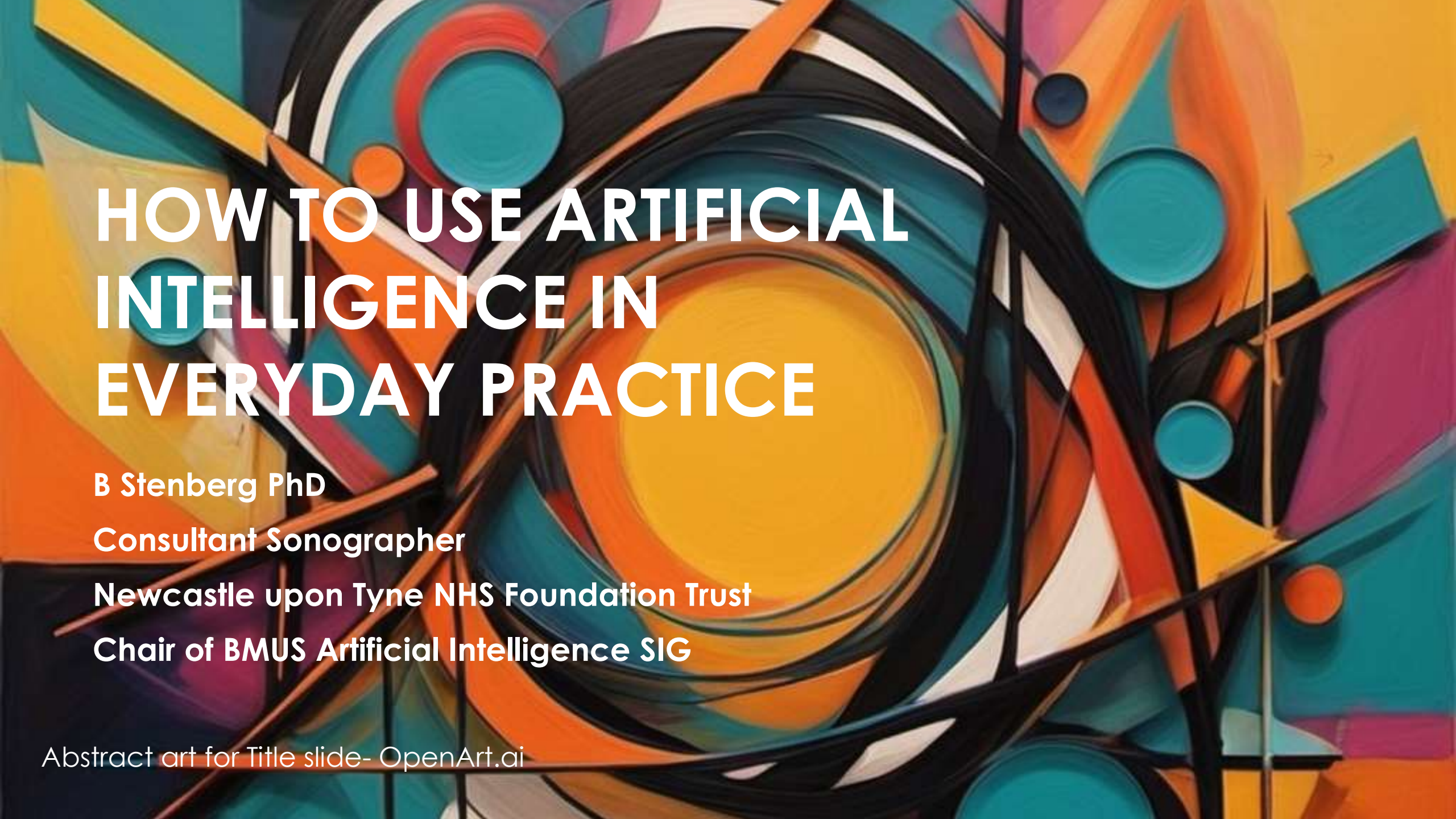

HOW TO USE ARTIFICIAL INTELLIGENCE IN EVERYDAY PRACTICE

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Newcastle upon Tyne NHS Foundation Trust

Chair of BMUS Artificial Intelligence SIG

Abstract art for Title slide- OpenArt.ai

- Definition (according to ChatGPT):
  - AI, or Artificial Intelligence, refers to the field of computer science focused on creating machines or software that can perform tasks typically requiring human intelligence.
  - These tasks include learning, problem-solving, decision-making, speech recognition, and visual perception.
  - AI systems can be categorized into narrow AI, which is designed for specific tasks, and general AI, which aims to replicate human-level intelligence across a wide range of activities.

WHAT IS ARTIFICIAL INTELLIGENCE?

- Definition I prefer:
  - the theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages.

- Visual Perception
- Decision making

WHAT IS ARTIFICIAL INTELLIGENCE?

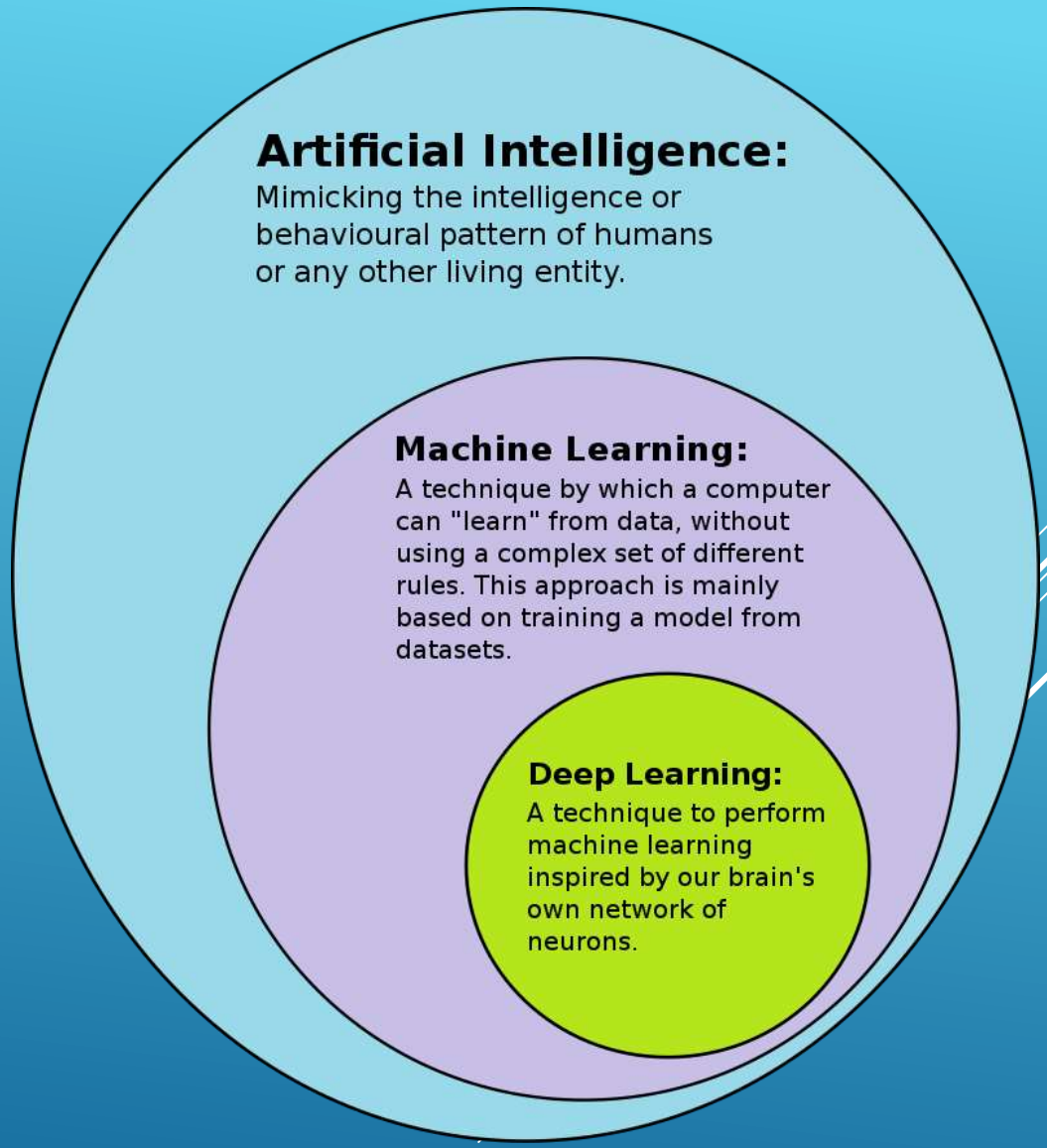
WHAT IS ARTIFICIAL INTELLIGENCE?

