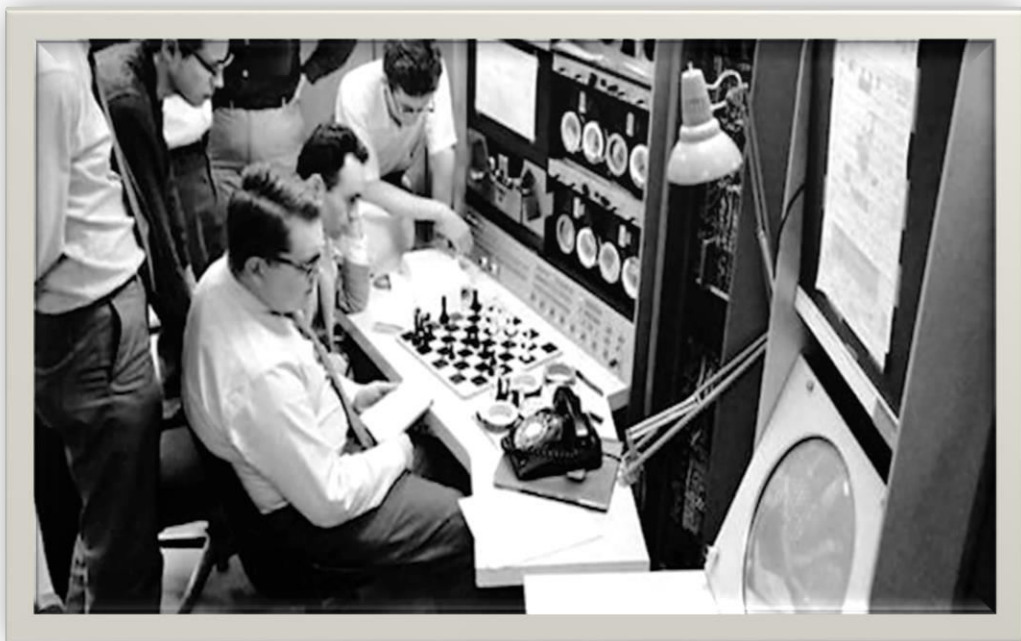


Ricevi l'offerta

MODULO SU FACEBOOK  
**Nuova BMW X4**  
Per maggiori informazioni:

1949...playing chess

1959



## 1999

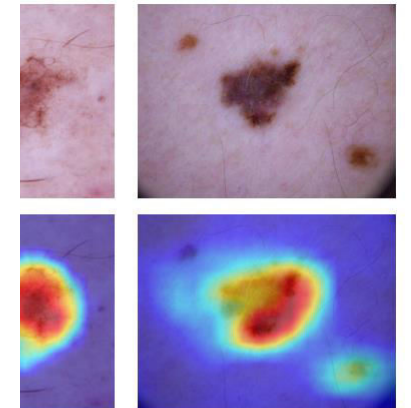
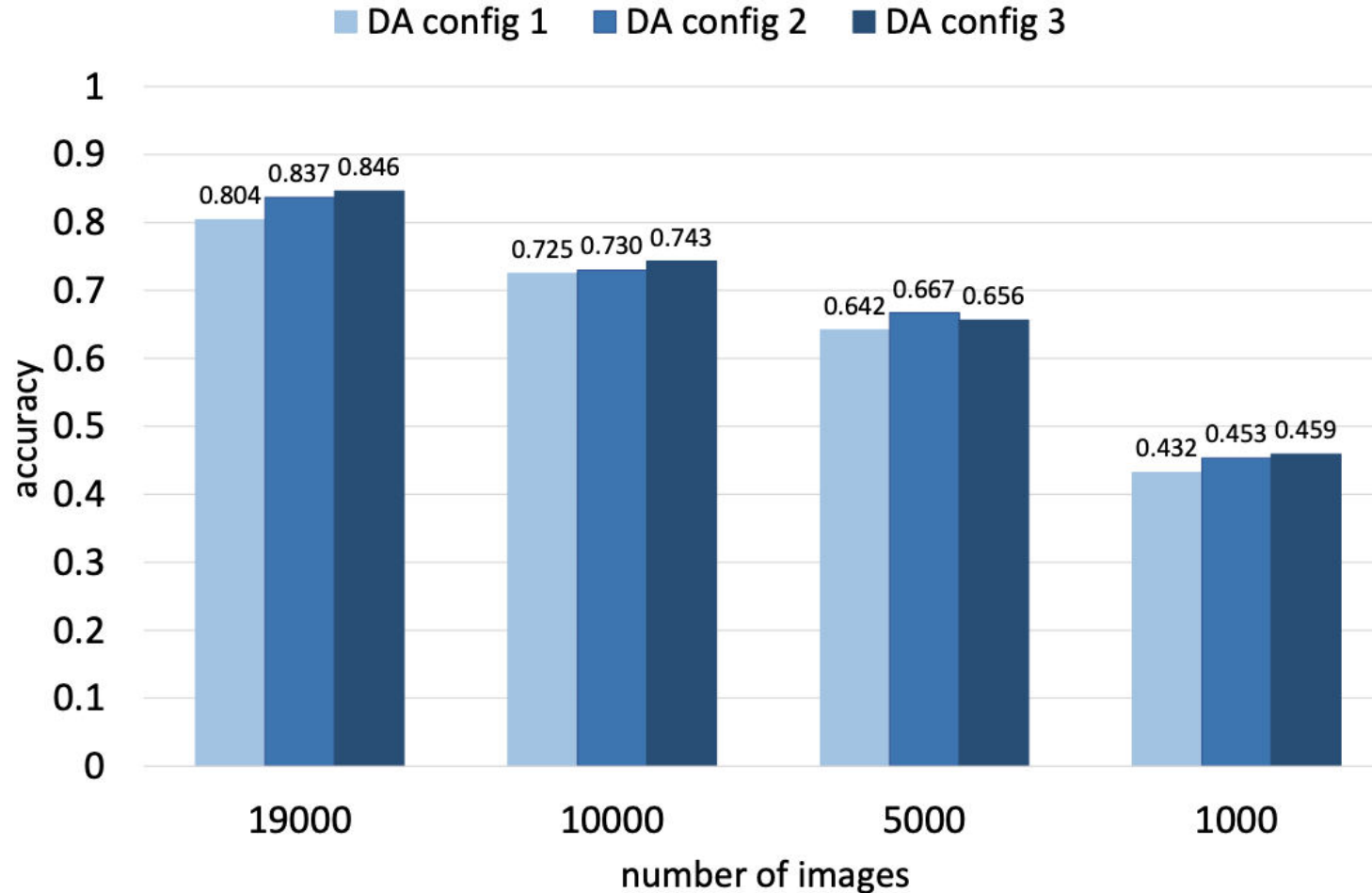
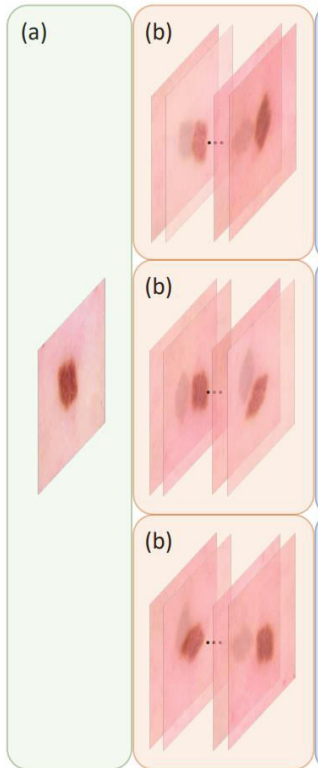




# A Deep Analysis on High Resolution Dermoscopic Image Classification

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www.ietdl.org

*F. Pollastri,<sup>1</sup> M. Parreño,<sup>2</sup> J. Maroñas,<sup>2</sup> F. Bolelli,<sup>1</sup> R. Paredes,<sup>2</sup> D. Ramos,<sup>3</sup> and C. Grana,<sup>1</sup>*



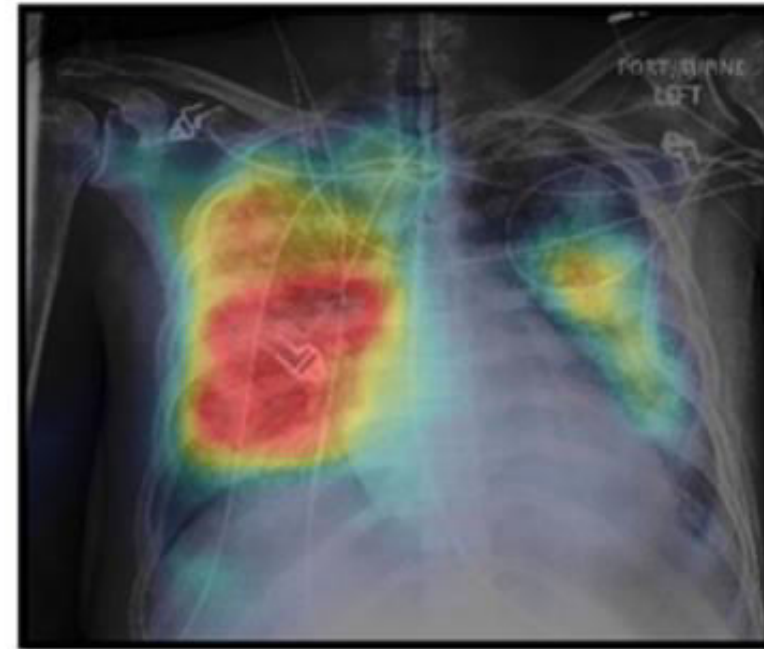
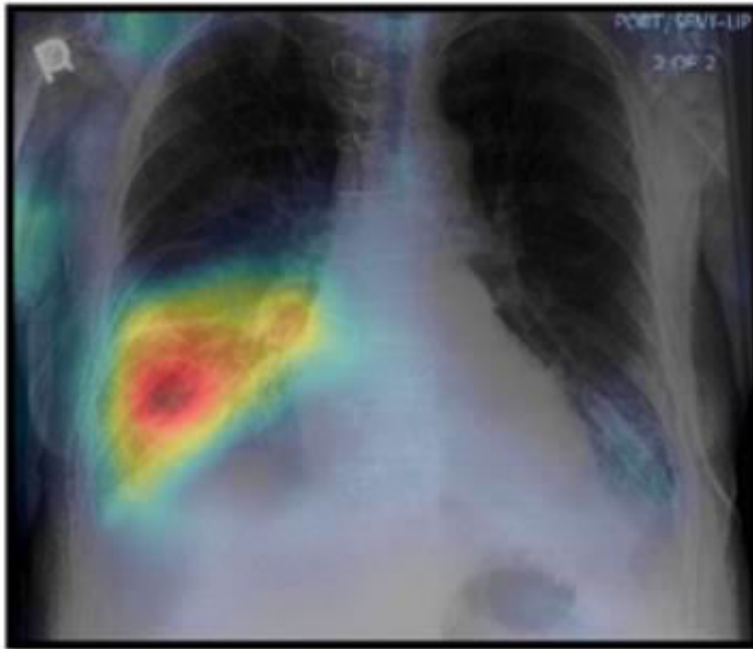
dataset and attention heatmaps  
AM method. Besides always  
can aim its attention at specific  
most image) or darker patches

