

EVAR Imaging Innovations for Safer Treatment

Artificial Intelligence Algorithm for an Automatic Thoracic Aorta Assessment

LINC | Leipzig

28.01.2021 | Dr. med. Johannes Rückel, B.Sc.



Siemens Healthineers:
Research cooperation & speaker's activity

Artificial Intelligence

Applications

Search engines



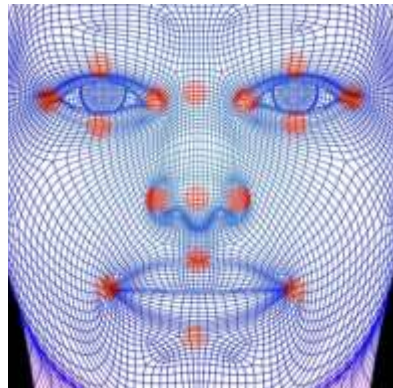
Voice control



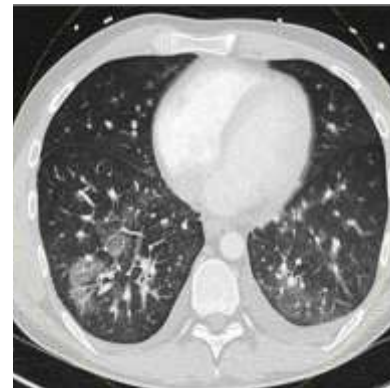
Genetic data analysis



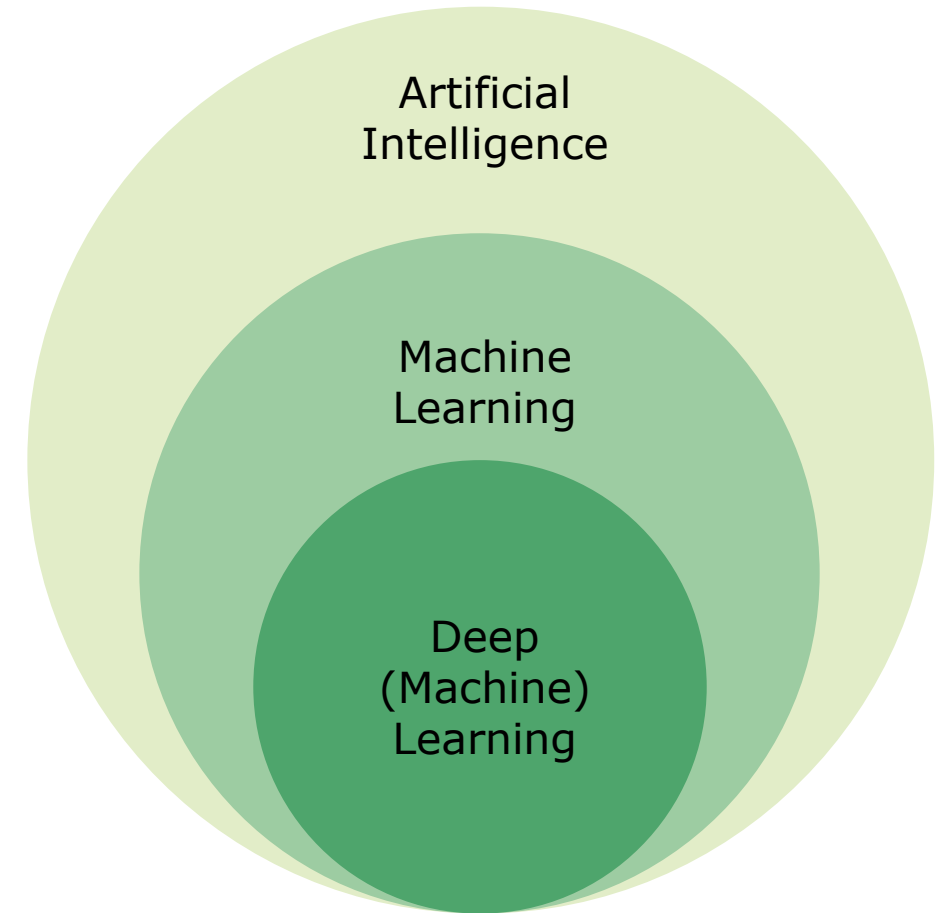
Imaging analysis



Radiology

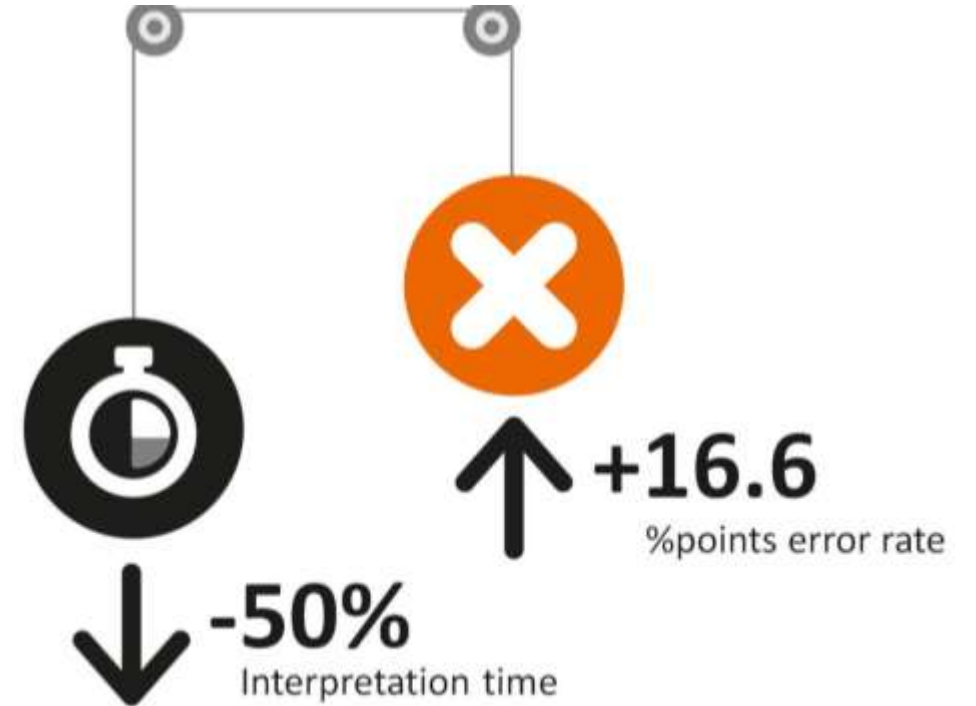
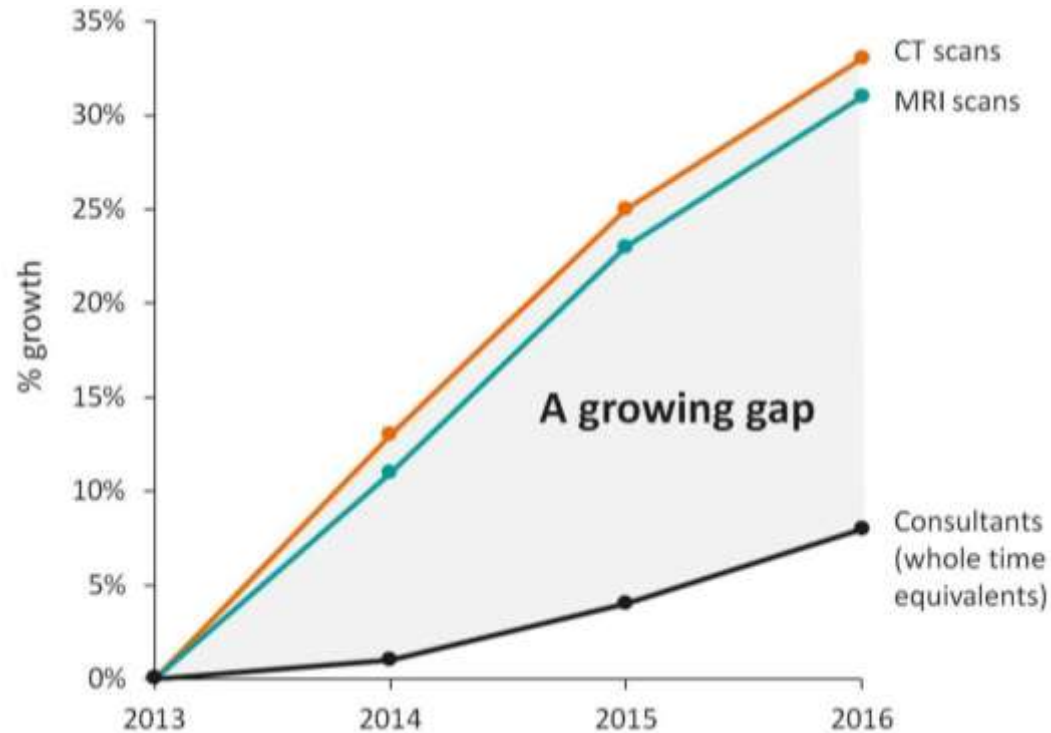


Autonomous vehicles



Increasing Workload & Error Rate

... how to deal with....?



