Tehisaru radioloogias

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Eesti Radioloogia Ühing

Tartu Ülikooli Kliinikum

Better Medicine

2025

Tartu

Huvikonflikti deklaratsioon

Ettevõtte Better Medicine kaasasutaja ja osanik

Miks radioloogia?

Tehniline eriala

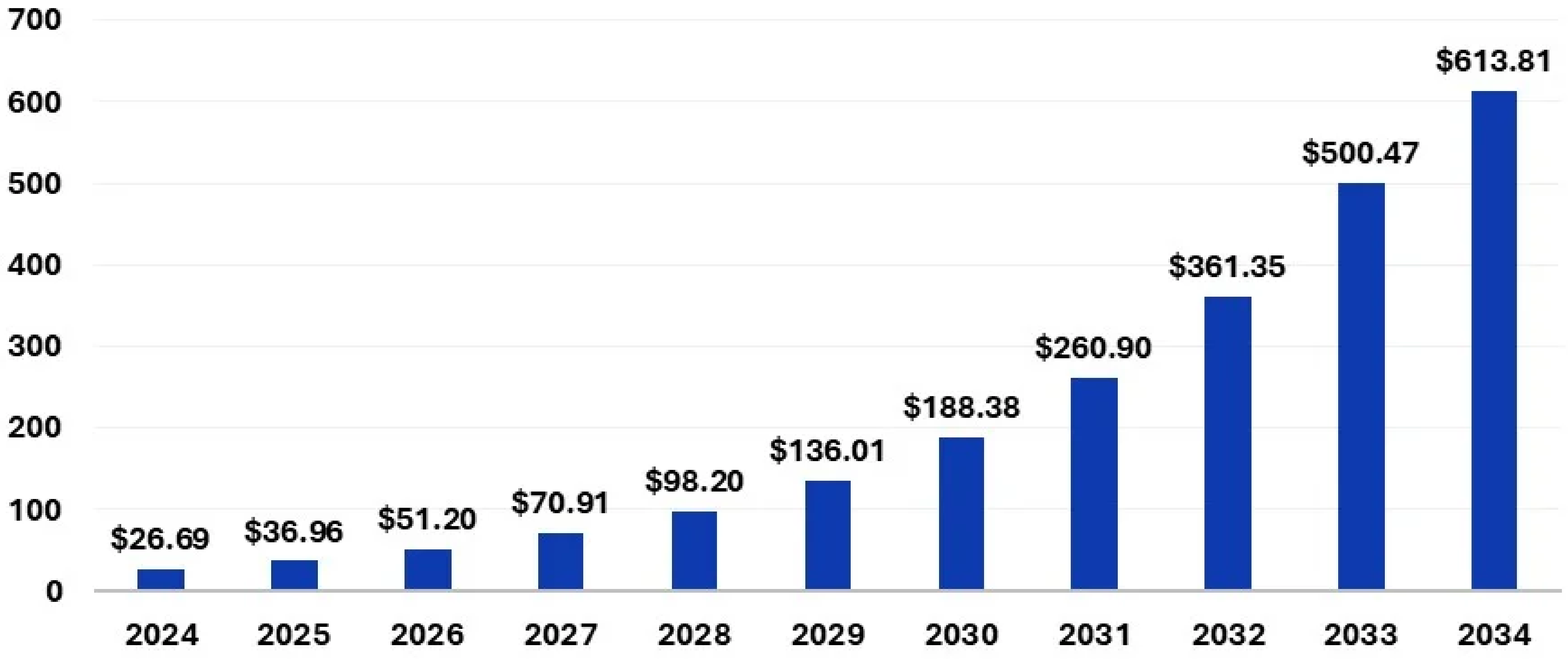
Arenenud IT süsteemid

Suured andmed

- Uuringute näol palju piltandmeid
- Kaasuvalt (+/- seotult) meditsiinilised andmed
- Tekstil baseeruvad andmed