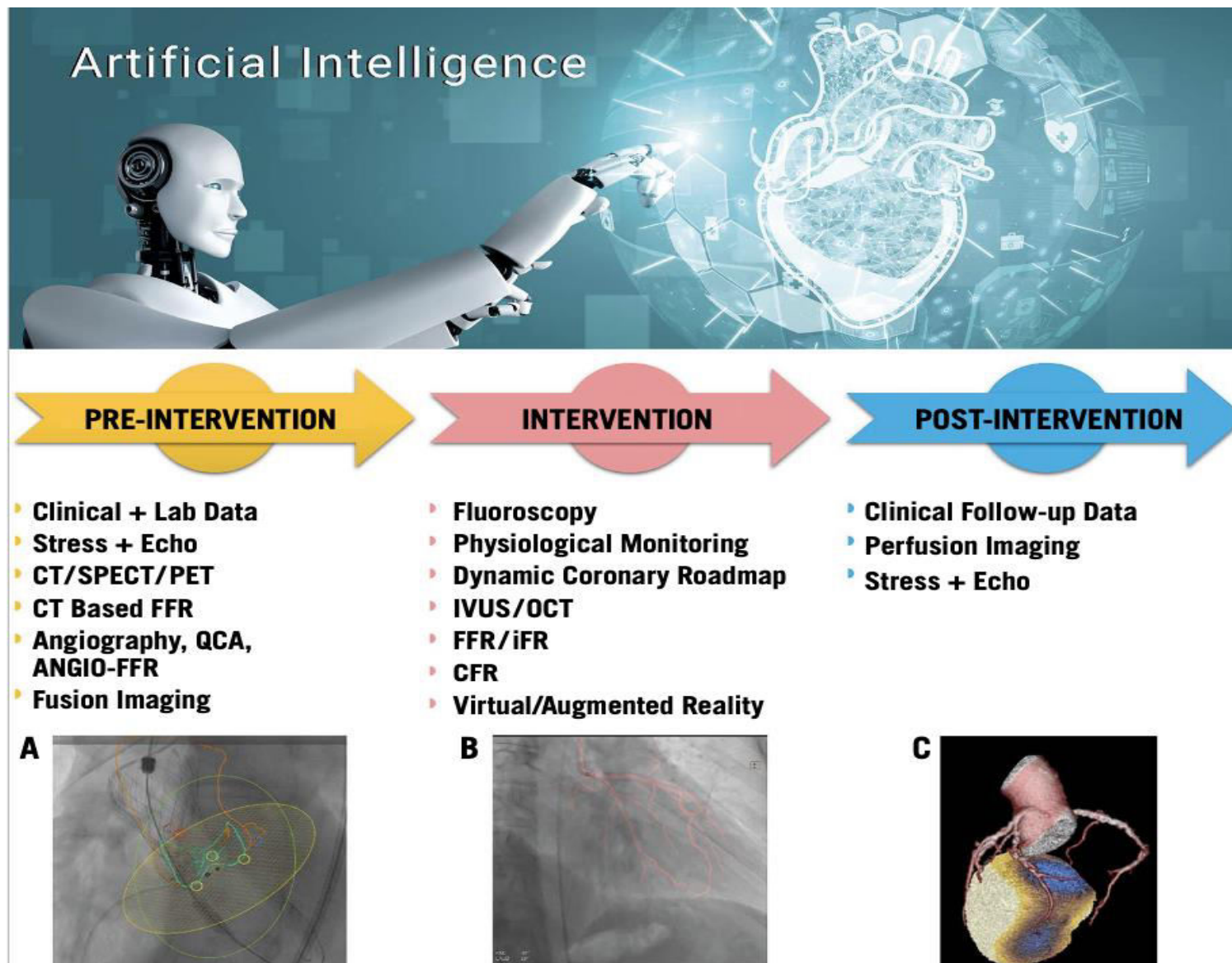
# Covid CXR Hackathon:

Global event with more than 1000 experts in radiology, epidemiology and AI from 70 different countries

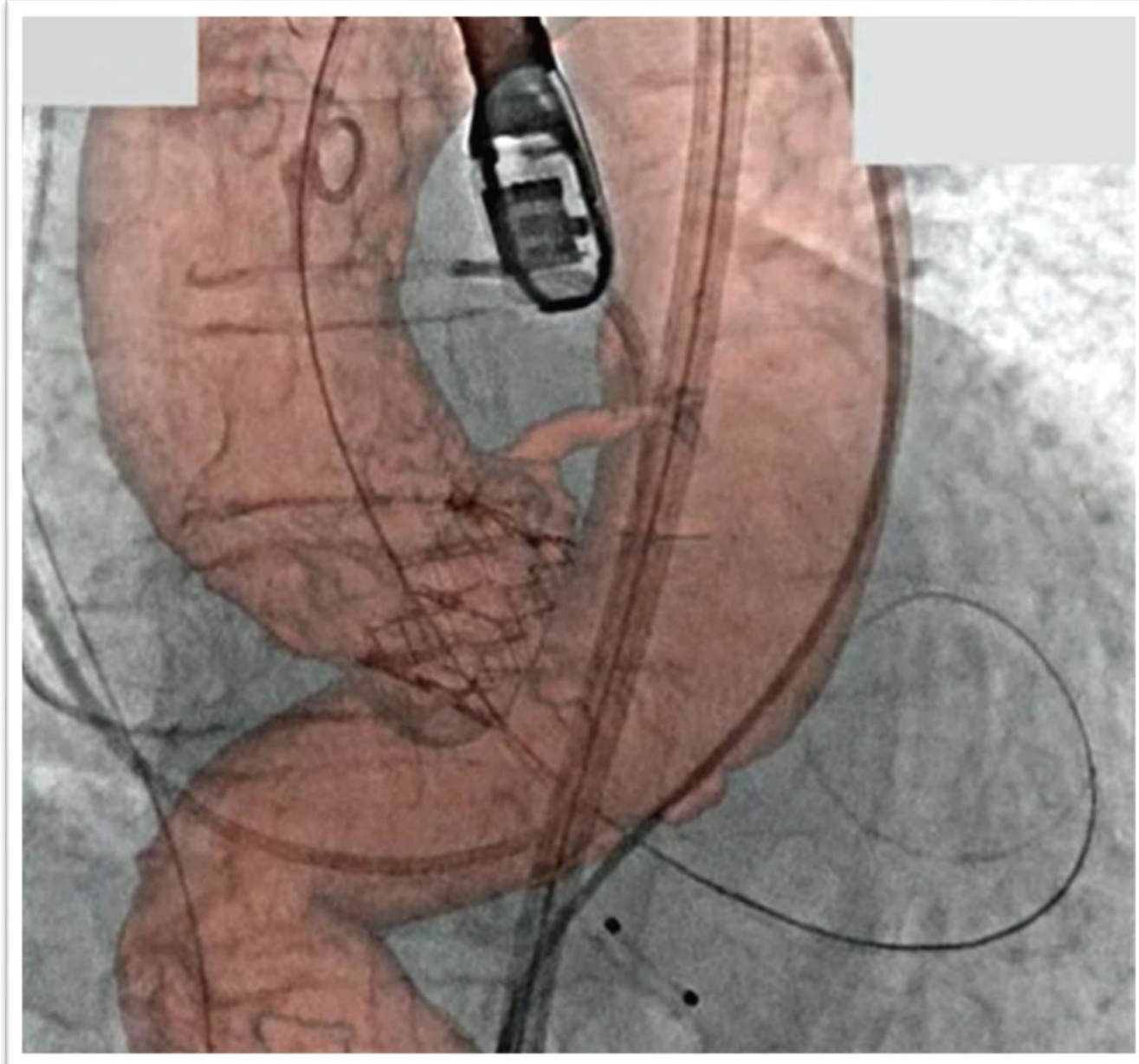


*aims at accuracy and effective solutions based on machine learning and data science supporting the medical doctor to formulate a Covid-19 prognosis.*

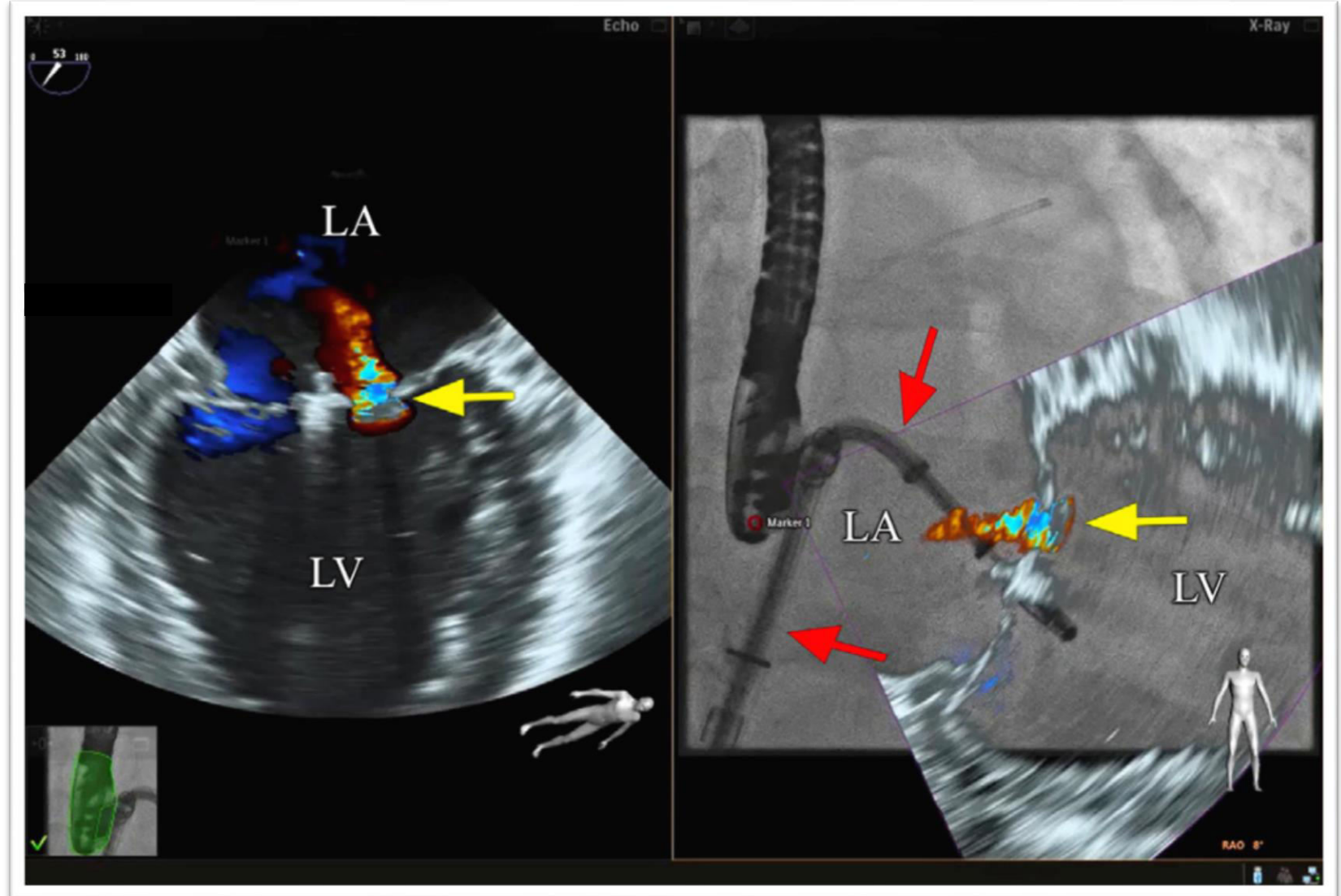
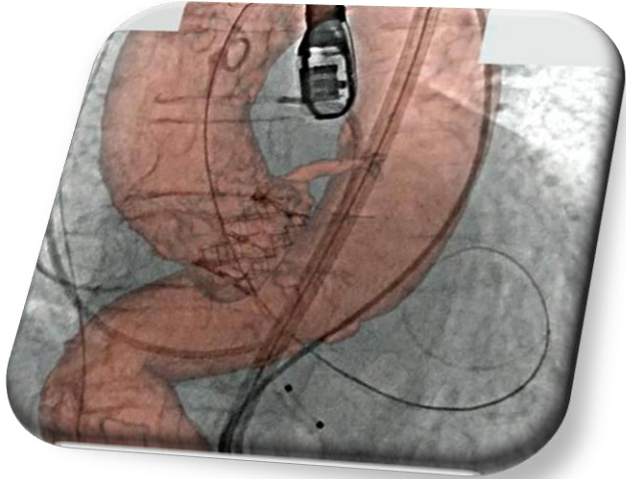