- Distinct Abilities for the software:-
  - to reason
  - To make deductions from knowledge base to answer questions
  - to plan or make predictions of real world events
  - to learn by experience

- Deep learning is one of the most important aspect for the future of AI.

DEEP LEARNING

- Deep learning is a subset of machine learning but it is vital for true AI in that it uses neural pathways similar to a human brain, to build new connections allowing for **experiential learning**.
- What that means for radiology is that you can use multiple images and expert opinion for anatomy, pathology, segmentation to achieve consensus.



WHY DO WE NEED AI?

- Cars
  - 94% of crashes involve human error (NHTSA, 2016)
  - Reaction time: Human 1.6 s, S-DC 0.5 s
  - Does not get tired (or drunk)
  - Connected by “vehicle to everything” with 1 ms latency over 5G
- Translation
  - Speech translation in real-time breaking down language barriers, automatic subtitles in live TV.
  - Story sign, translates books into sign language to help deaf children learn to read.

- Bioscience
  - BenevolentAI uses data science to predict which chemical compounds will be able to cure a certain symptom or disease, accelerating the process by which life-altering drugs can be developed.
- Internet of things
  - Massive interconnected web of sensors and objects
  - "AI helps cities make smarter decisions, and because AI learns, these decisions improve over time," NquiringMinds

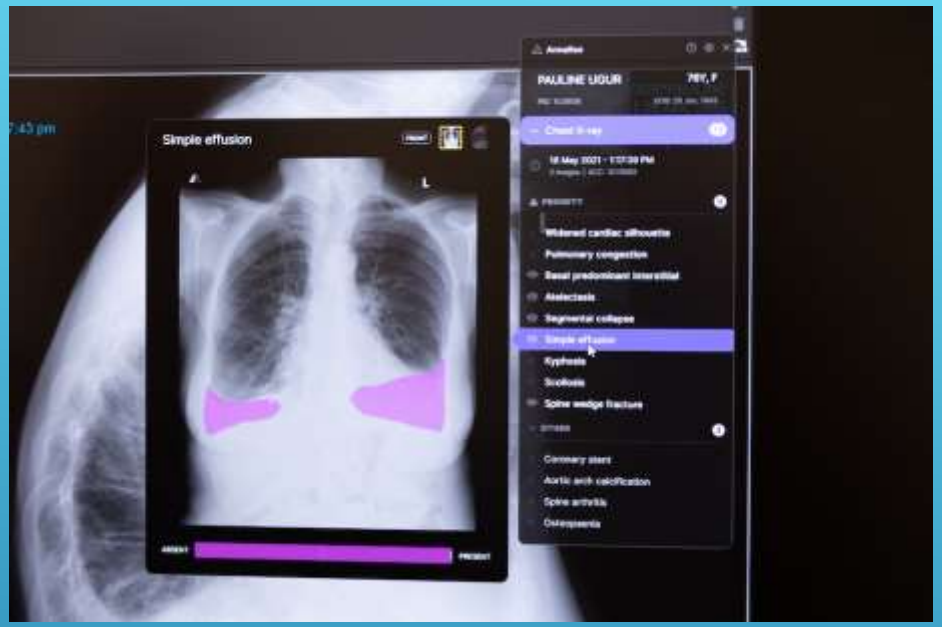
WHY DO WE NEED AI?

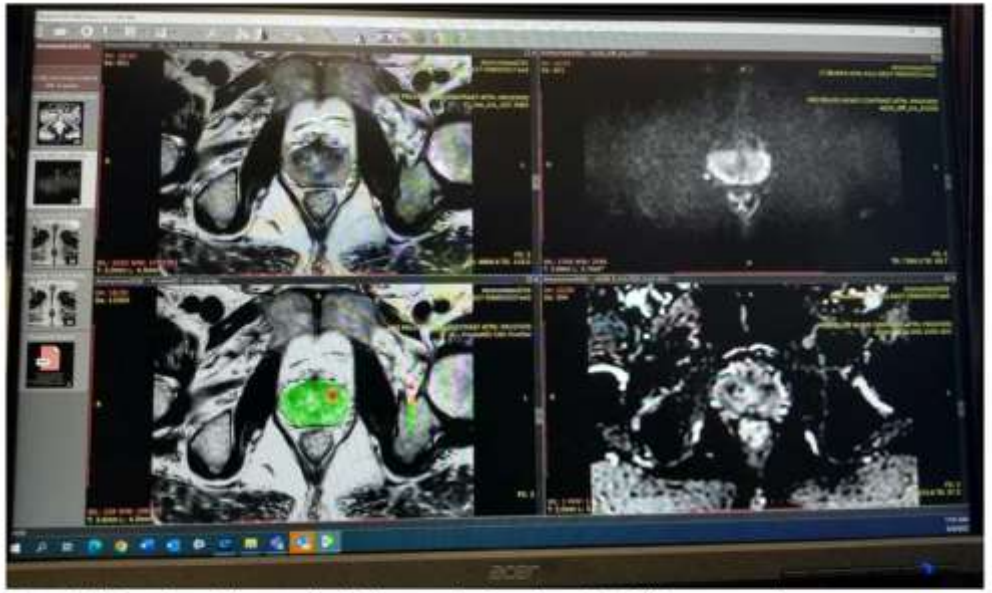
WHY DO WE NEED AI?

- What can we apply to healthcare?
  - Enormous datasets
  - Lightening reaction and data access speeds to all historical medical data
  - Does not get tired
  - Not subject to "human error"- e.g. thinking about what its going to have for tea

- Medical imaging is an ideal area for artificial intelligence with large numbers of the same examination and using image manipulation.
- X-ray, CT and MRI are perhaps more obvious candidates with less operator dependence in the acquisition, limited views or 3D datasets and offline manipulation and assessment.

AI IN MEDICAL IMAGING





ProstatID output (lower left) is a colorized probability map of cancer overlaid on an original T2W image (top left). The other two inputs from the MR exam are DWI (top right) and ADC (bottom right).

(NON-US) RADIOLOGY AI

AI IN ULTRASOUND

- This has been a challenging area for some time.
  - Non-standardised, non-planar 2D image capture
  - Significant operator dependence
  - Variable image quality
  - Real-time imaging

AI (HIDDEN) IN ACCEPTED PRACTICE

- Previous US machines had voice recognition and control from 2004. since been removed on more recent platforms (before their time??)
- AI is available on most modern ultrasound machines
  - Automatic b-mode optimisation
  - Automatic Doppler optimisation
  - waveform assessment
  - Interestingly, all subjective but with high degree of agreement.