Tihe koostöö IT arenduse ja tööstusega

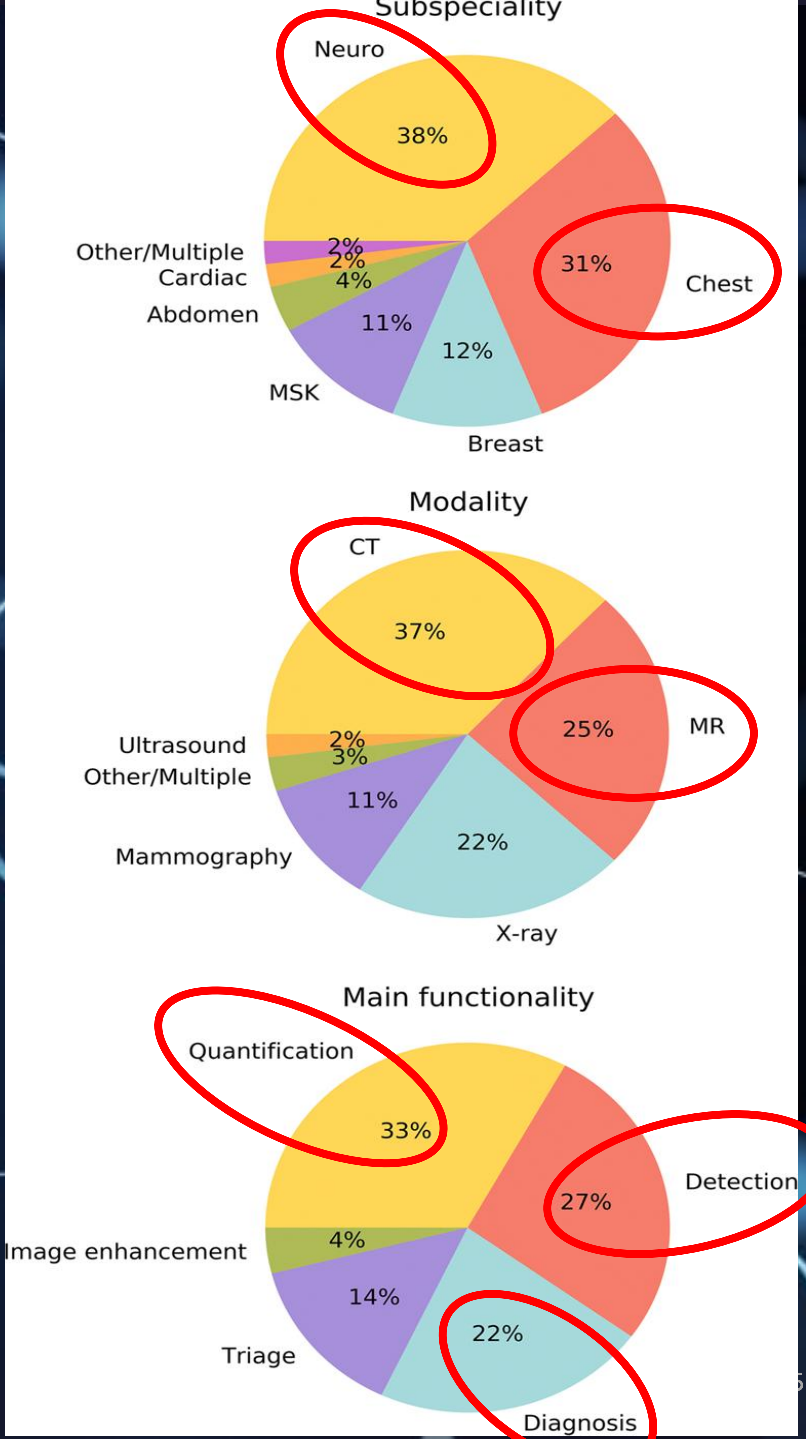
Artificial Intelligence in Healthcare Market Size 2024 to 2034 (USD Billion)



Source: https://www.precedenceresearch.com/artificial-intelligence-in-healthcare-market

AI radioloogias?