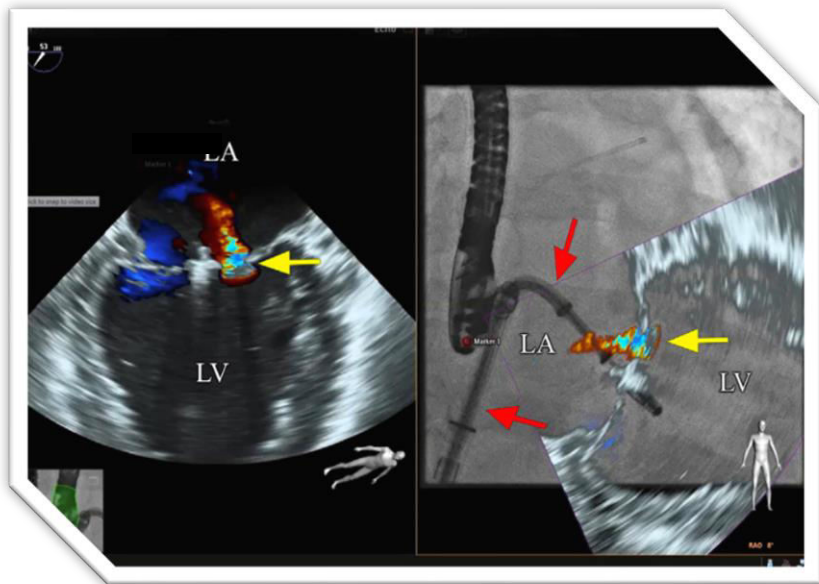
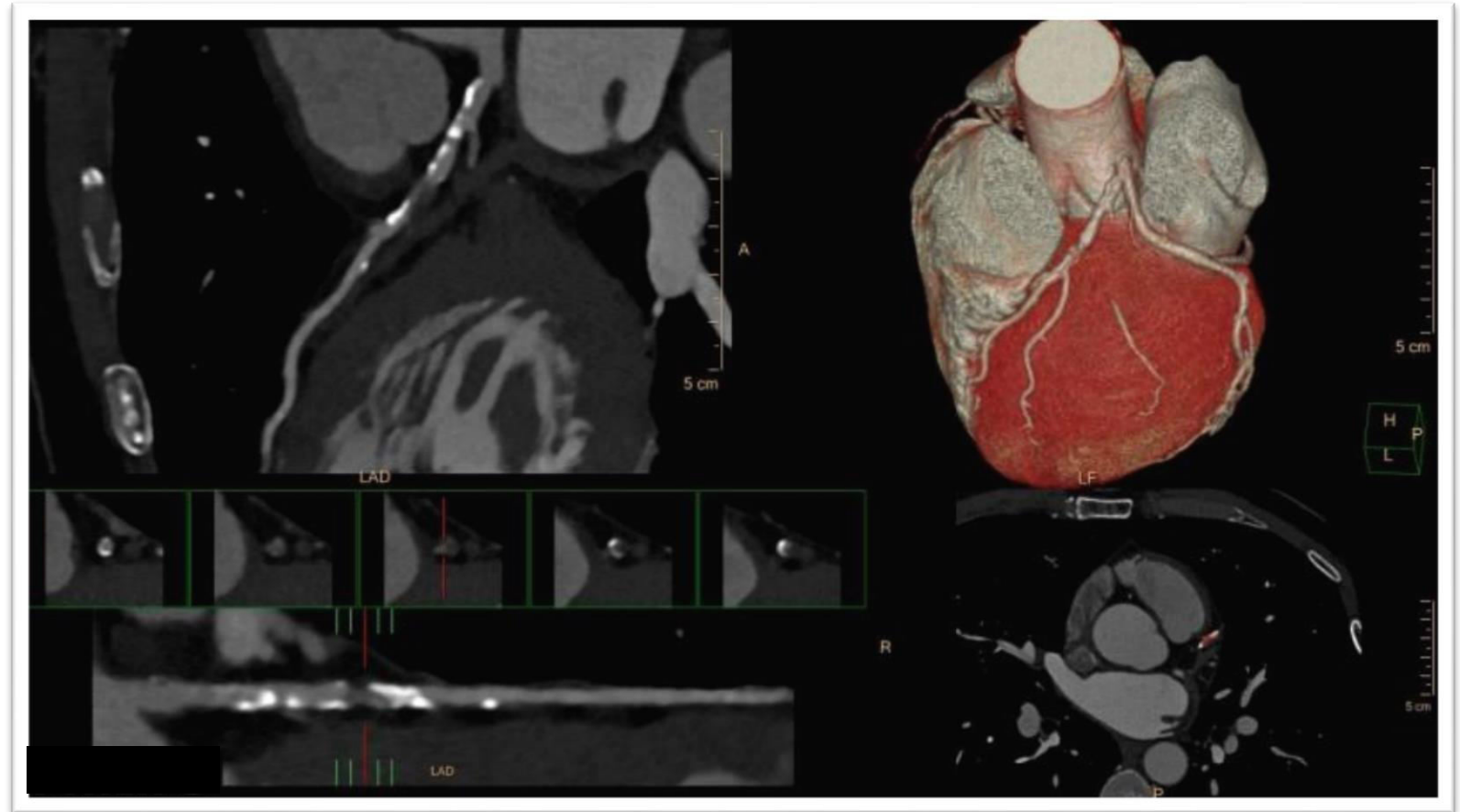
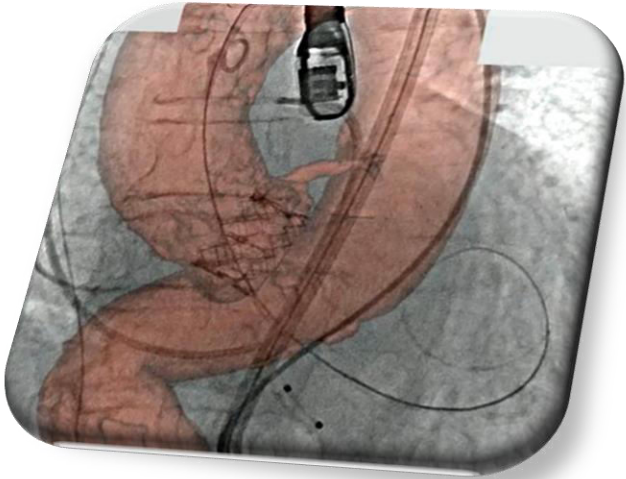


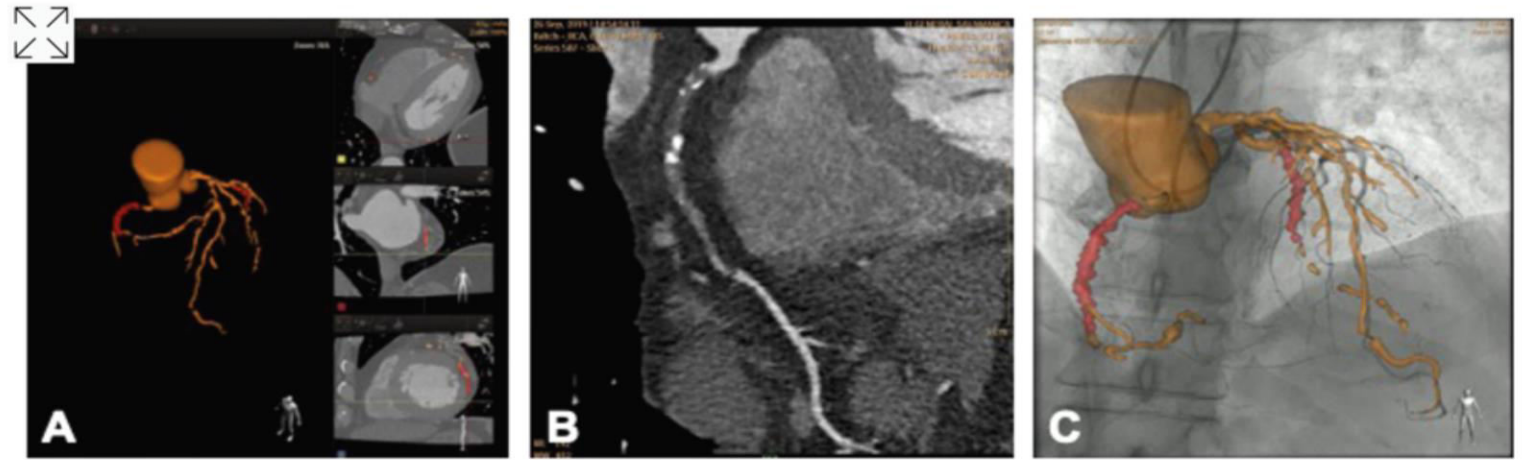
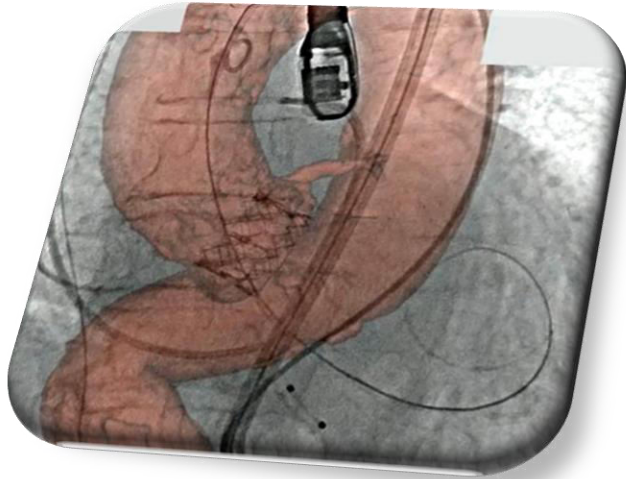
# *The real world: AI in the Cath Lab*