In average a radiologist diagnoses an image every 3-4s, 8 h/d
(Choi et al. 2016).

4% of all radiological diagnosis are errors
– clearly higher at abdomen-CT
(Radiology Quality Institute 2012; Berlin 2007)

Increasing work pace increases error rate up to 30%
(Sokolovskaya et al. 2015)

Aortic Diameter Assessment

Guidelines (European Society of Cardiology, 2014)

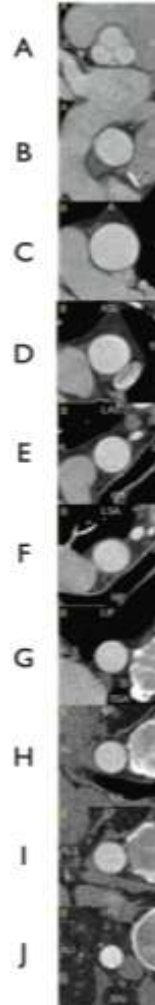
Three-dimensional reconstruction



Parasagittale MPR along centerline



MPRs orthograde to centerline



Landmark		Definition	Diameter Mean	Diameter SD
#1	root	sinuses of Valva	37.7mm	3.8mm
#2		sinotubular junction	33.2mm	3.7mm
#3	ascending	maximum diameter of the middle third between #2 and #4	28.6mm	3.6mm
#4	arch	origin of brachiocephalic trunk	28.2mm	3.5mm
#5		Between left common carotid and left subclavian artery	27.7mm	3.3mm
#6	descending	2cm distal to left subclavian artery	27.3mm	3.2mm
#7		level of pulmonary arteries	26.9mm	3.1mm
#8		diaphragm	25.6mm	3.4mm
#9		celiac trunk origin	26.1mm	3.0mm