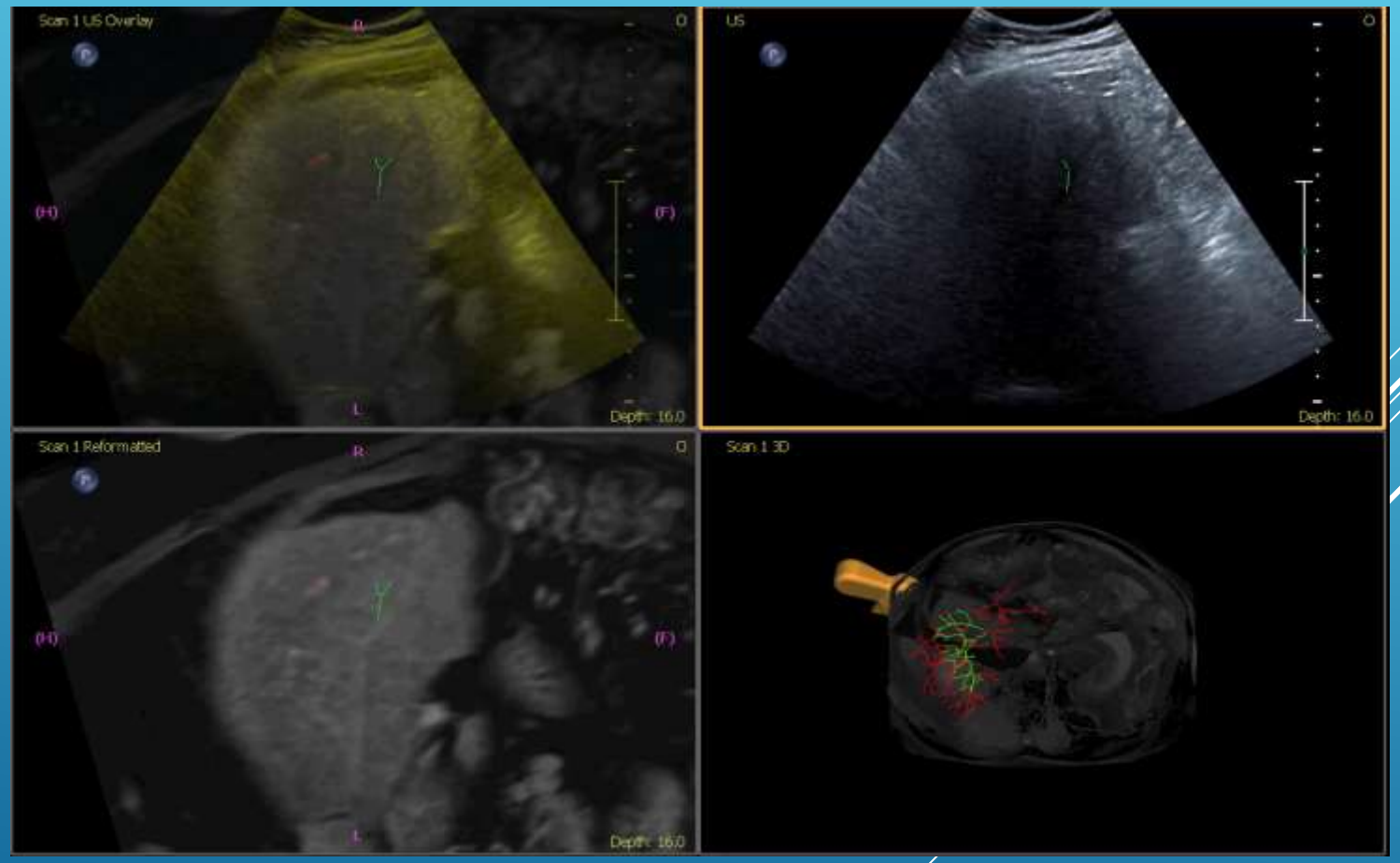
AI- Perform tasks normally requiring human intelligence, such as visual perception, speech recognition, and decision-making

CURRENT APPLICATIONS OF AI

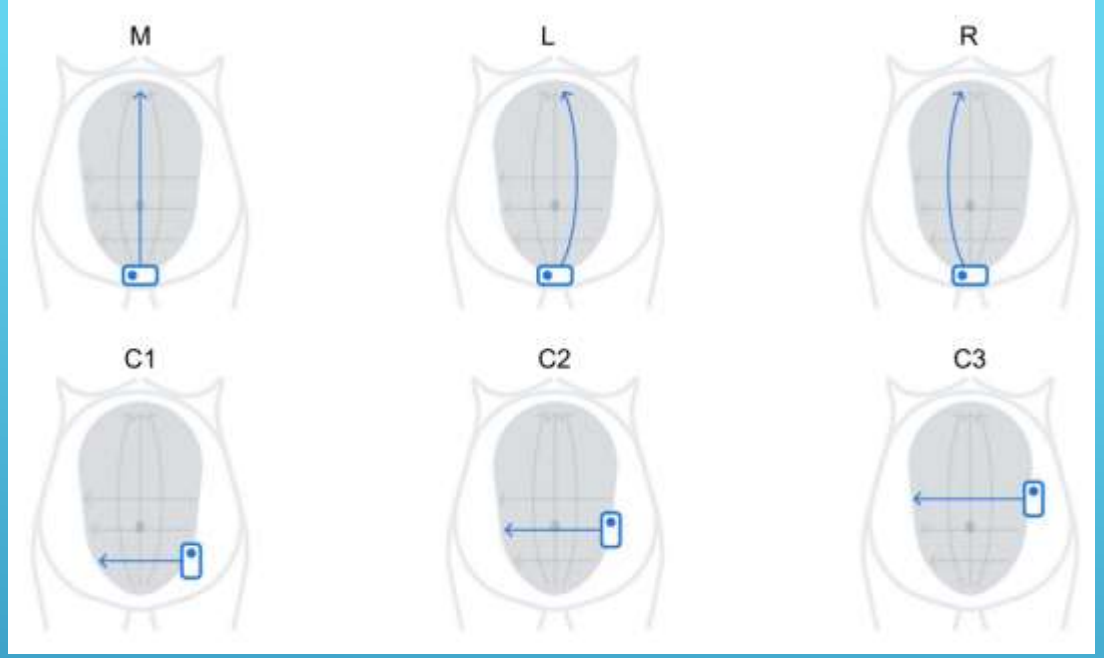
- Segmentation
  - Auto anatomical segmentation
  - Auto-segmentation with 3d scanners- bladder scanners
- Diagnosis
  - Sdetect for breast and thyroid
  - LiRads CEUS assessment
- Workflow
  - Auto image annotation/acquisition
  - Auto fusion
  - Fetal heart navigator
  - Auto-report

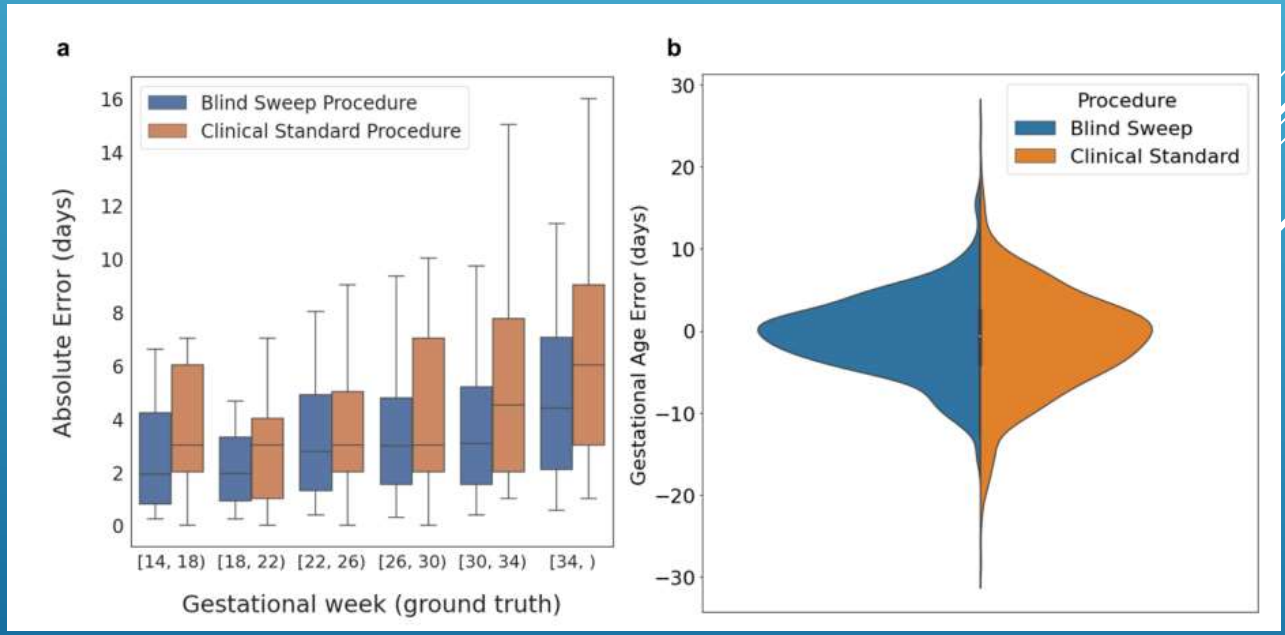
WORKFLOW

AUTO FUSION REGISTRATION



- Google AI sponsored
- USA and Zambia- 521 participants
- Scanned by sonographers and "novices"
- AI used to assess the sweeps of both as well as clinical standard foetal biometry
- Offline using Android phone- less than 3 seconds





Gomes, R.G., Vwalika, B., Lee, C. *et al.* A mobile-optimized artificial intelligence system for gestational age and fetal malpresentation assessment. *Commun Med* **2**, 128 (2022).