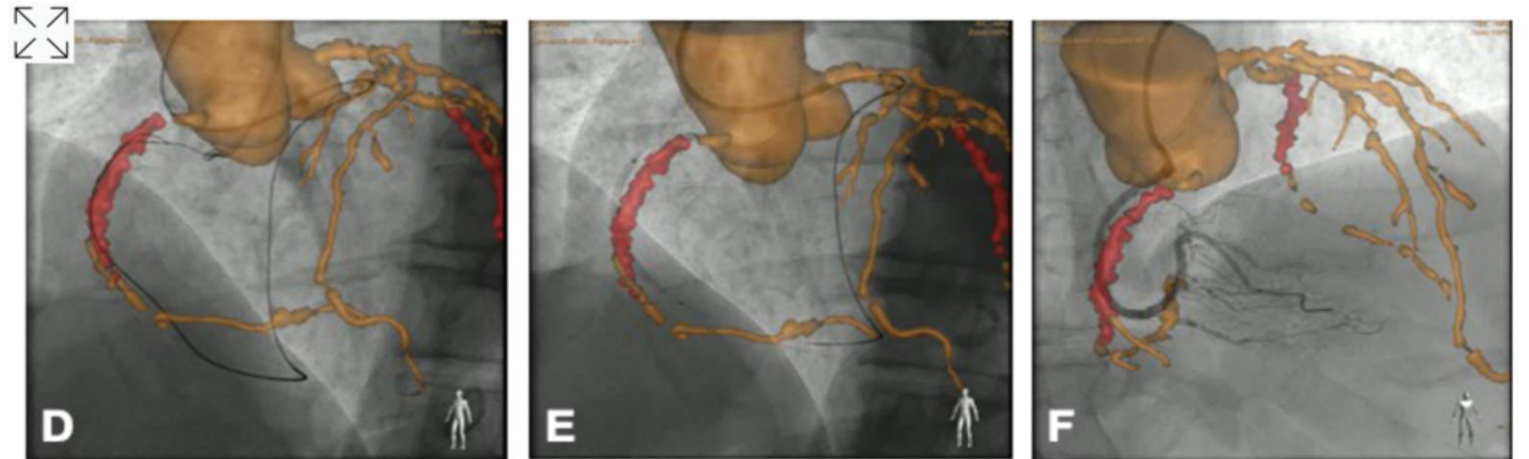
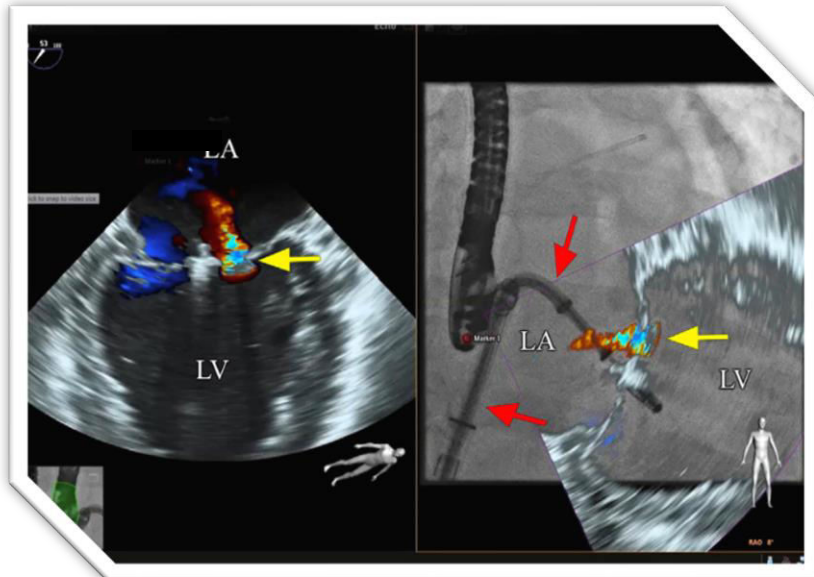
# The real world: AI in the Cath Lab







**FIGURE 1.** (A) Angio-computed tomography 3-dimensional reconstruction; occluded segments highlighted in red. (B) Right coronary angiography longitudinal reconstruction, lack of contrast, and calcified nodules. (C) Simultaneous catheterization by biradial access.



**FIGURE 1.** (Continued) (D) Controlled antegrade and retrograde tracking-reverse technique and advancement of the retrograde wire into the antegrade catheter. (E, F) Arterio-arterial loop was created, followed by predilatation and stent implantation.

# The real world: AI in the Cath Lab

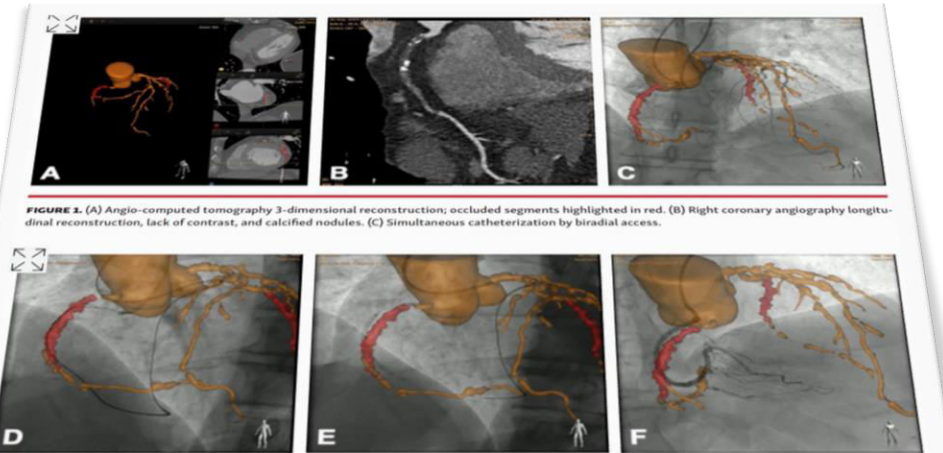
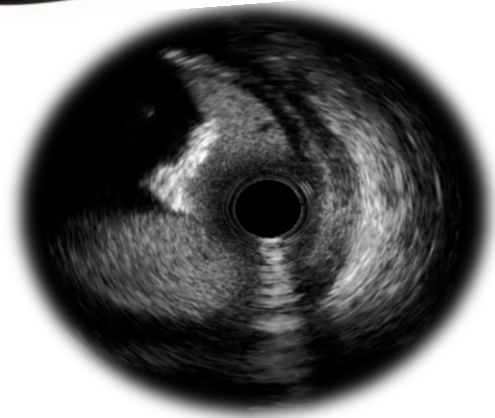
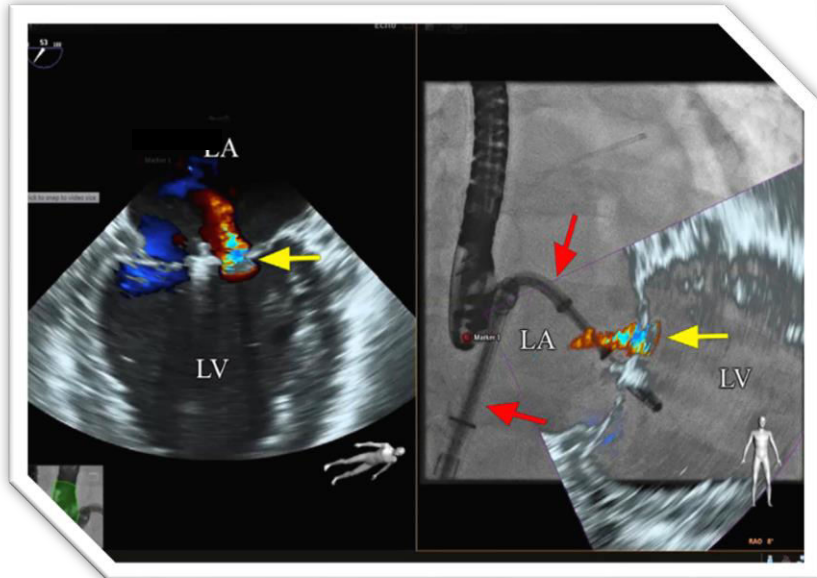
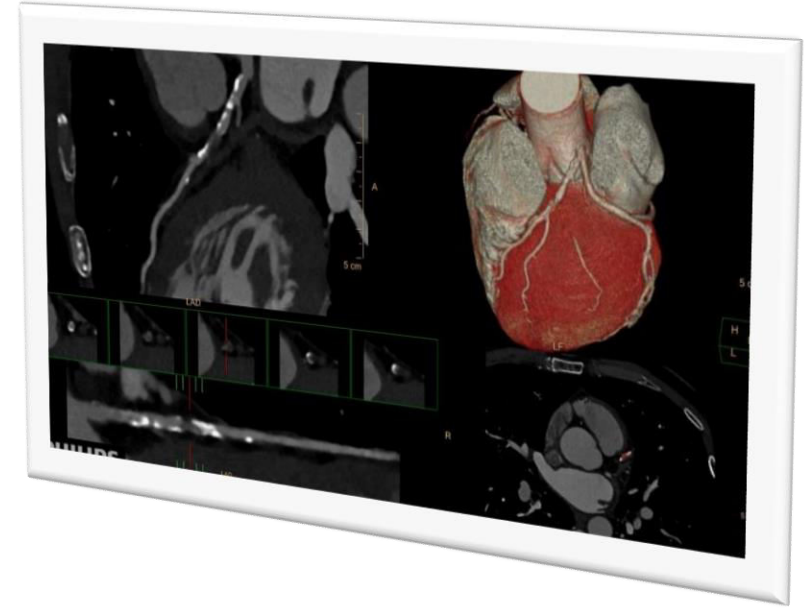
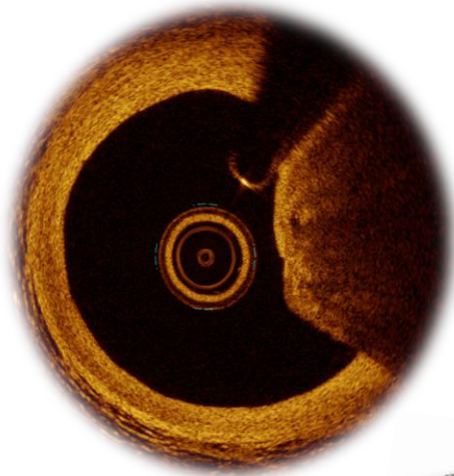
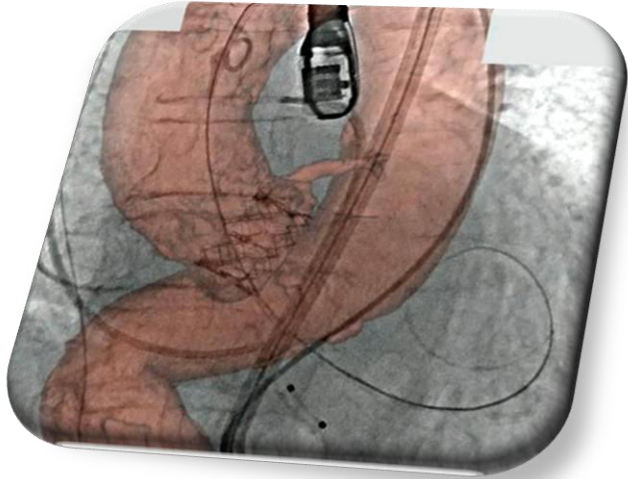


FIGURE 1. (A) Angio-computed tomography 3-dimensional reconstruction; occluded segments highlighted in red. (B) Right coronary angiography longitudinal reconstruction, lack of contrast, and calcified nodules. (C) Simultaneous catheterization by biradial access.