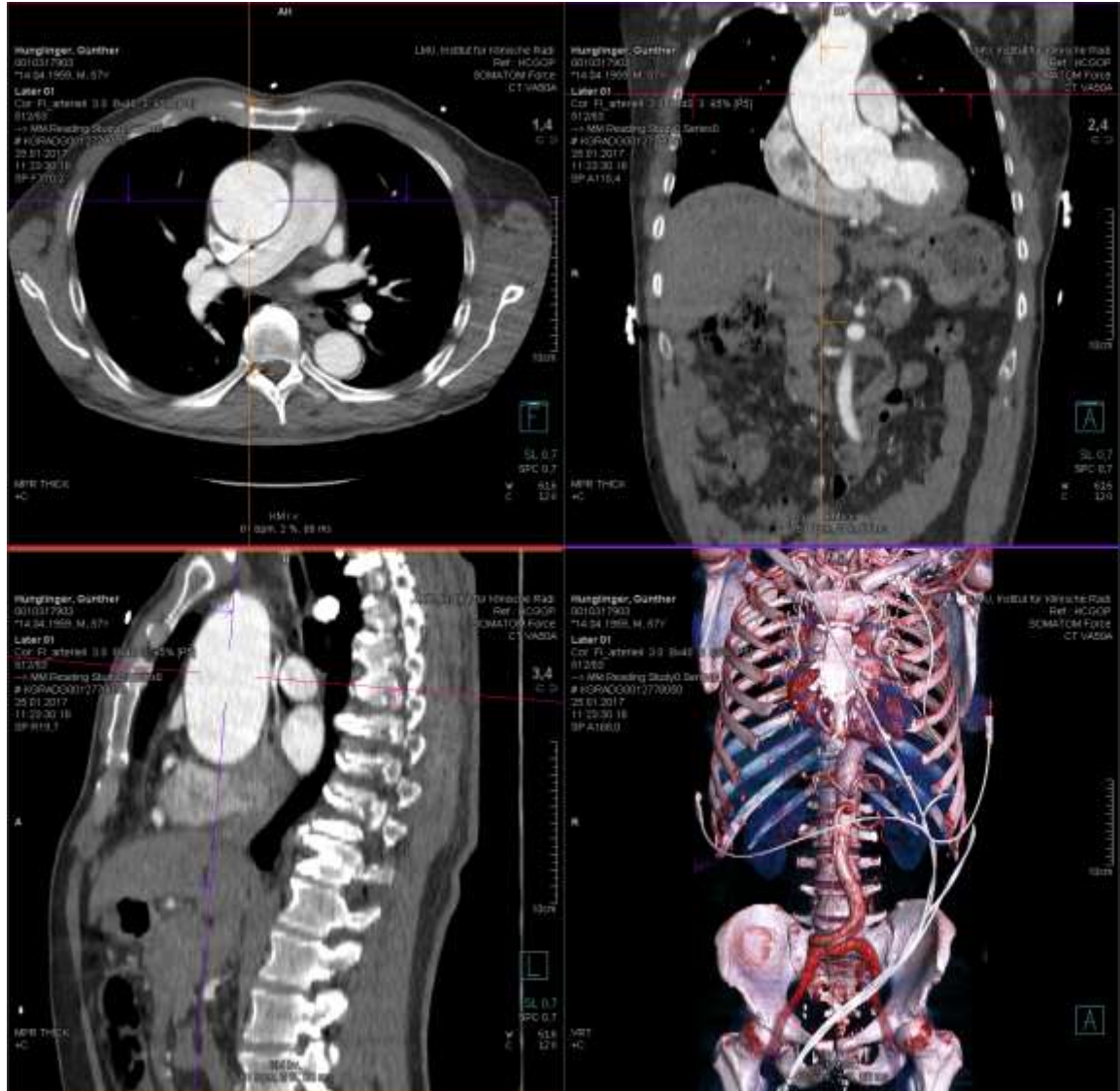
Rueckel, J. *et al.* Artificial intelligence assistance improves reporting efficiency of thoracic aortic aneurysm CT follow-up. *Eur J Radiol* **134**, 109424 (2021).

Erbel, R. *et al.* 2014 ESC Guidelines on the diagnosis and treatment of aortic diseases: Document covering acute and chronic aortic diseases of the thoracic and abdominal aorta of the adult. The Task Force for the Diagnosis and Treatment of Aortic Diseases of the European Society of Cardiology (ESC). *Eur. Heart J.* **35**, 2873–2926 (2014).