- No freezing, no annotating, no storing. SonoLyst live takes image recognition to the next level by capturing images as you scan, in real-time

SONOLYST

IMAGE OPTIMISATION

FOETAL BIOMETRY

- Canon's Biometry assist
- Tells you when you are in the right plane and have the optimum image for analysis

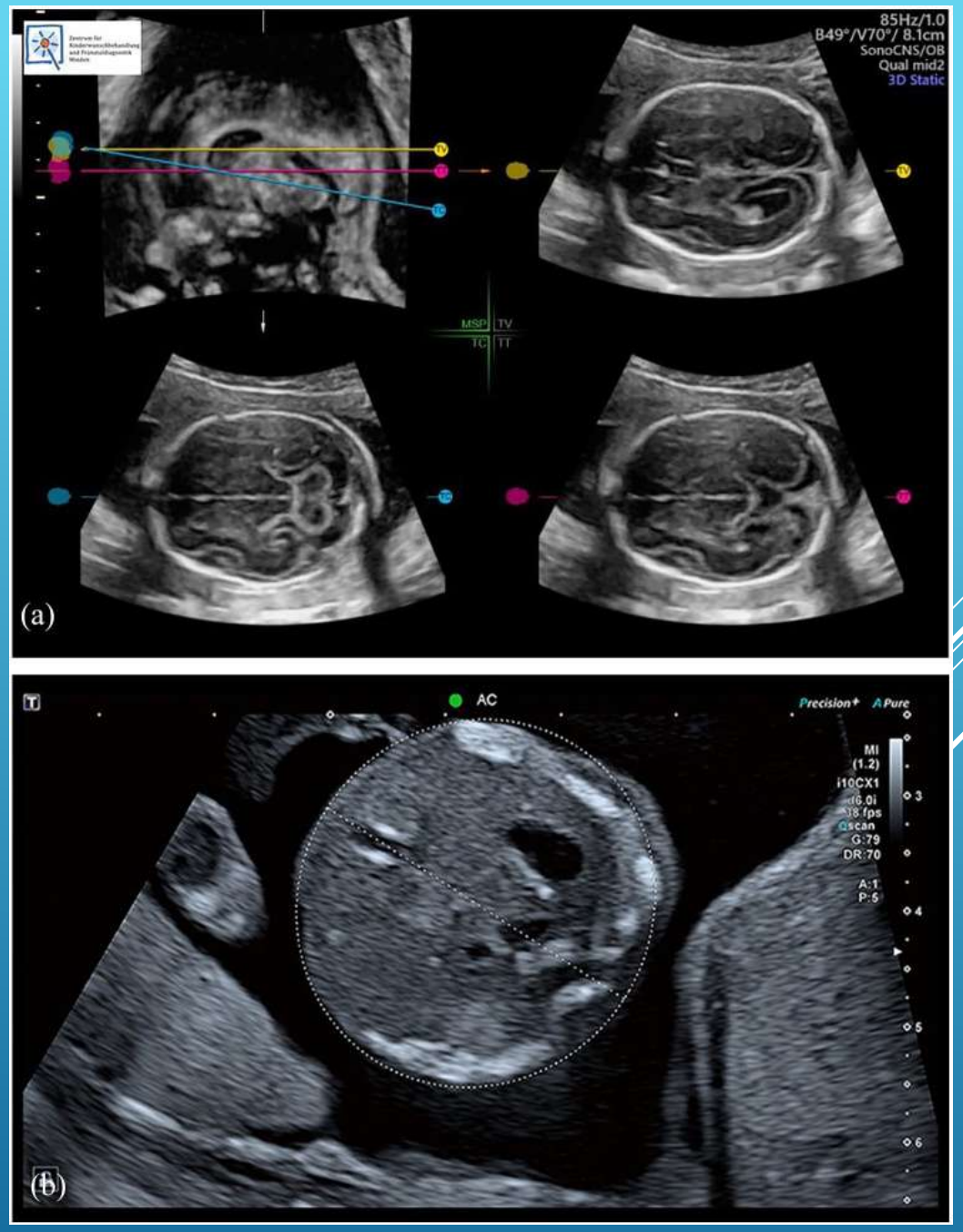


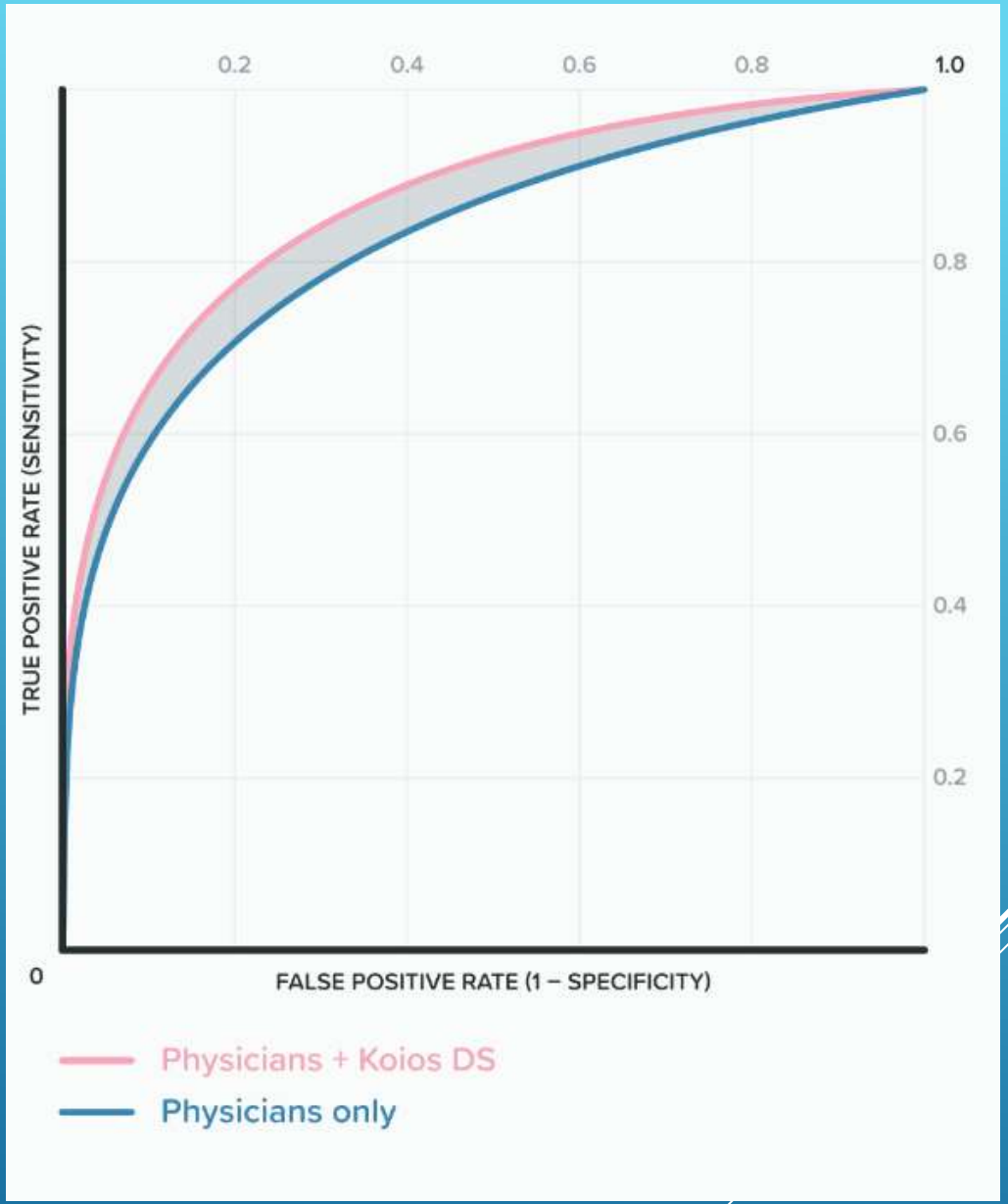
Image courtesy of Canon Medical

COMPUTER ASSISTED DIAGNOSIS (CAD)