FIGURE 1. (Continued) (D) Controlled antegrade and retrograde tracking-reverse technique and advancement of the retrograde wire into the antegrade catheter. (E, F) Arterio-arterial loop was created, followed by predilation and stent implantation.





FIGURE 1 (continued) (D) Controlled antegrade and retrograde tracking-reverse technique and advancement of the retrograde wire into the subgraft catheter. (E, F) Arterio-arterial loop was created, followed by predilation and stent implantation.



**7,000+ IMAGE FRAMES**



# MORPHOLOGY



**OCT-based calcium score**

1. Maximum calcium angle (°)	≤180°	⇒ 0 point
	>180°	⇒ 2 points
2. Maximum calcium thickness (mm)	≤0.5 mm	⇒ 0 point
	>0.5 mm	⇒ 1 point
3. Calcium length (mm)	≤5.0 mm	⇒ 0 point
	>5.0 mm	⇒ 1 point
<b>Total score</b>	<b>0 to 4 points</b>	

## Calcium

F: 175 1 mm

Total Angle **273°**

Max Thickness **0.71 mm**



L

D

**LENGTH DIAMETER**



Morphology

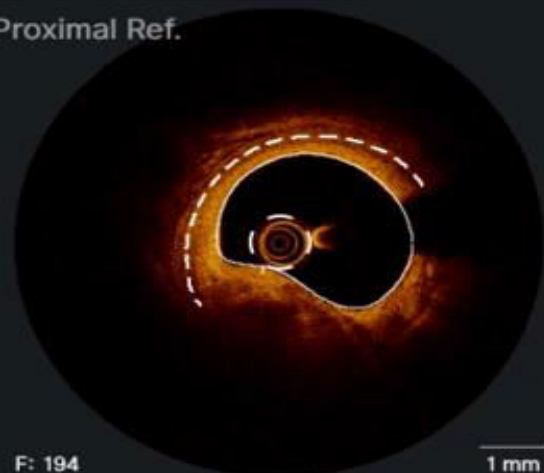
**Sizing**

Deployment

Review



Proximal Ref.



F: 194

1 mm

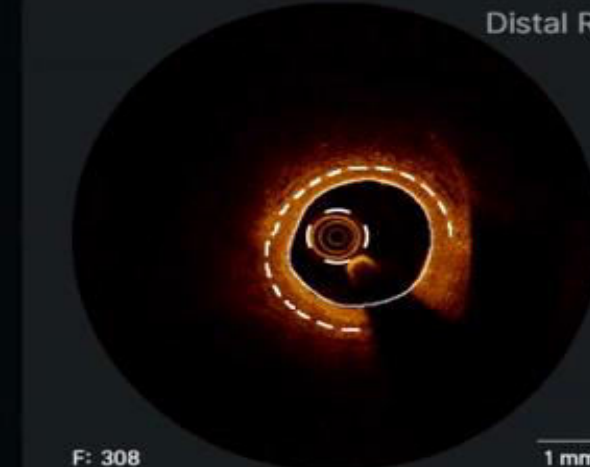
EEL **3.90** mm  
Lumen **2.63** mm



F: 198

1 mm

EEL **2.68** mm  
Lumen **2.68** mm

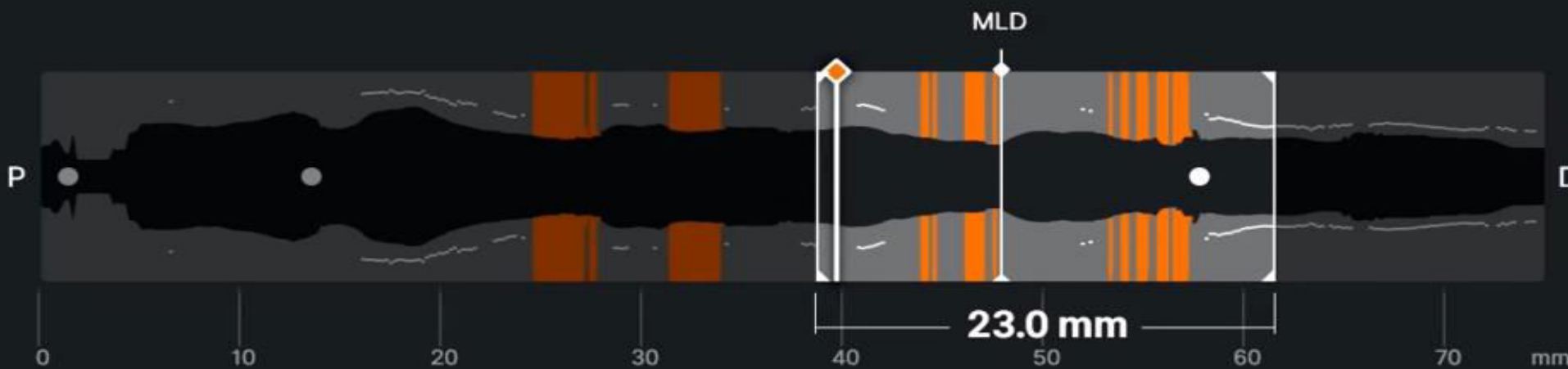


Distal Ref.

F: 308

1 mm

EEL **2.82** mm  
Lumen **2.15** mm



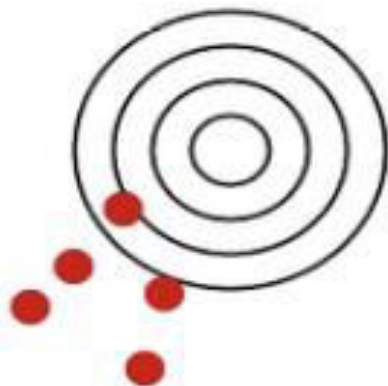
Last, First

Calcium threshold: 180°

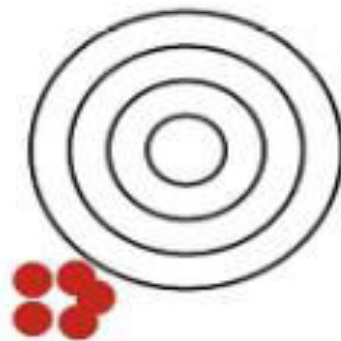
PBK 2: LCX, Proximal-Mic

# Precision vs. Accuracy

Not Precise or Accurate



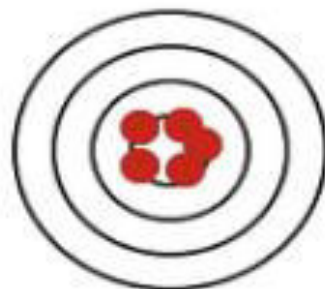
Precise, but not Accurate



Accurate, but not Precise



Precise and Accurate

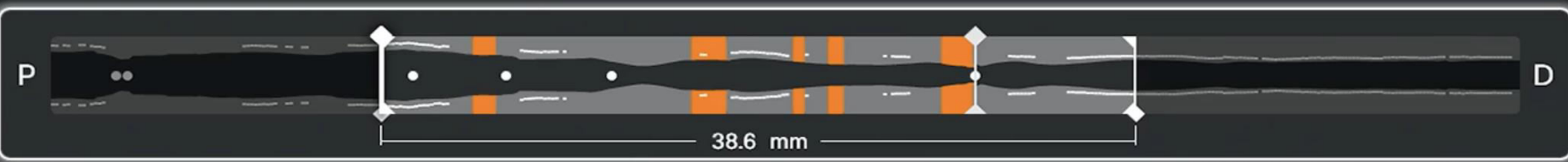
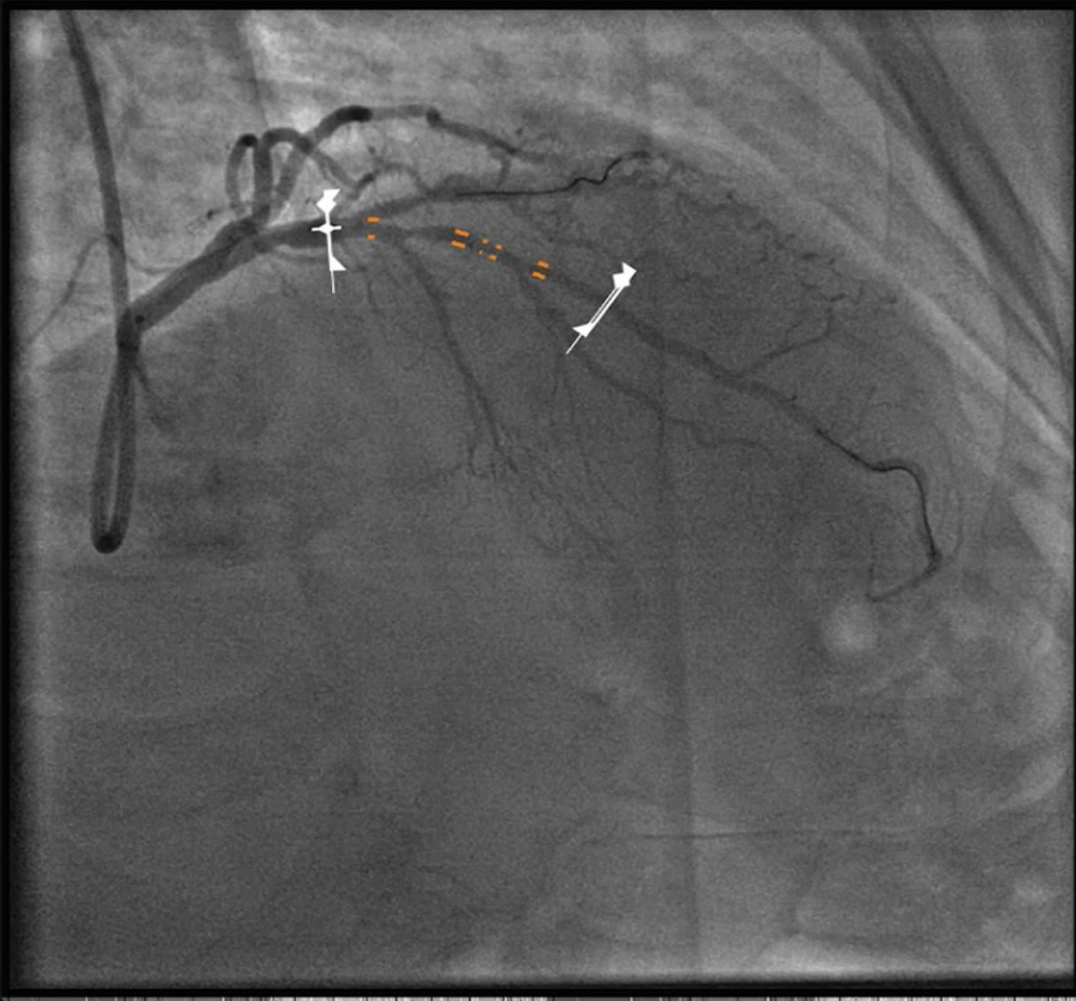