AI rakenduste jaotumine radioloogia subspetsialiteetide, modaliteetide ja funktsionaalsuse lõikes



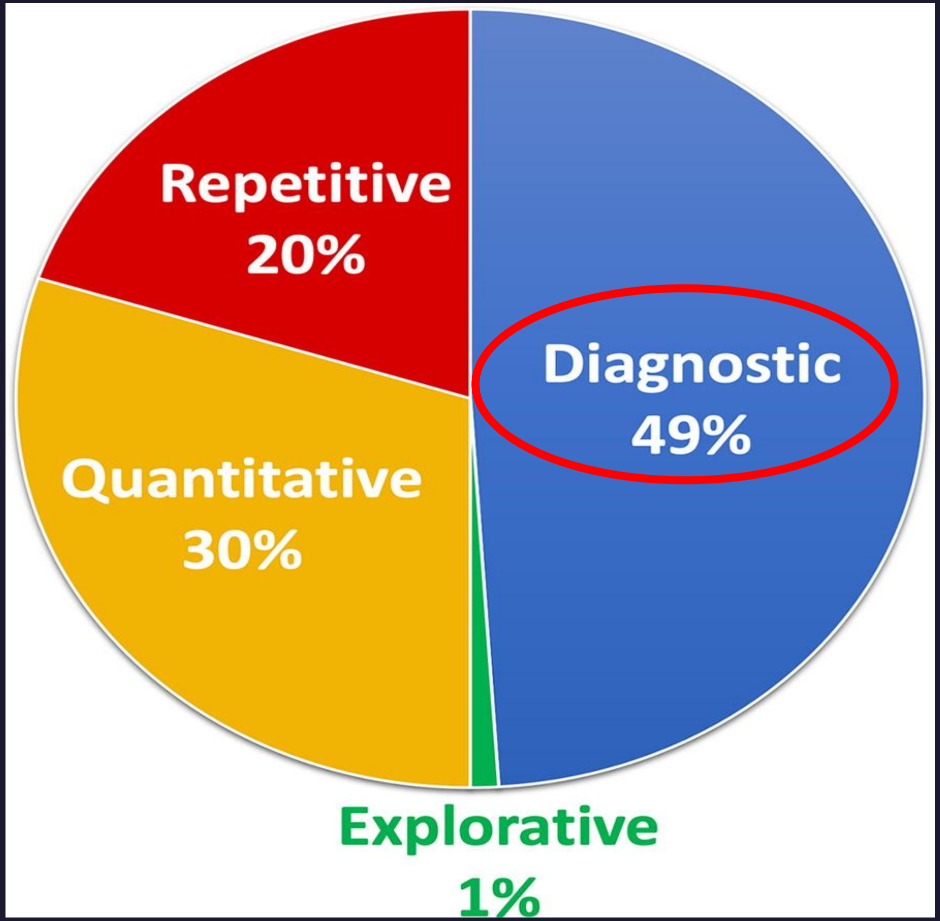


Figure 1: Artificial intelligence companies by type of task (repetitive, quantitative, diagnostic, or explorative) of 119 software offerings. Repetitive tasks mainly target high-volume, low-complexity tasks such as lung nodule detection or tracking of multiple sclerosis lesions. Quantitative tasks include measuring volume of emphysema on chest CT images or measuring bone density. Explorative algorithms are designed to allow a radiologist to select an area of interest on an image and return similar-appearing regions from other scans with associated diagnoses. Last, diagnostic tasks cover the majority of remaining algorithms and include functions such as detection of pneumonia on chest radiographs, classification of breast lesions, and grading of liver tumors.

Tadavarthi Y. Published Online: November 11, 2020
https://doi.org/10.1148/ryai.2020200004