Probably Malignant
Irregular
Not Parallel
Clock
3
00
3
2.71
2.42
1.77

KOIOS BREAST

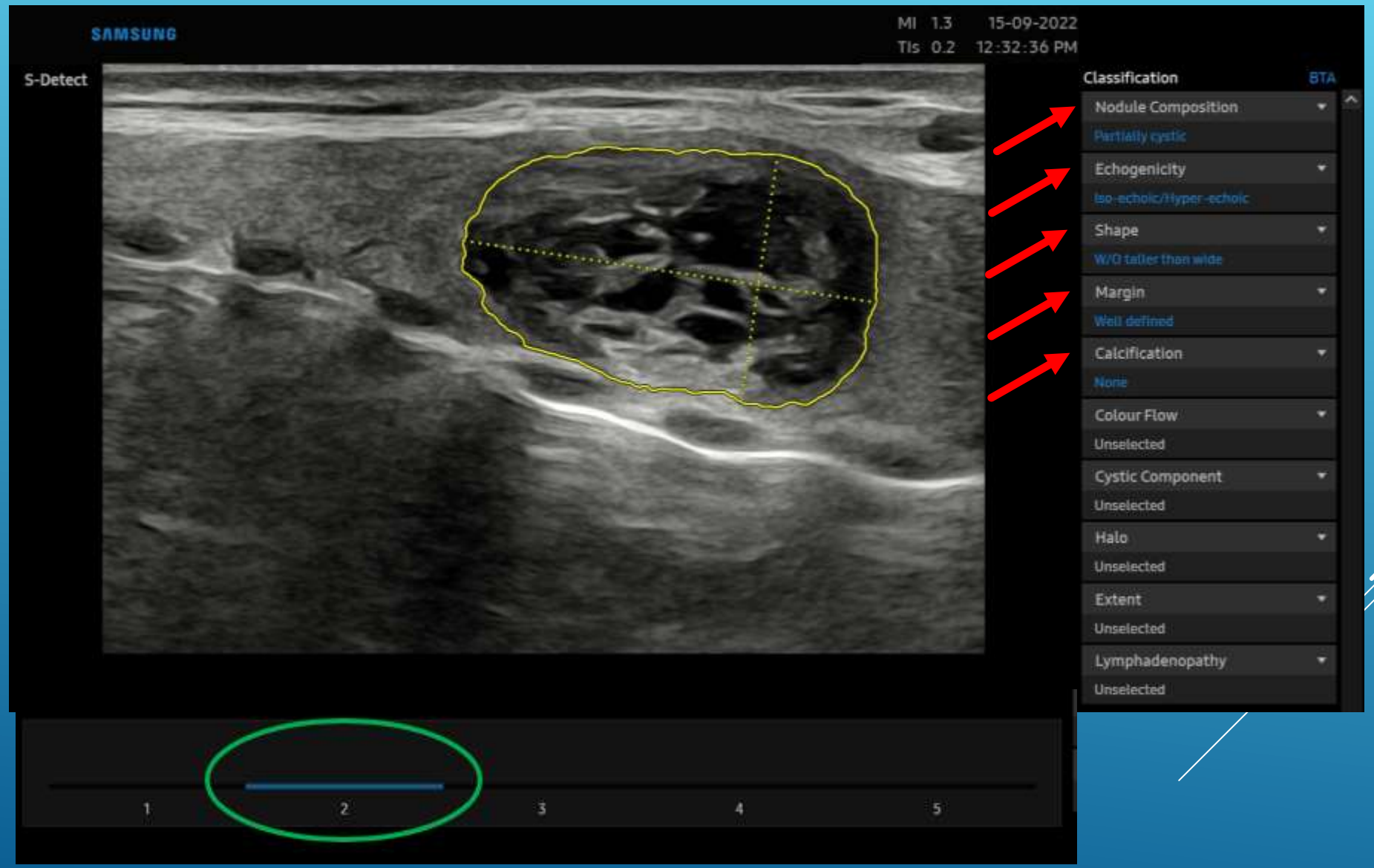
- Reduced biopsies up to 31% - AJR study



AI THYROID

- Koios and S-detect both assess still images of thyroid nodules to give a risk stratification
- S-Detect uses set parameters (Machine learning)
- Koios uses set parameters but adds an adaptor based on deep learning

Automated Segmentation

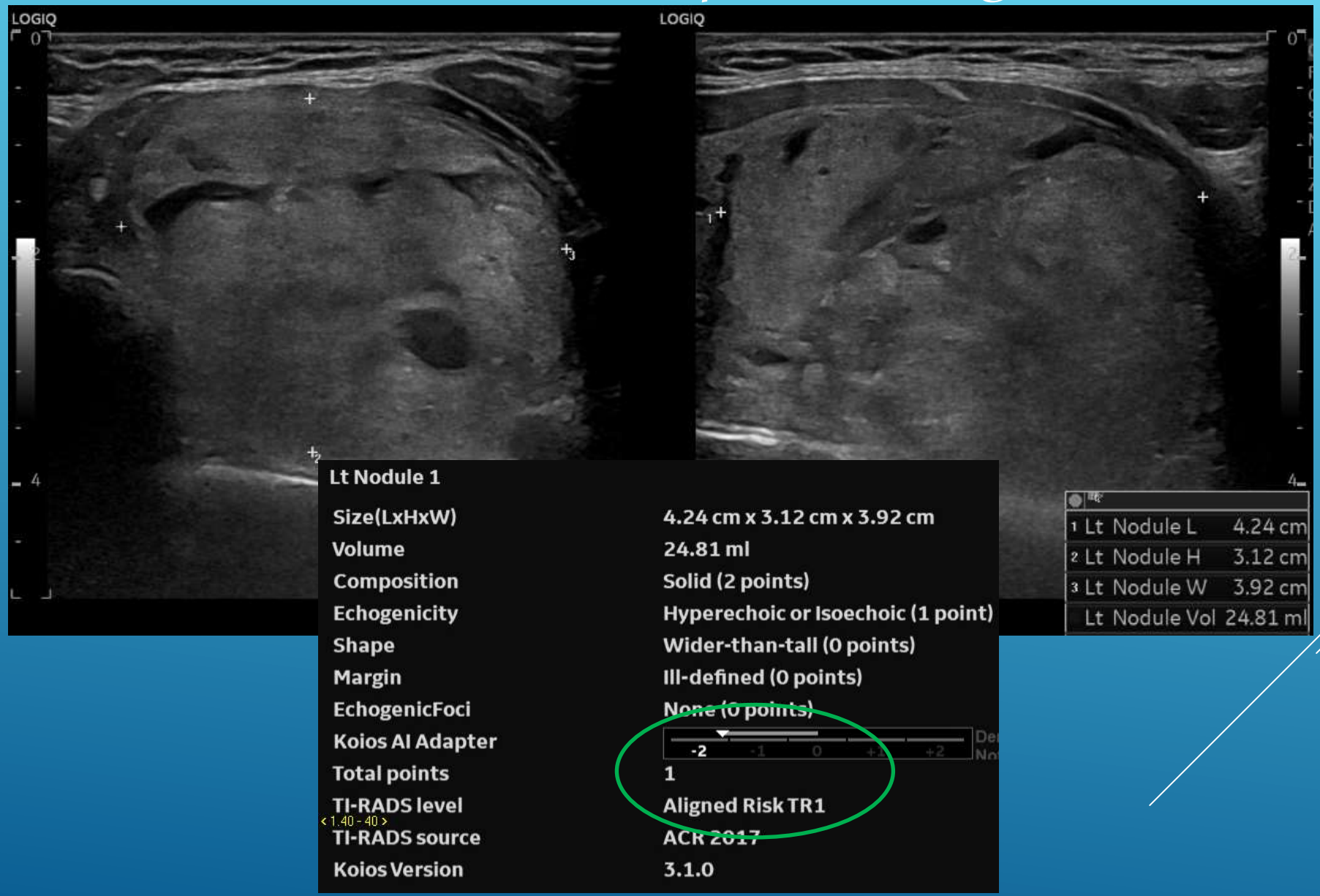


Nodule Segmentation & Feature Analysis

Rt Nodule 1

Size(LxHxW)	1.02 cm x 0.86 cm x 1.03 cm
Volume	0.43 ml
Composition	Mixed cystic and solid (1 point)
Echogenicity	Hyperechoic or Isoechoic (1 point)
Shape	Wider-than-tall (0 points)
Margin	Ill-defined (0 points)
Echogenic Foci	None (0 points)
Koios AI Adapter	-2 -1 0 +1 +2 Demonstration only. Not for diagnostic use
Total points	0
TI-RADS level	Aligned Risk TR1
TI-RADS source	ACR 2017
Koios Version	3.1.0