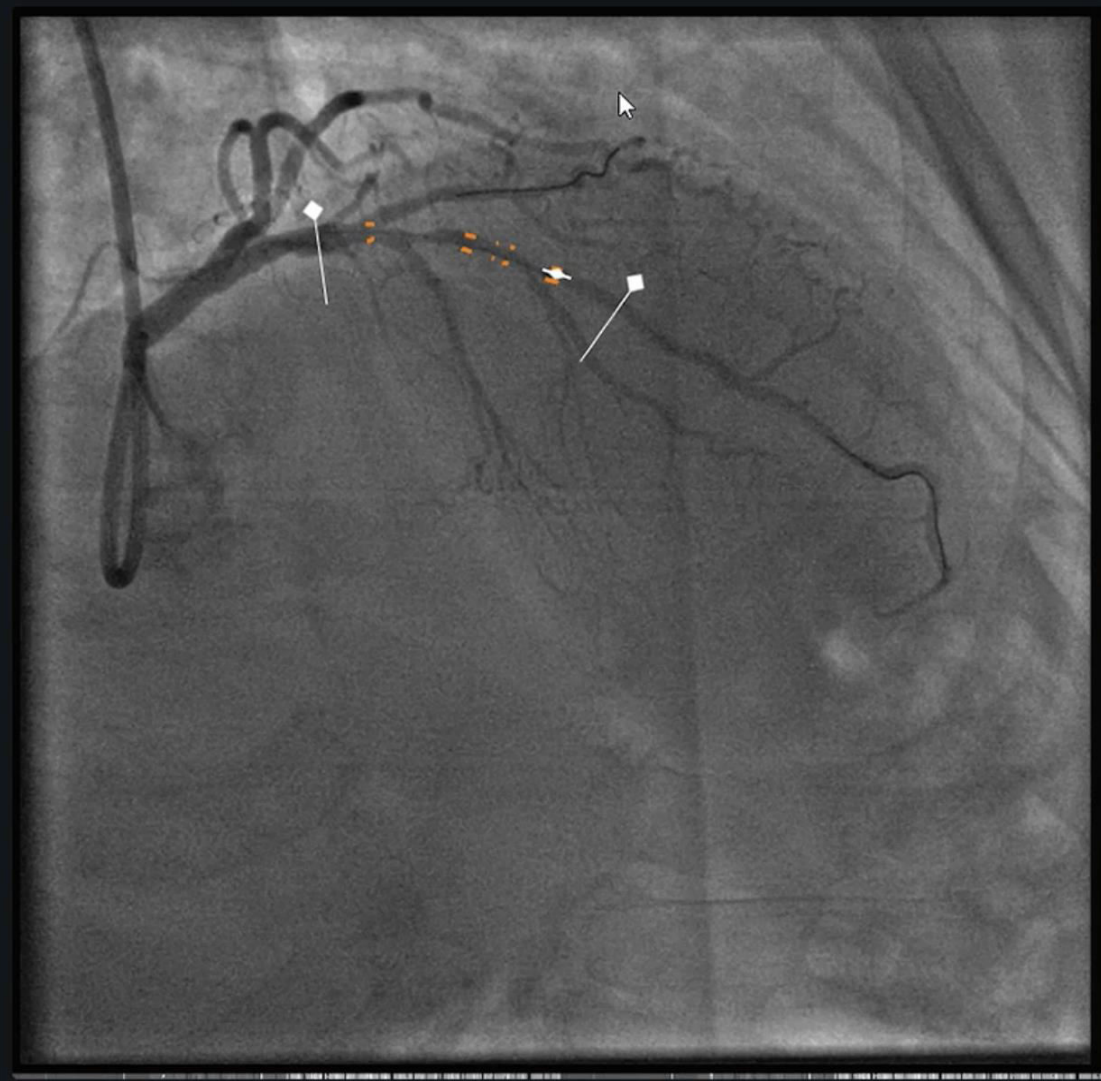
**Angiography**

**IVUS**

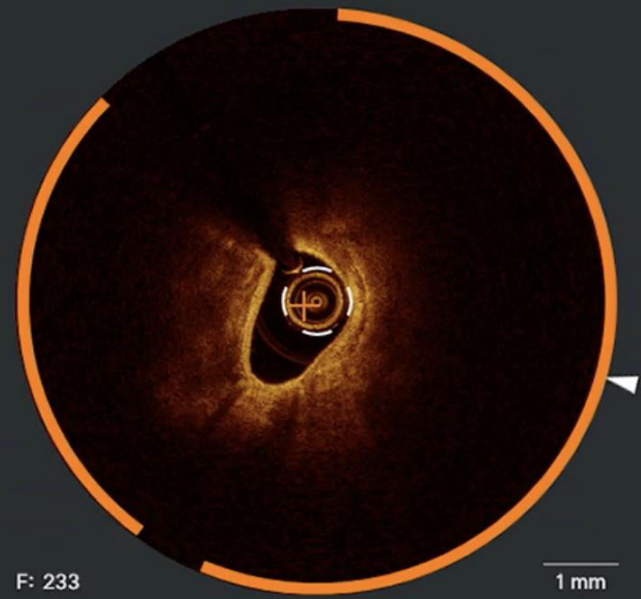
**FD-OCT**

**Co-registration + AI**





# Calcium

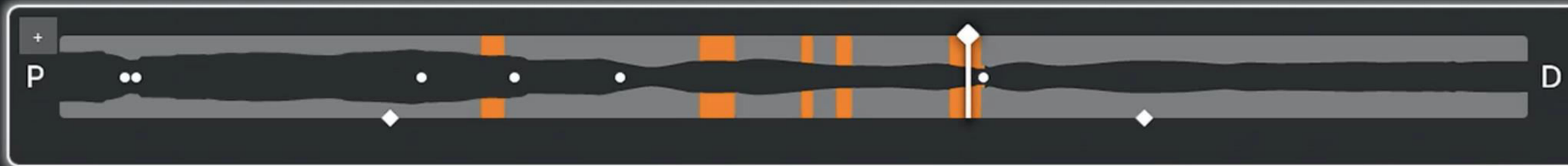


F: 233

1 mm

Total Angle  
**296°**

Max Thickness  
**1.04 mm**



B, G

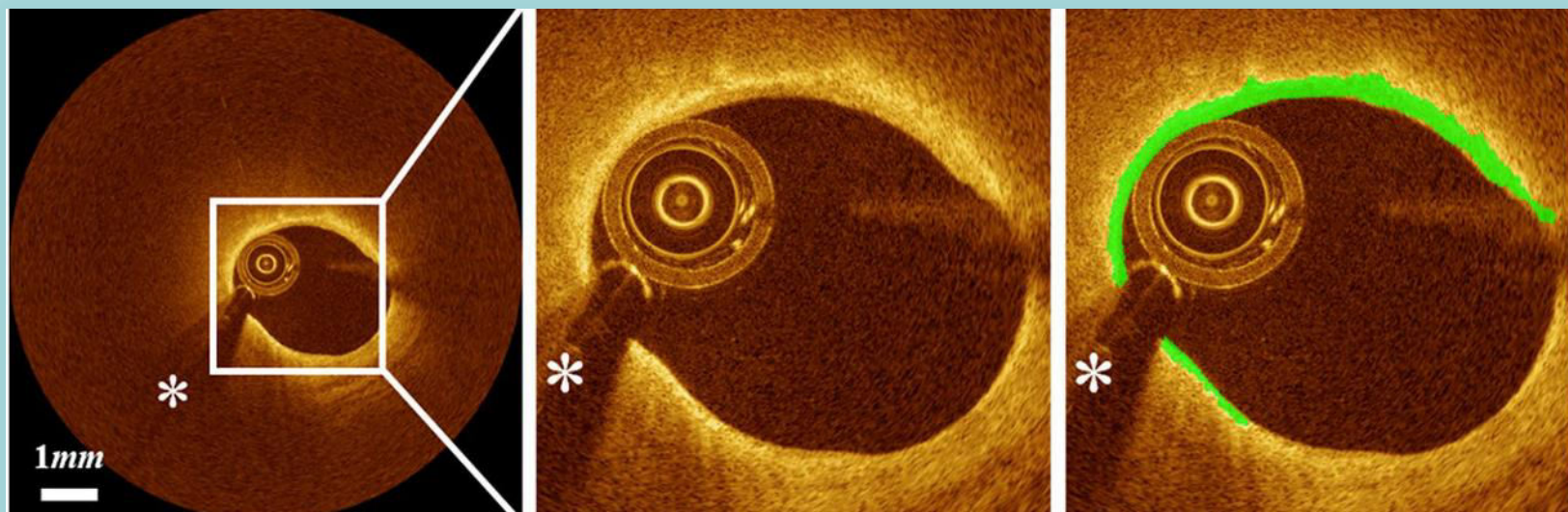
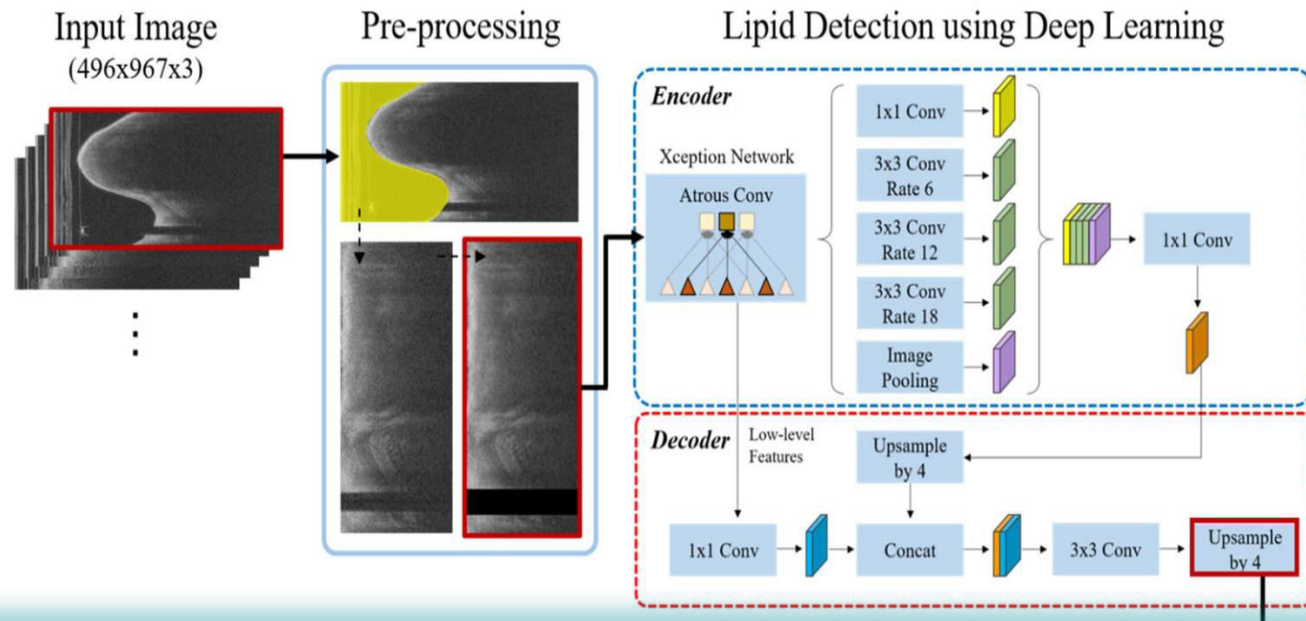
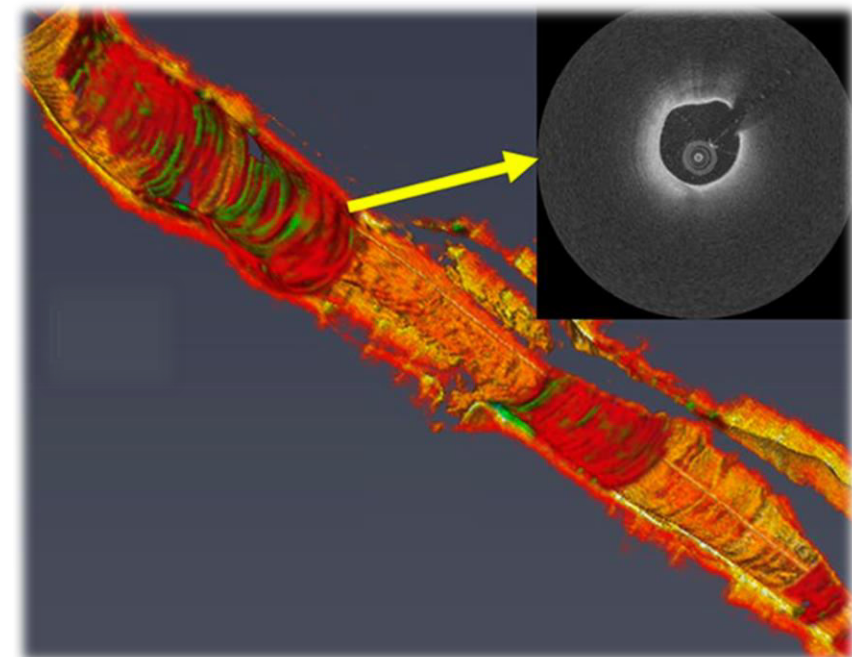
Calcium threshold: 180°