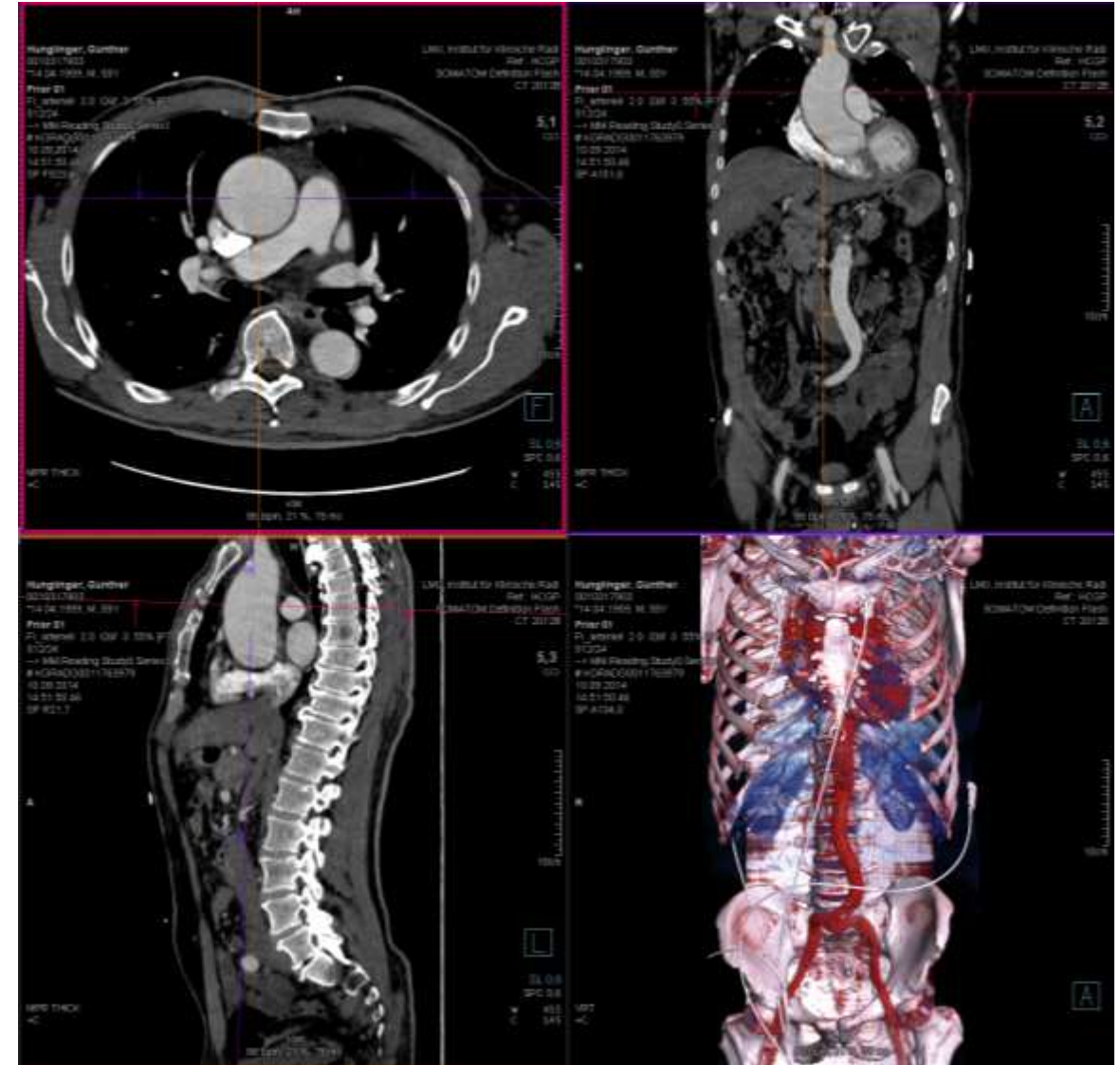
“Manual” Aortic Diameter Assessment

Time-consuming and error-prone...