Koios DS – *AI Adapter downgrade*

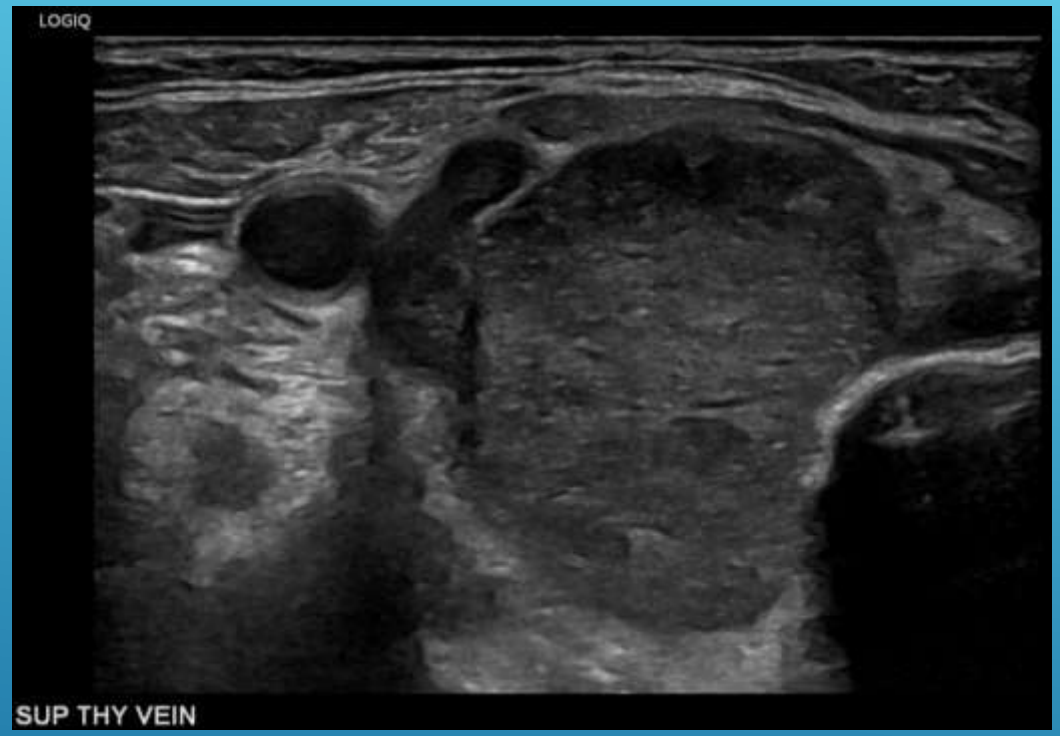


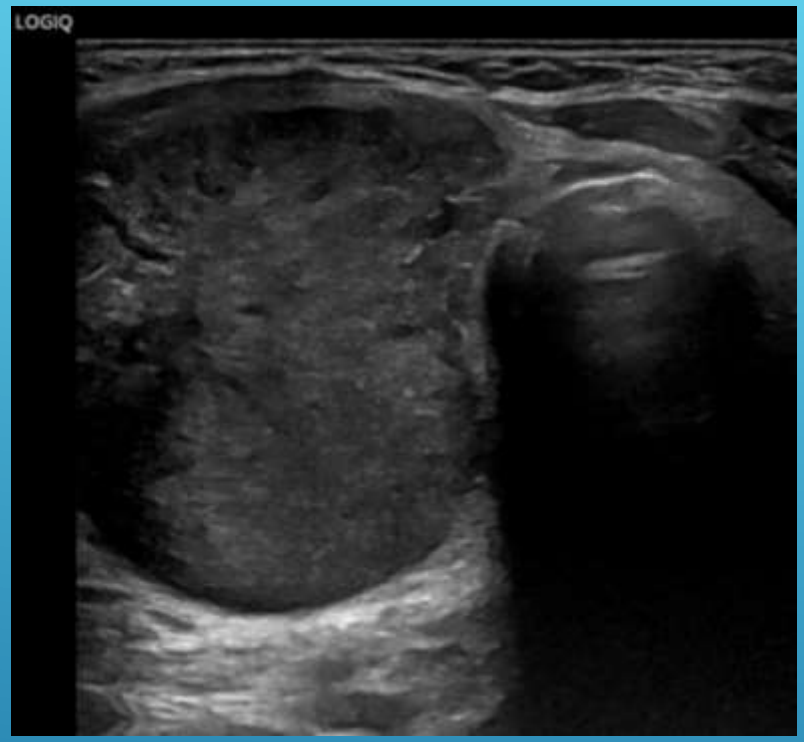
Suspicious nodules

Rt Nodule 1	
Size(LxHxW)	3.46 cm x 3.49 cm x 3.32 cm
Volume	19.19 ml
Composition	Solid (2 points)
Echogenicity	Hypoechoic (2 points)
Shape	Wider-than-tall (0 points)
Margin	Smooth (0 points)
EchogenicFoci	None (0 points)
Koios AI Adapter	-2 -1 0 +1 +2
Total points	5
TI-RADS level	Aligned Risk TR4
TI-RADS source	ACR 2017
Koios Version	3.1.0

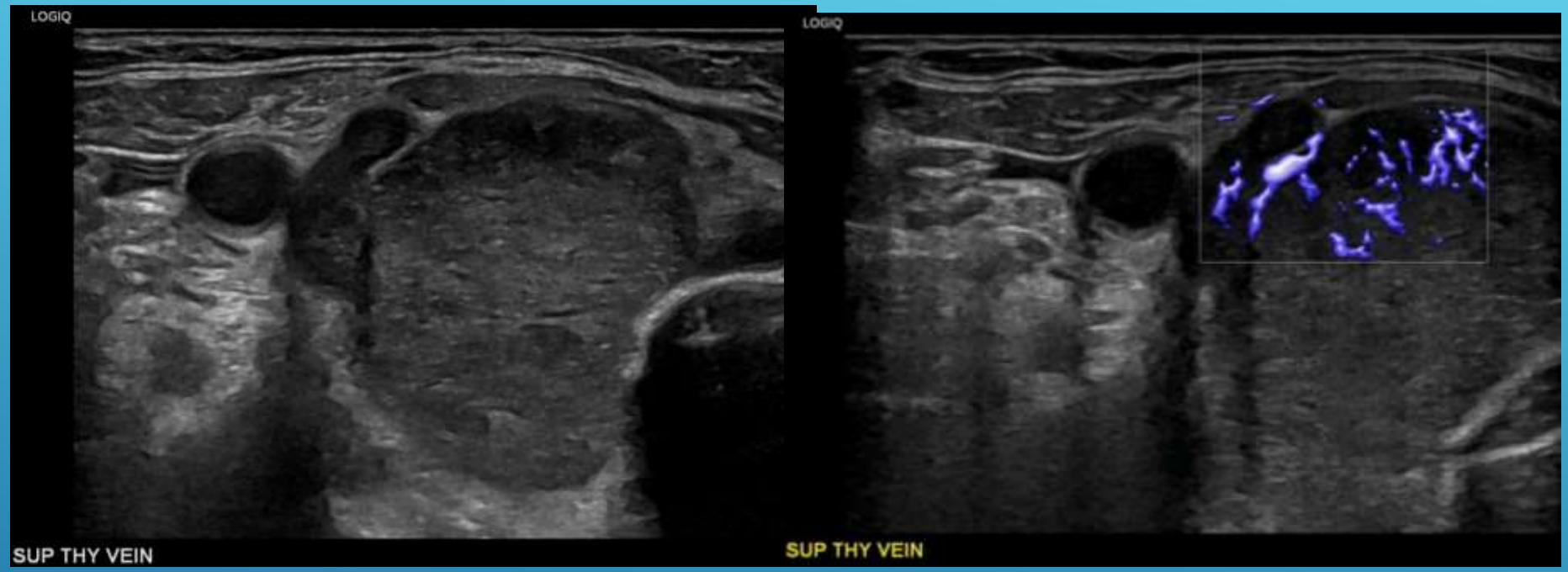
< 1.40 - 40 >

AI can only assess what the human shows..