PBK 1: LAD, Proximal-Mid Pre-PCI





# The future just behind the door



*Not hundreds, not thousands... but hundred thousands...*

**MILLION DATA**

*=> To generate augmented /synthetic data... you need data*

*=> To make algorithm generalizable... you need data*

*=> To validate approaches with large scale ... you need data*

*=> To have unbiased results... you need data*



data collection

data sharing

Privacy

- *Who takes care of the continuous training?*
- *Certification of data quality.*
- *Tolerated a margin of error?*
- ***Medico-legal responsibility...***
- *National and worldwide security (cyber attack,...).*
- *There is not a regulation or specific guidelines*



*Salmons in a river...*

*...by AI*

# Blindly believers?

← Morphology **Sizing** Deployment Review     

Proximal Ref.



F: 212 1 mm

EEL **5.25** mm

Lumen **4.06** mm



F: 265 1 mm

EEL **3.82** mm

Lumen **1.78** mm **2.50** mm<sup>2</sup>

Distal Ref.



F: 291 1 mm

EEL **4.23** mm

Lumen **3.08** mm



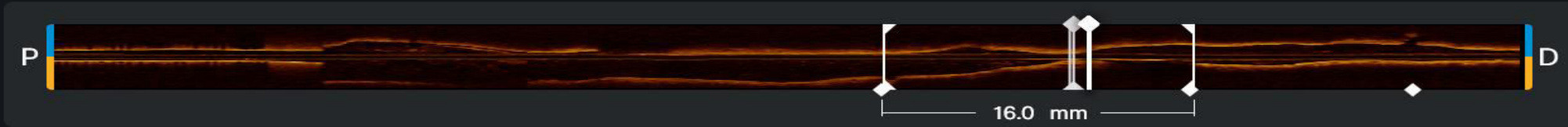
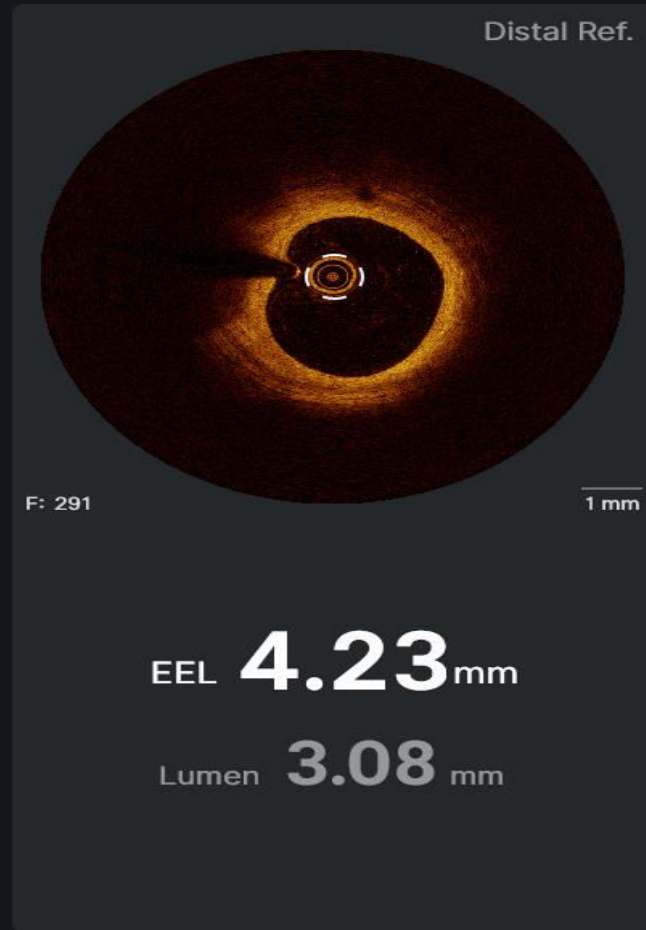
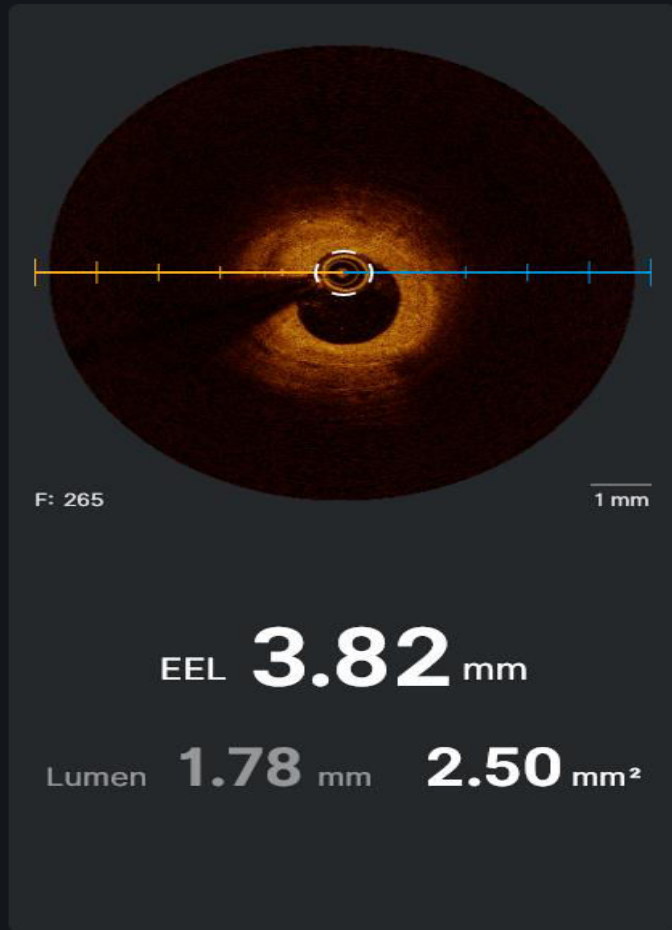
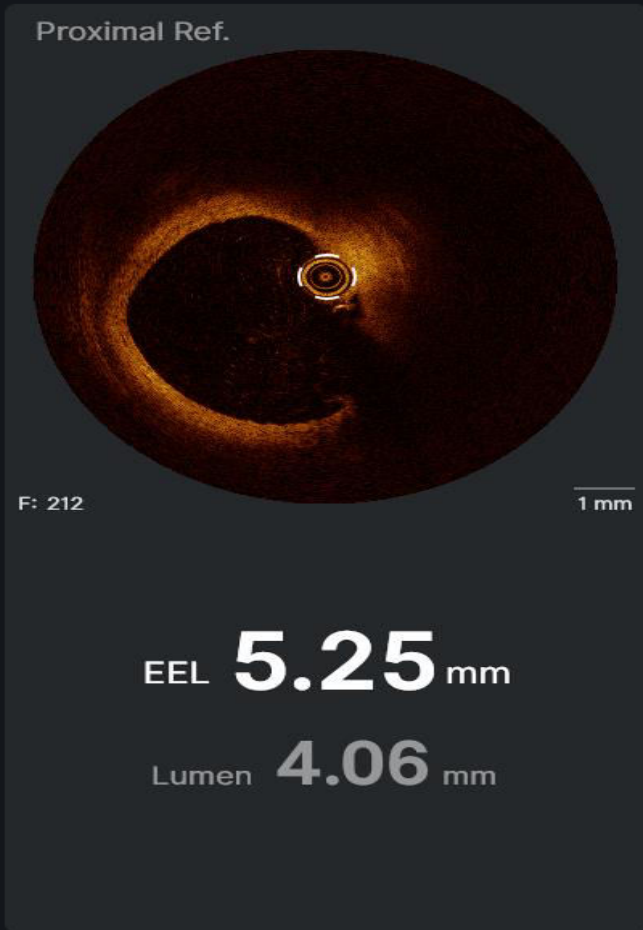
Anonymous Anonymous