Current Examination

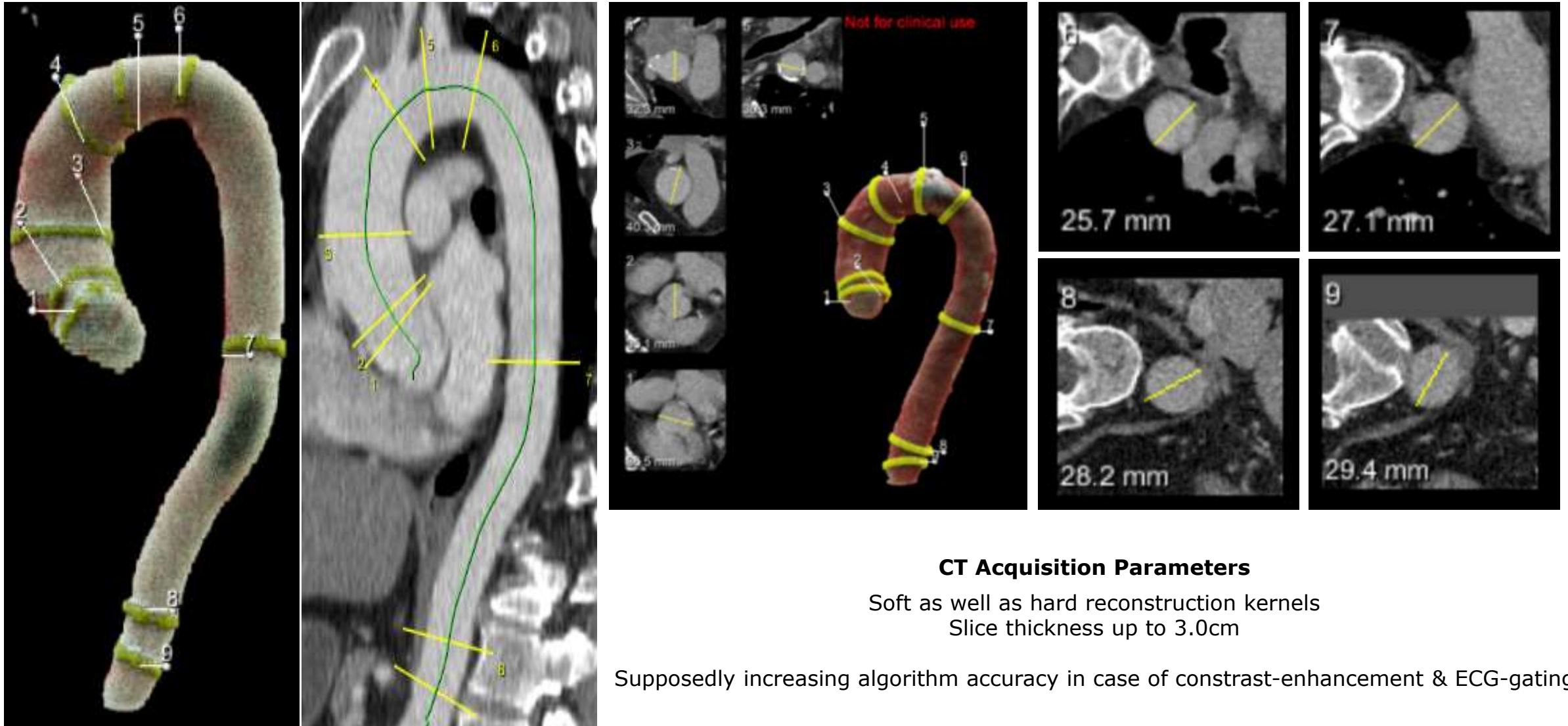


Prior Examination



AI-Assisted Aortic Diameter Assessment

Automatic Segmentation & Diameter Quantification



CT Acquisition Parameters

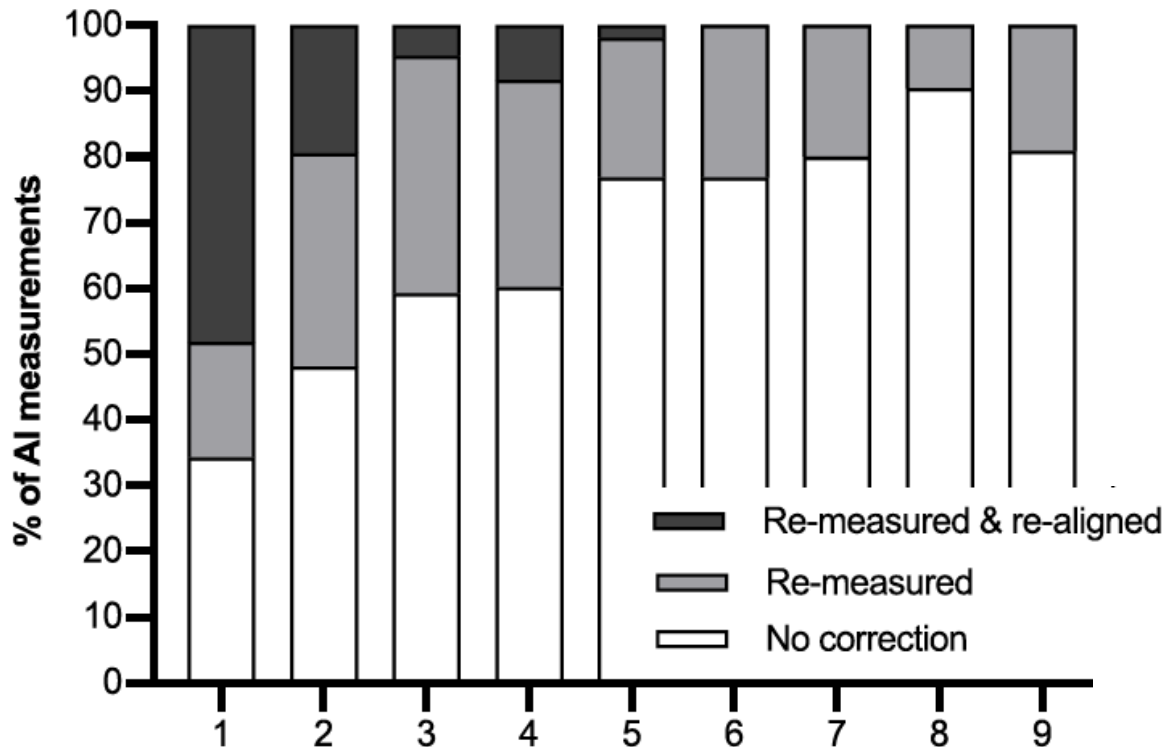
Soft as well as hard reconstruction kernels
Slice thickness up to 3.0cm