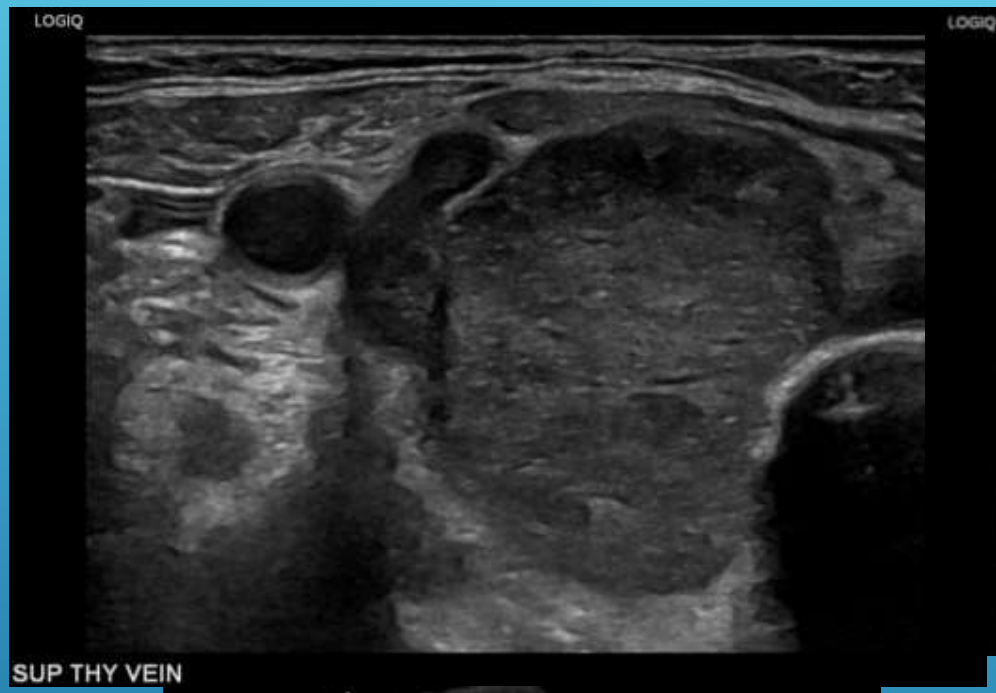


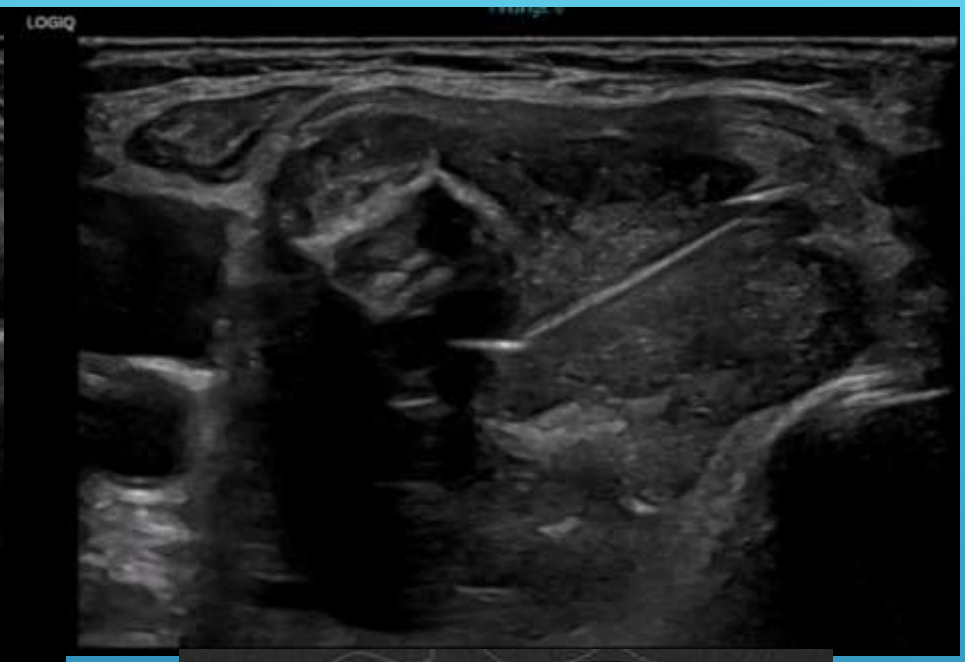


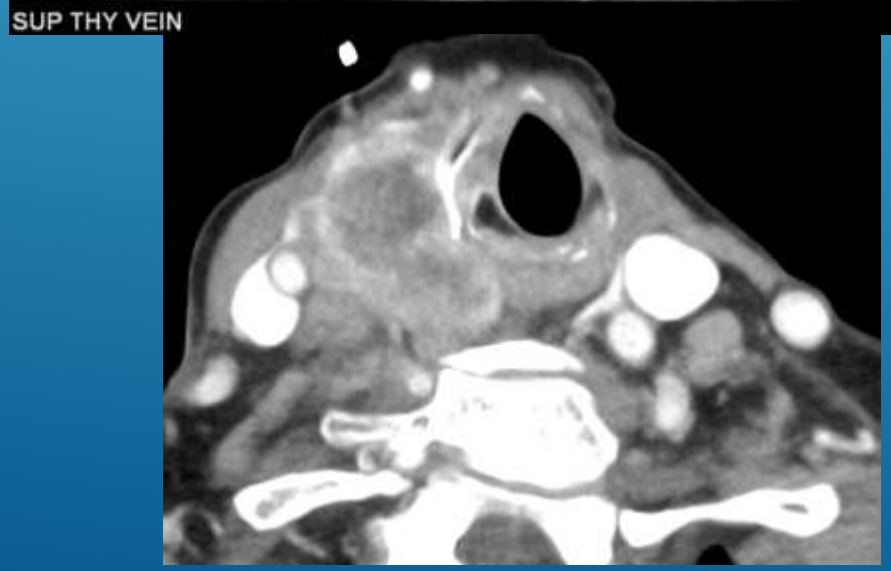
Extrathyroidal extension



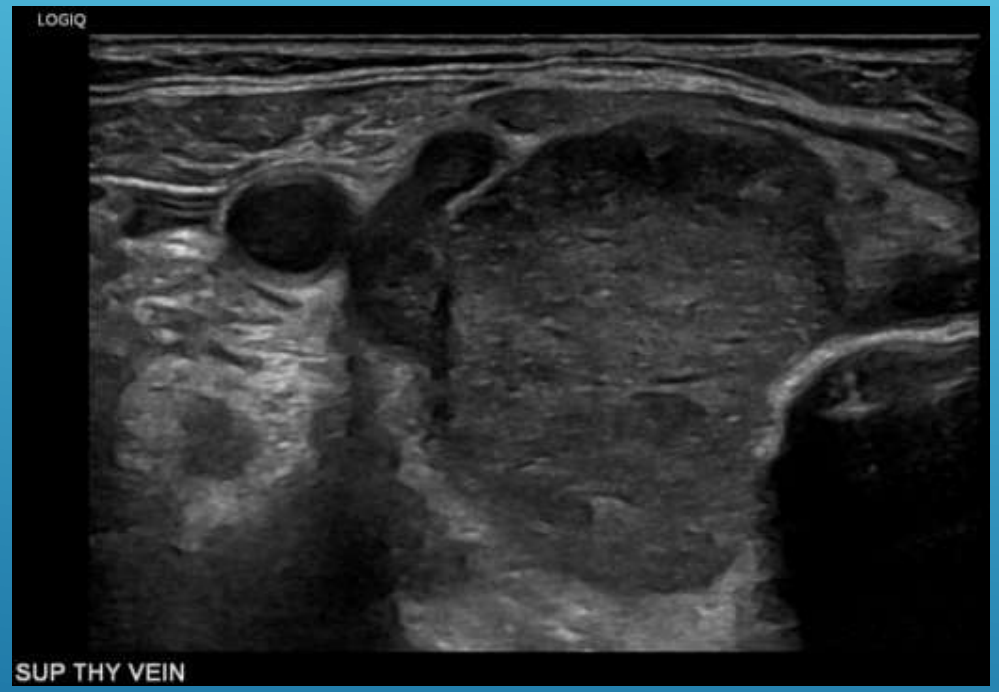
Aggressive TC = Core Bx & Staging CT

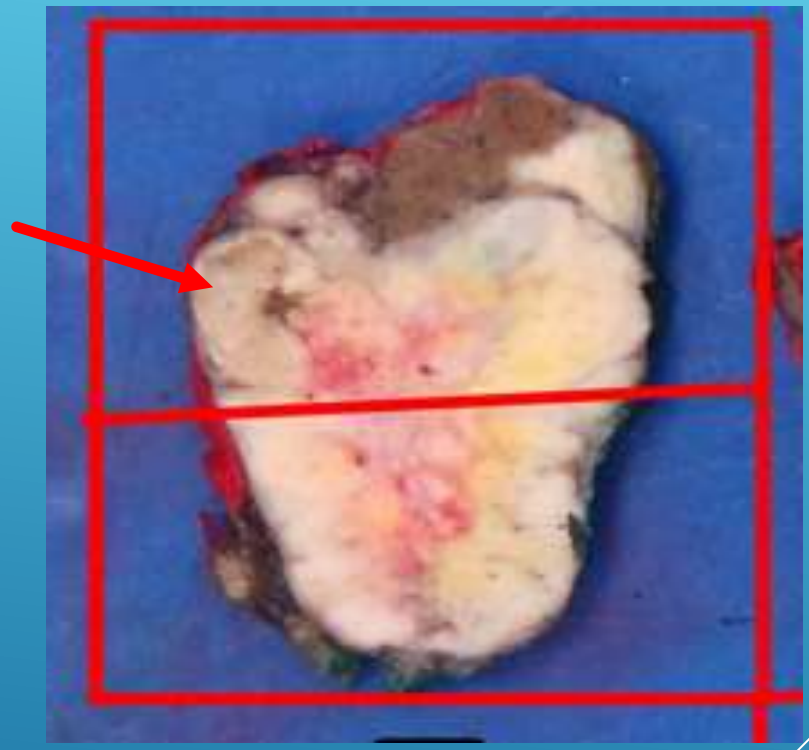






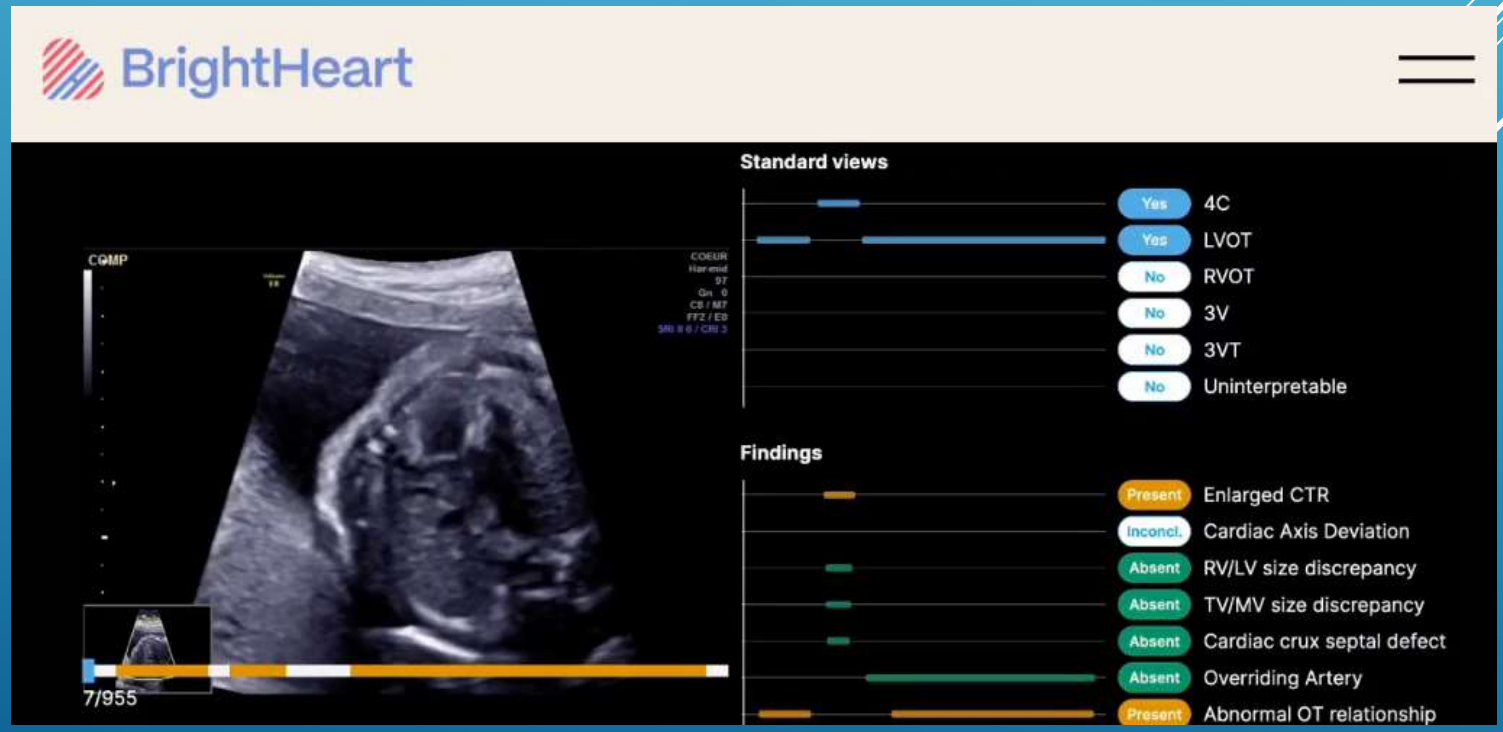
Poorly Differentiated Thyroid Carcinoma





- FDA approved 2 weeks ago
- Assists clinicians in detecting signs of potential abnormalities earlier but also enhances their confidence in confirming normal findings, which is equally critical for the peace of mind of expectant families