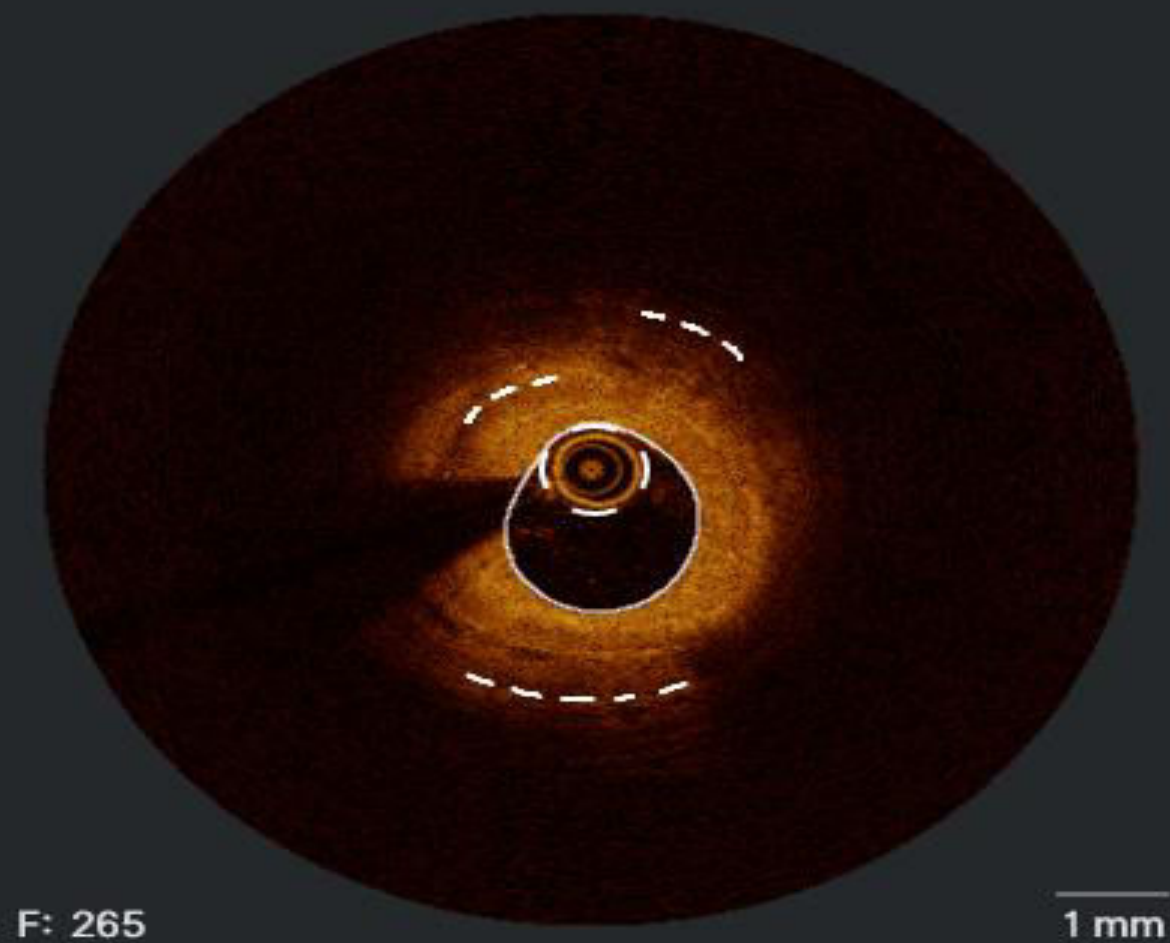
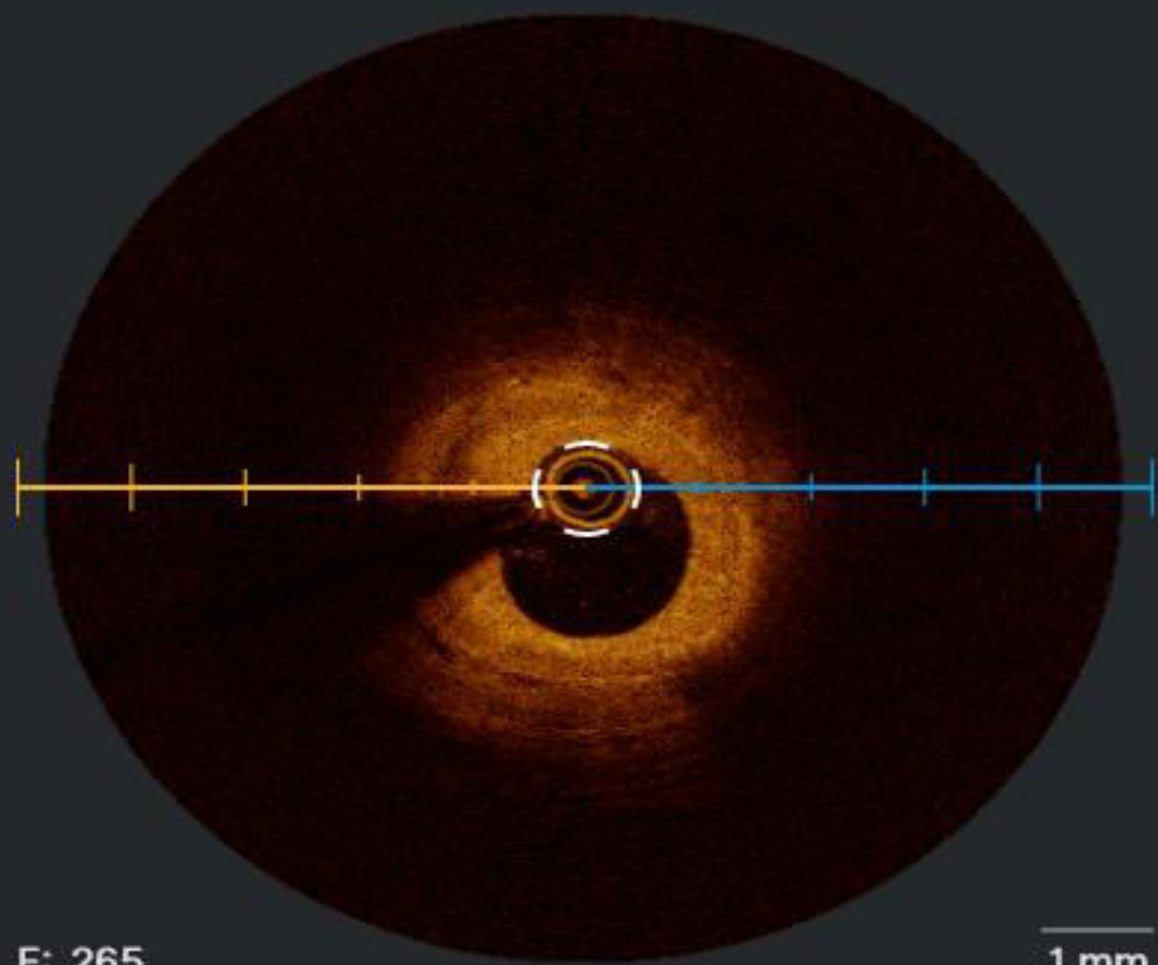
Calcium threshold: 180°

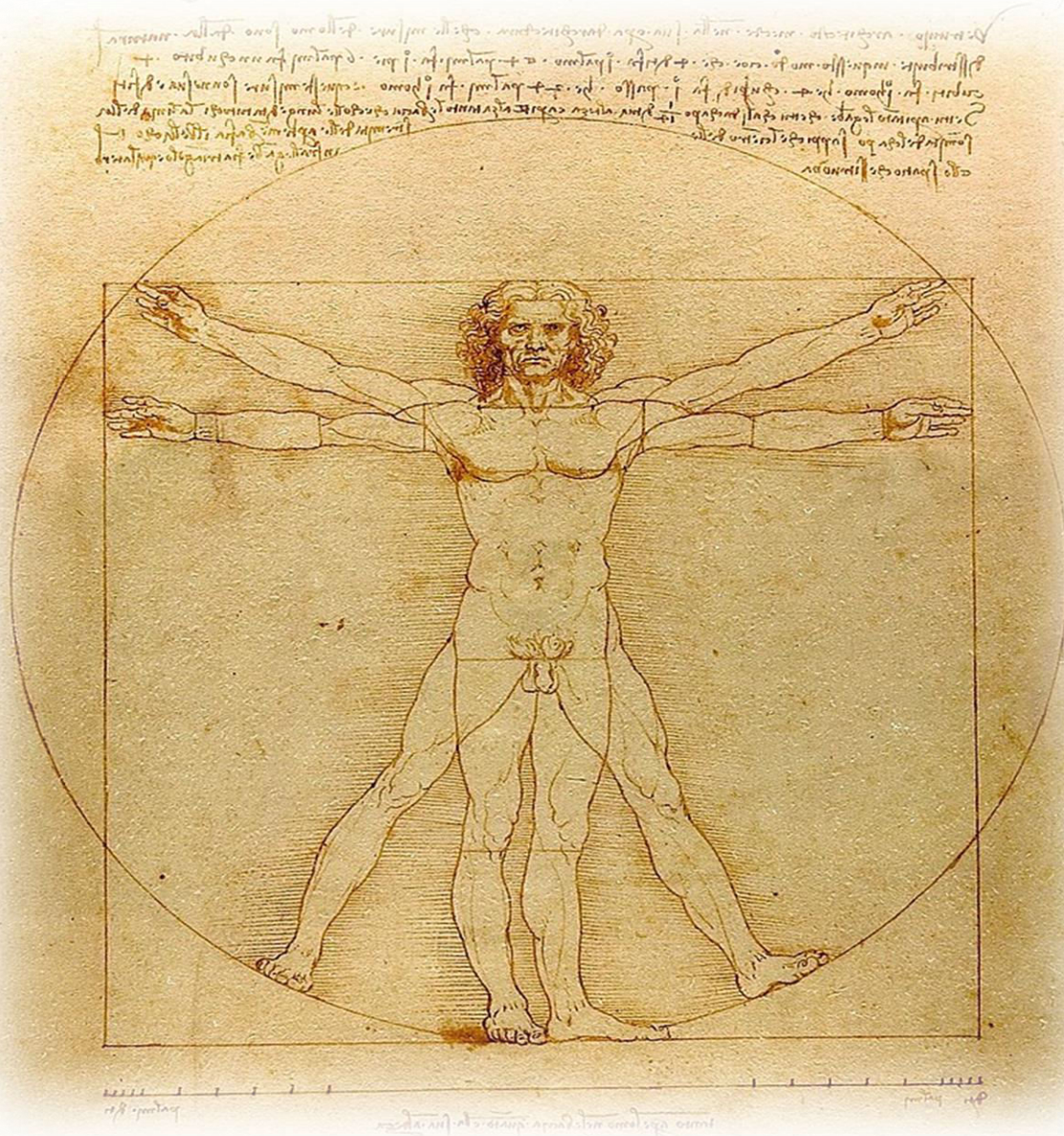
PBK 1: LCX, Mid Pre-PCI

# Blindly believers?

← Morphology **Sizing** Deployment Review     







*“Ars medica”*

*Reasoning  
≠  
processing data*

*Right or wrong*



*“L'intelligenza artificiale sta imparando a vivere nel mondo  
ha bisogno di maestri”.*



*Is this  
what we should expect?*



# Intelligenza artificiale: il futuro è ora!

*Paolo CANOVA, MD*

*Interventional Cardiology Unit*

*Cardiovascular Department - Papa Giovanni XXIII Hospital – Bergamo*

*Genova, 14 Aprile 2023.*