Supposedly increasing algorithm accuracy in case of contrast-enhancement & ECG-gating

Study Characteristics

- 18 patients with TAA (at least involving the ascending aorta), each with two follow-up CTs
- Manually radiological assesment, wash-out period, AI-assisted assessment (three radiologists, guideline-compliant)
- Comparison with original reports, accuracy and reporting time quantification

Raw AI Measurement Accuracy

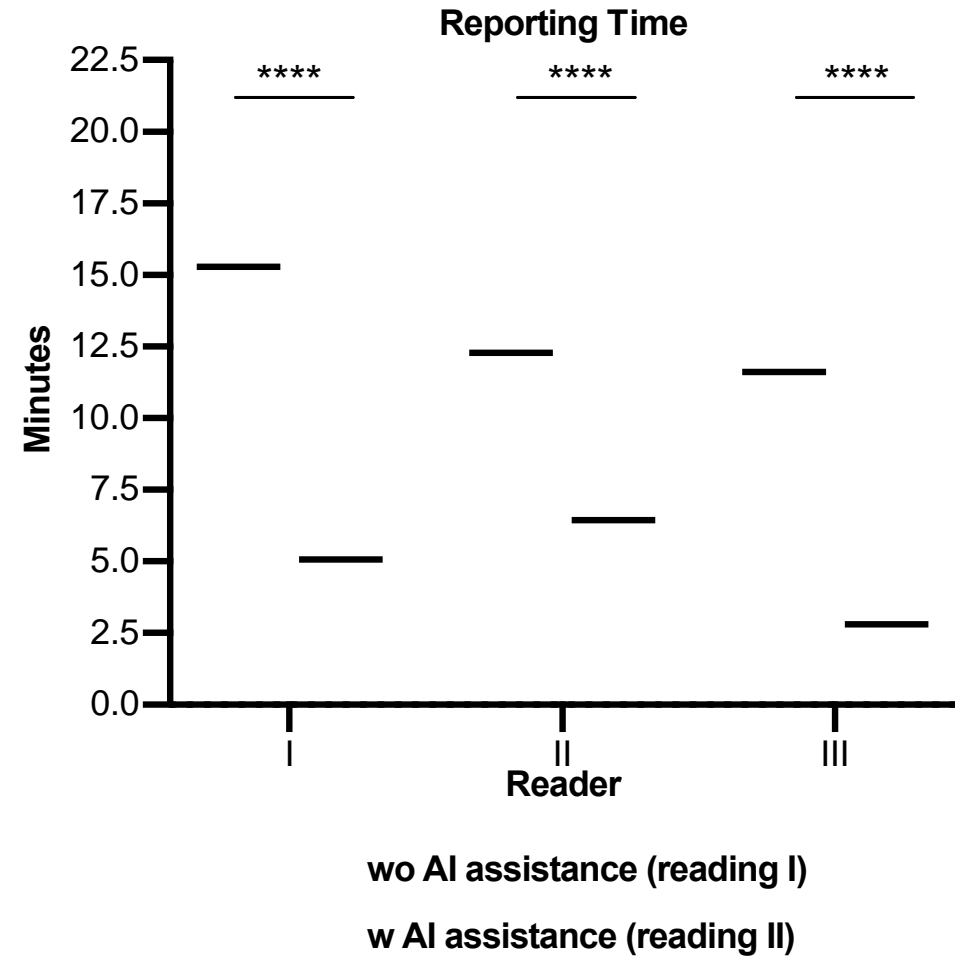
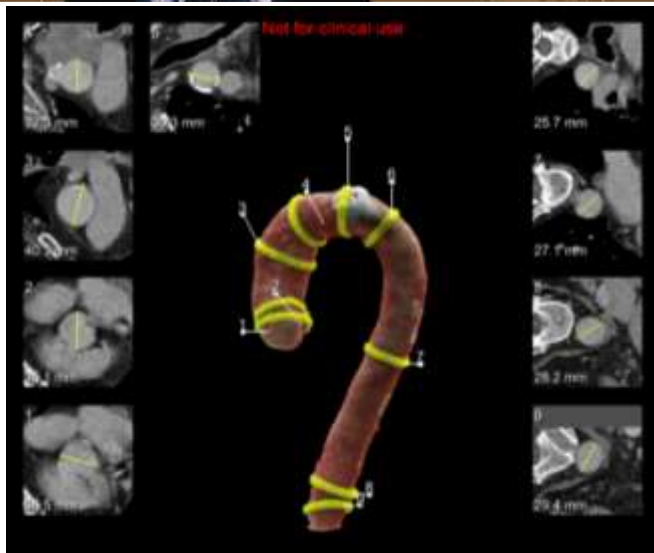