Radiology: Artificial Intelligence

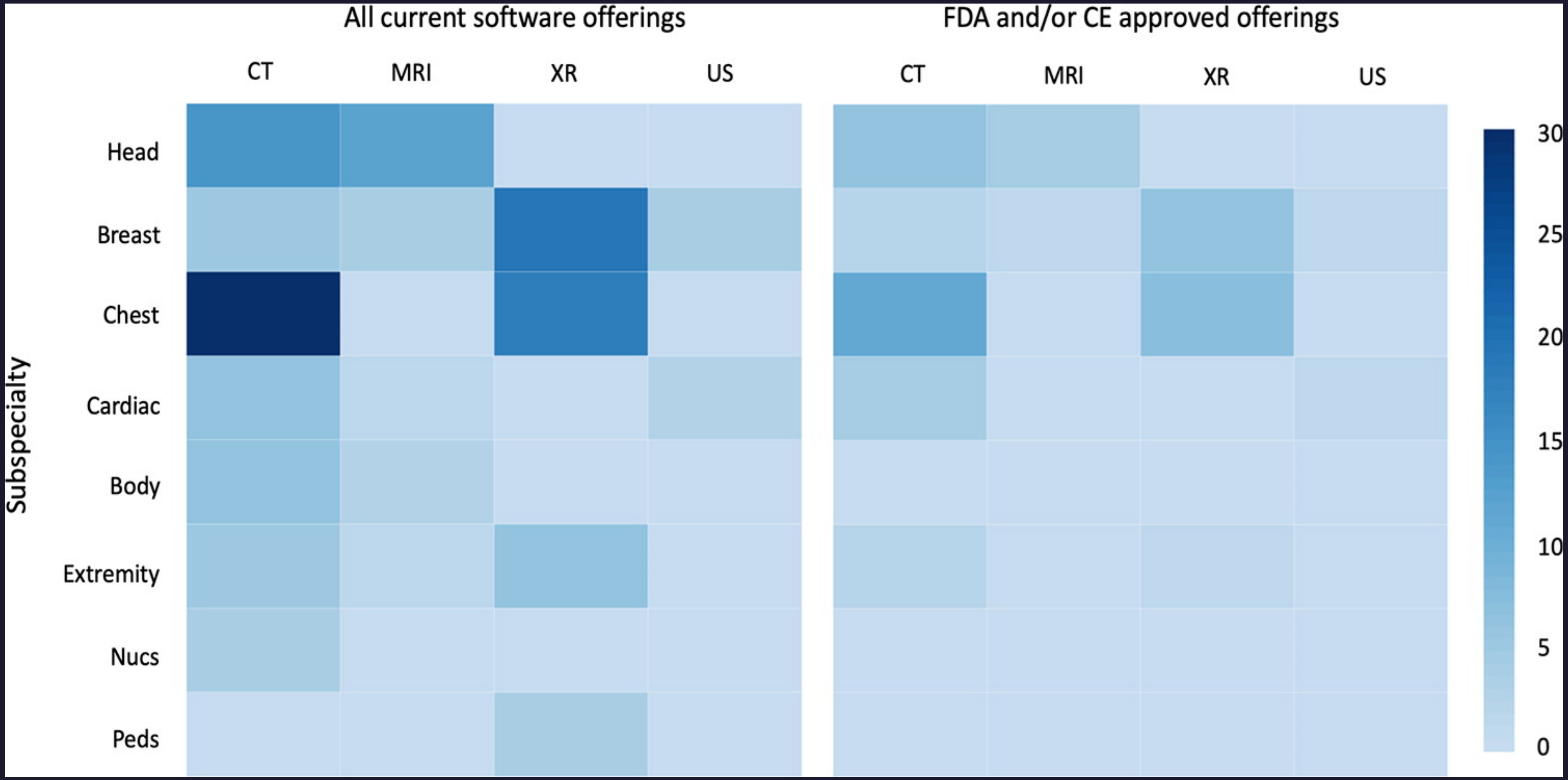


Figure 3: Distribution of current radiology artificial intelligence (AI) software offerings. The left panel represents the frequency of all radiology AI software offerings by subspecialty and modality, whereas the right panel demonstrates only those with Food and Drug Administration (FDA) and/or Conformité Européenne (CE) mark of approval at the time of writing (November 2019). Nucs = nuclear medicine, Peds = pediatric, XR = radiography.