BRIGHT HEART

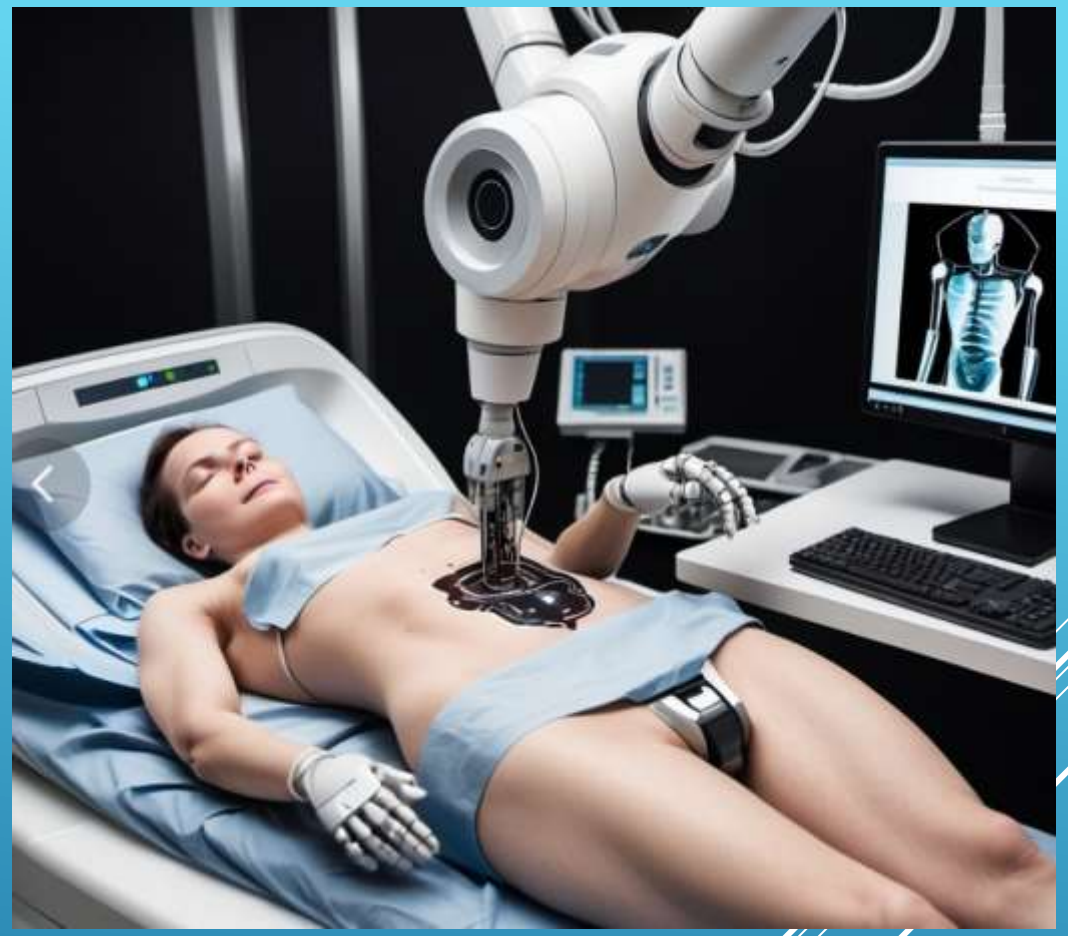


AI IN EDUCATION

- Now is the time to embed AI learning into Sonography education and make it a key part of the curriculum.
- We need a cohort of sonographers who are tech literate and unencumbered by the fears of the older generation.

FUTURE APPLICATIONS OF AI

- Blue sky thinking
- Anatomy overlay
- Geo-location tag
- Facial recognition
- Diagnosis assist
- Self-drive machines??



Robot performing an abdominal ultrasound scan on a human – Openart.ai

THANK YOU