- **Time-consuming guideline-compliant aortic measurements revealed additional affections of the root / arch for 80 % of aneurysms that had initially been reported to be limited to the ascending aorta.**
- **33% of AI measurements were manually corrected with a predominance at the proximal parts.**
- **AI-assistance reduced the total diameter inter-reader variability by 42%.**
- **Manual and AI-assisted aneurysm growth quantification varied to small extent (difference of 0.75mm as a mean over all patient / landmark positions) which did not significantly exceed the corresponding inter-rater variability.**

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AI-Assisted Aortic Diameter Assessment

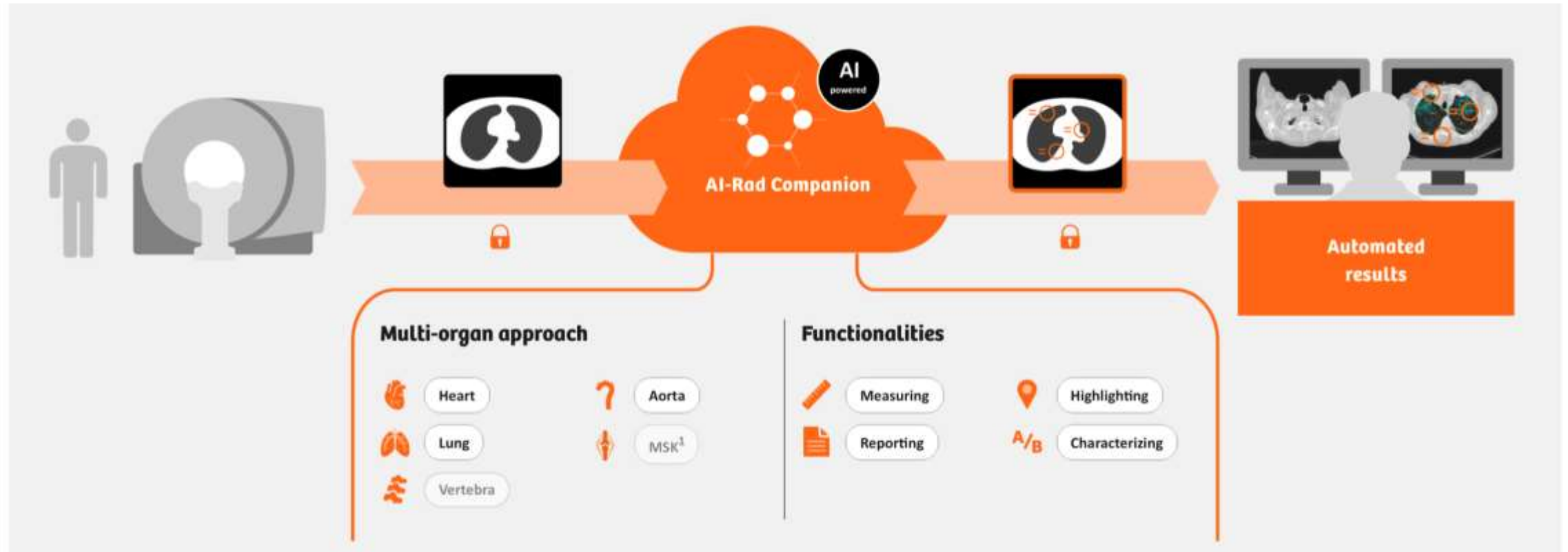
Reporting Time Efficiency



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AI-Rad Companion

Integration in Radiologists' Daily Routine



**Thanks for your
Attention!**

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