Tadavarthi Y. Published Online: November 11, 2020
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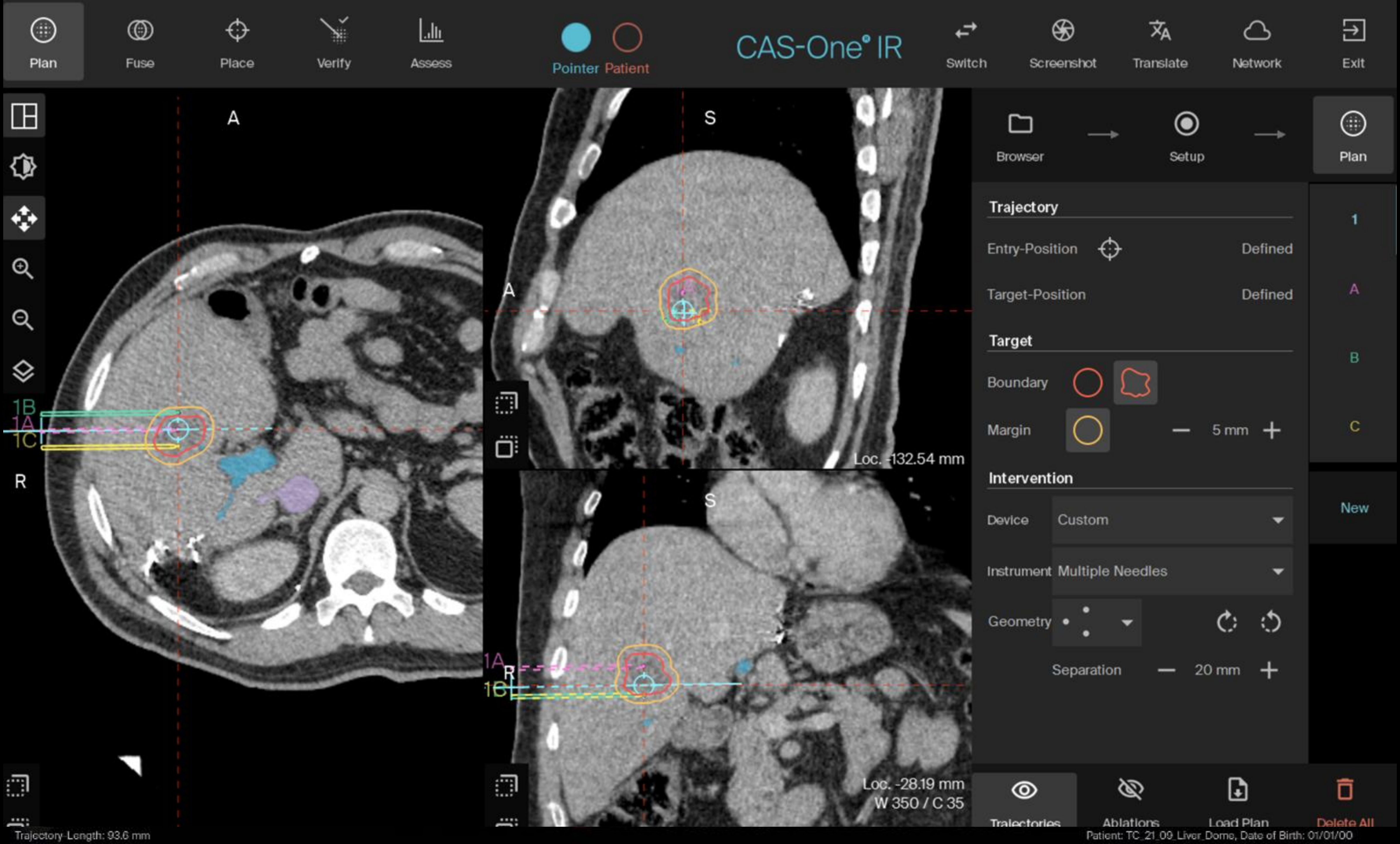
Radiology: Artificial Intelligence


Plan
Fuse
Place
Verify
Assess
Pointer Patient
CAS-One® IR
Switch
Screenshot
Translate
Network
Exit
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1B
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1C
R
Loc. -132.54 mm
1A
1B
Loc. -28.19 mm
W 350 / C 35
Browser
Setup
Plan
Trajectory
Entry-Position Defined
Target-Position Defined
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Boundary
Margin
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Intervention
Device Custom
Instrument Multiple Needles
Geometry
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1
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Ablations
Load Plan
Delete All
Trajectory Length: 93.6 mm
Patient: TC_21_09_Liver_Dome, Date of Birth: 01/01/00

dermtest

Asukohad | Patsiendile | Tervishoiutöötajale (Pildivaatur) | Dermtestist | Sisene arstina | Eesti keeles ▾

25. jaanuar 2023

Eestlaste meditsiinitarkvara on nüüd kasutusel Saksamaa tervisesüsteemis

Better Medicine

Neeruvähi puhul diagnoos tihti juhuleiuna või liiga hilja

Hinnanguliselt 50% radioloogi tööst kulub korduvatele tegevustele

- **Üle 60% neeruvähist avastatud juhuleiuna**

35% tuvastatavatest juhtudest korduvalt mitte raporteeritud uuringu vastuses[1]

- **1.8M kopsuvähi surma igal aastal**

- **Üle 400 miljoni KT uuringu aastas** [2]
- **51.6 miljonit tundi korduvatele tegevustele**

1. A.J. Bradley (2021) Routes to diagnosis and missed opportunities in the detection of renal cancer, Clinical Radiology, 76(2), p129-134. Link
2. The UNSCEAR 2020/2021 Report, Annex A (2022) Evaluation of Medical Exposure to Ionizing Radiation. Link

Kidney mass + metastatic lymph nodes annotated as Malignant lesion category

BMVision Kidney

Clinical Validation Study Results

- **22.6%** absolute increase in **object-level agreement** compared to unaided radiologists.
- **Kappa score** improved **from 0.68** in the unaided workflow **to 0.88 with AI assistance**, indicating a substantial increase in inter-radiologist agreement.
- For malignant lesions, the **disagreement rate** was reduced by **34.3%** for malignant lesions and **48.6%** for benign lesions, further demonstrating the positive impact of AI on consistency in lesion detection.

Object-level agreement: *Evaluates the percentage of lesions consistently identified by all six radiologists.*

Disagreement: *Measures the variation in the number of findings reported per scan by each radiologist, compared to the mean number of findings.*

Cohen's kappa coefficient: *Quantifies the agreement between pairs of radiologists, accounting for the possibility of agreement occurring by chance.*

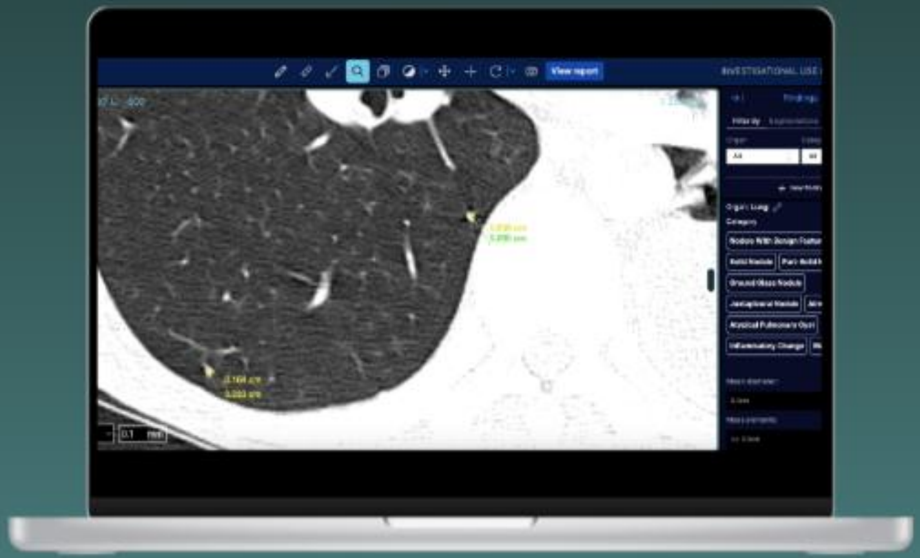
Source: Petryshak, B., Iljin, M., Denissova, A. et al. (2025) BMVision: A Clinically Validated AI Framework for Kidney Cancer Detection and Characterization (undergoing submission)

BMVision Lung

Better Medicine

Transform Lung Cancer Screening with AI-Driven Precision

*Enhance detection accuracy with automatic lung AI, streamline workflows with human-guided AI measurements, and improve early detection —all through our custom-built viewer.**



In 2020, more than **2.2 million** people were diagnosed with lung cancer, making it the greatest economic burden of all cancers in terms of lives lost.[1]

In North America, lung cancer deaths account for 22.8% as a percentage of total cancer deaths.[1]

Over 40% of lung cancer patients are diagnosed at stage IV, with a five-year survival rate below 10%, compared to stage I, where survival is significantly higher (68-92%)[4]. Therefore, early detection is crucial for improving survival outcomes.[1]

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*Clinical Research use Only

.The Lung Cancer Policy Network (2024) Lung cancer screening: learning from implementation. Link: https://www.lungcancerpolicynetwork.com/app/uploads/Lung-cancer-screening-learning-from-implementation.pdf

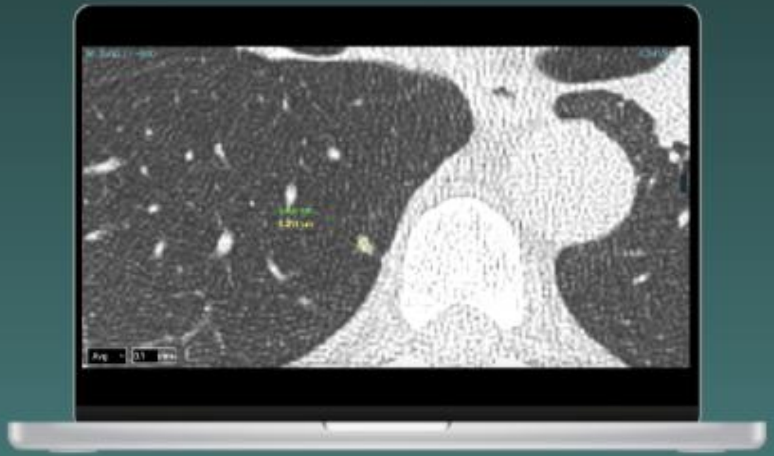
BMVision

iMeasure

♡ Better Medicine

Automate lesion and nodule measurements and improve reporting times with just one-click

*A user friendly and effective tool for consistent lesion measurement and reporting**



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Select and measure lesions automatically in CT scans for any solid organ within the chest and abdomen

Diagnostilise AI sooritus radioloogias

Näide MSK radioloogiast *Guermazi et al, 2021 Radiology*:

- **Retrospektiivne uuring 480 patsienti**

  AI assisteeritud hindamisel 10.4% parem murru tuvastamise sensitiivsus

  (75.2% vs 64.8%, superiority P < .001)

  seda ilma spetsiifilisuse languseta

  (5.0%, 95.6% vs 90.6%; P = .001 for non-inferiority)

- **AI lühendas röntgenuuringu hindamise aega 6.3 sekundit per patsient (P = .046)**

- **Tulemused ei paranenud vaid õlaliigese, rangluu ja torako-lumbaalse lülisamba osa hindamisel**

- **Ainult AI sooritud murdude tuvastamisel -> AUROC 0.97**

Improving Radiographic Fracture Recognition Performance and Efficiency Using Artificial Intelligence

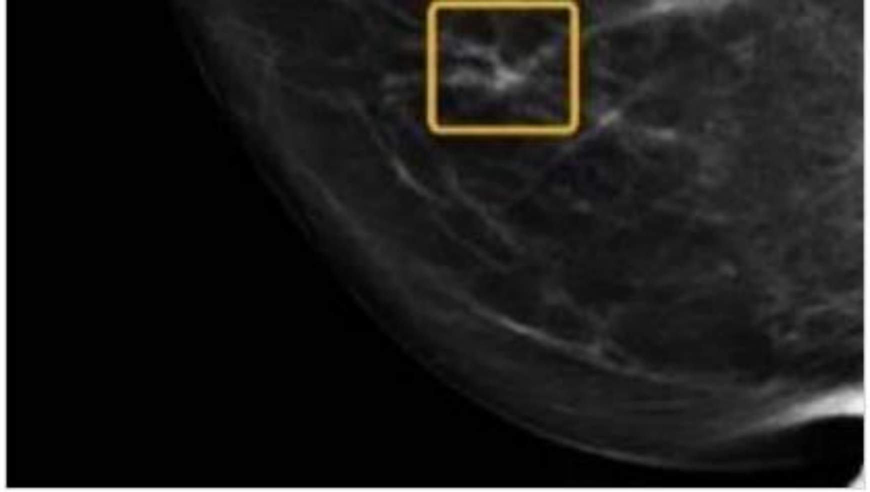
Radiograph shows a fracture of the right femoral neck (arrows) that was detected by AI using the FRACT threshold (box).

- In a retrospective study of 480 patients, an AI-assisted radiographic interpretation by 24 readers showed 10.4% improvement of fracture detection sensitivity (75.2% vs 64.8%, superiority *P* < .001) without specificity reduction (+5.0%, 95.6% vs 90.6; *P* = .001 for noninferiority).
- AI assistance shortened the reading time by 6.3 seconds per patient (*P* = .046).
- The stand-alone performance of AI algorithm for fracture detection had an AUC of 0.97 (*P* < .001).

Guermazi A et al. Published Online: December 21, 2021
https://doi.org/10.1148/radiol.210937
Radiology

https://doi.org/10.1148/radiol.210937

"In our study, we addressed a common concern that machine learning results fail to generalise to new populations by re-training the algorithm using UK data only and then testing it on US data," adds Google Health employee Shravya Shetty. "Despite a small drop in performance, the AI system continued to demonstrate a reduction in false-positive and false-negative rates [3.5% and 8.1%, respectively]."



Credit: Reproduced from McKinney, S. M. et al. *Nature* **577**, 89–94 (2020).

When used to provide a rapid second opinion as part of the double-reading process used in the UK, the accuracy of the AI system was non-inferior to serial reading by two radiologists, and the simulated workload of the second reader was reduced by 88%. Thus, AI has the potential to alleviate pressures on services in the context of a worldwide shortage of radiologists.

Diagnostilise AI sooritus radioloogias

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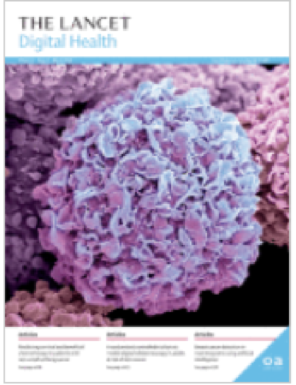
THE LANCET Oncology

The AI developed in this study is not yet available for clinical use and still requires further validation. However, the researchers believe that AI has the potential to greatly enhance prostate cancer diagnostics in the future, by reducing the workload on radiologists and providing more accurate diagnoses.

Although the real clinical value needs to be confirmed by prospective studies, these results suggest that early detection of breast cancers by AI might contribute to a reduction of interval cancer and improvement of outcomes for patients with breast cancer. Lastly, the diagnostic performance of AI was less affected by breast density than was the performance of radiologists. Radiologists' performance can decrease with dense breasts, since dense parenchymal tissue is more likely to mask cancer lesions in mammograms.[33] The sensitivity difference of AI between fatty and dense breasts was much smaller than that of radiologists, leading to a significant improvement of radiologists' AI-aided performance in dense breasts.



Diagnostilise AI sooritus radioloogias

Radiologists Outperformed AI in Identifying Lung Diseases on Chest X-Ray

Clinical use of deep-learning-based AI tools for diagnosis still in infancy

Dr. Plesner and a team of researchers compared the performance of four commercially available AI tools with a pool of 72 thoracic radiologists in interpreting 2,040 consecutive adult chest X-rays taken over a two-year period at four Danish hospitals in 2020.

The median age of the patient group was 72 years. Of the sample chest X-rays, 669 (32.8%) had at least one target finding.

Tehisaru uuringute nõrgad kohad

- Valdavalt retrospektiivsed uuringud ja andmed
- Tihti puuduvad piisavad valimi mahtude kalkulatsioonid (sample size / power calculation)
- Treenitud valdavalt avalikel ja tasuta kättesaadavatel andmekogudel
- Väike uuritavate arv ja vähene valimi variatsioon
- Piiratud kaetusega patsientide kohort – etniline koosseis, vanuseline koosseis jne
- Piiratud diagnostilise täpsuse hindamise parameetrid ja limiteeritud info kontrollgrupis, mis ei simuleeri alati päriselulisi tingimusi
- Vähene väline valideerimine
- Vähene mudelite võrdlus kliinilise sooritusega
- Oht kallutatud treeningandmetele

Need punktid teevad mitmed kommertsiaalselt kättesaadavad tehisarul baseeruvad töövahendid haavatavaks, seletavad nähtavat kliinilises keskkonnas esinevat sooritustulemuste langust ning ei ole selle tõttu täielikult/iseseisvalt kliinilises situatsioonis kasutatavad

The current state of the AI debate:

AI ei ole kusagilt kaugelt tulemas, vaid on praegu meie ümber, igapäevaselt kasutuses ja me peame ka meditsiinis leidma viise kuidas seda patsientide hüvanguks ja meie töös kõige efektiivsemalt ja turvaliselt kasutada