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Focus on AI in imaging

Holiday Inn Brussels Airport

bmuc.be/bmuc2026



**13th Belgian Multidisciplinary
Meeting on Urological Cancers**

27 March 2026

Conflicts of interest

- I have no potential conflict of interest to report

*Many thanks to my colleague **Prof Geert Villeirs** for providing some slides of this presentation*

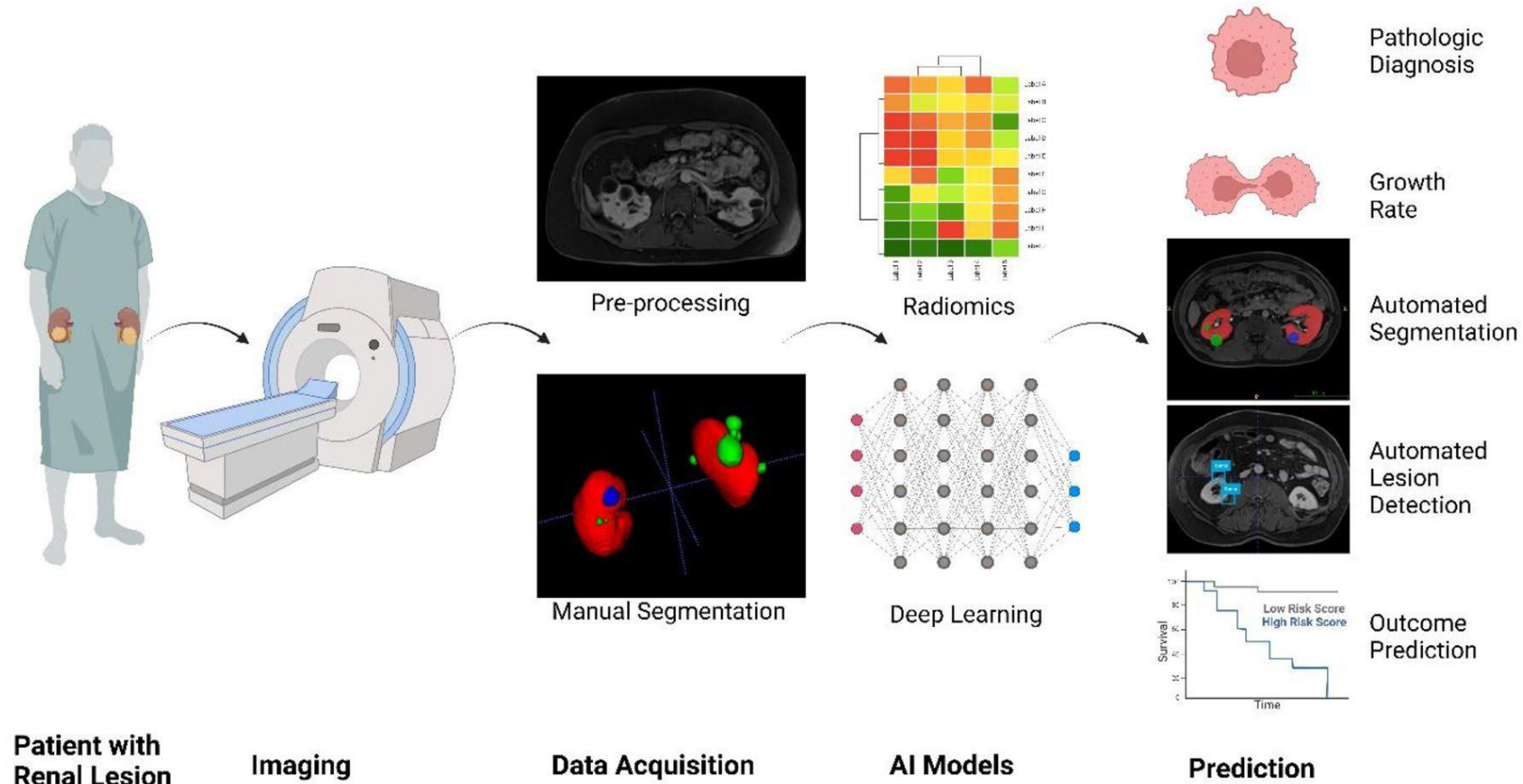


AI in imaging

Expectations



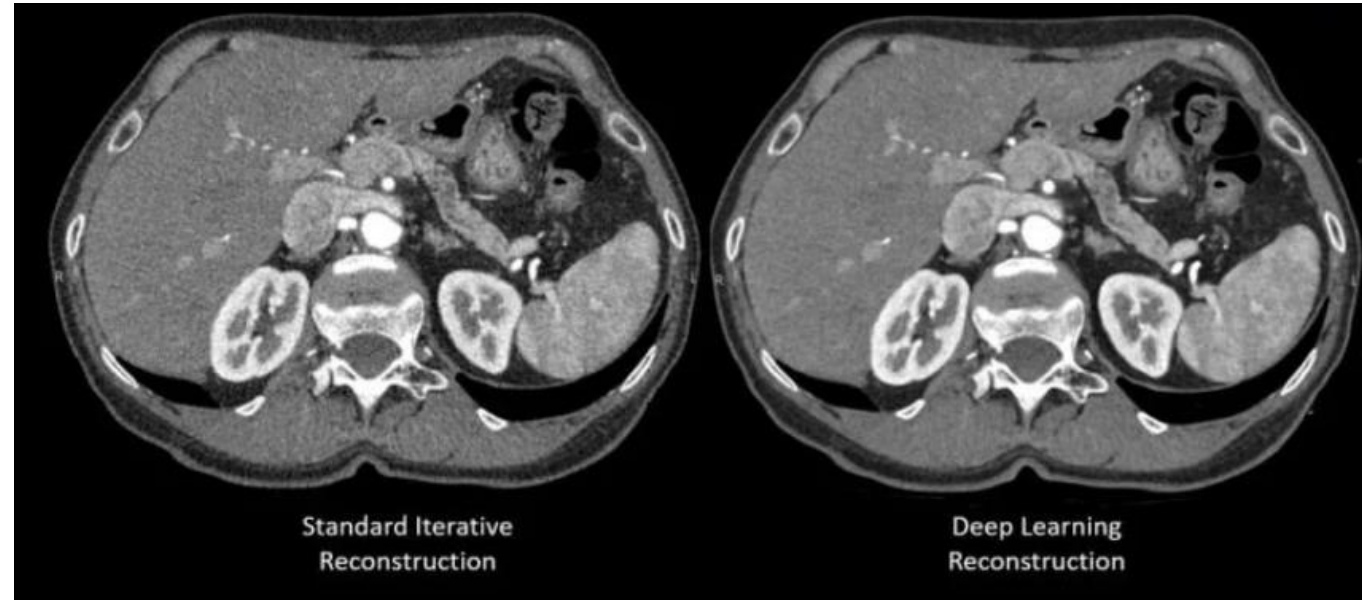
AI in imaging



AI in imaging: technical optimization

- **Improved image quality**

- Noise reduction
- Correction of motion artefacts
- Use a virtual 'mold' as pre-scan information for faster imaging



- **Image quality recognition** (good, intermediate, poor)
- **Inline quality control during scanning** (and immediate adjustment in case of problems)

Texture analysis

- Quantitative measurement of **tumor heterogeneity** and **pixel distribution analysis**.
- May e.g. **discriminate low grade from high grade bladder cancer**.
 - Greater heterogeneity of aggressive tumors.

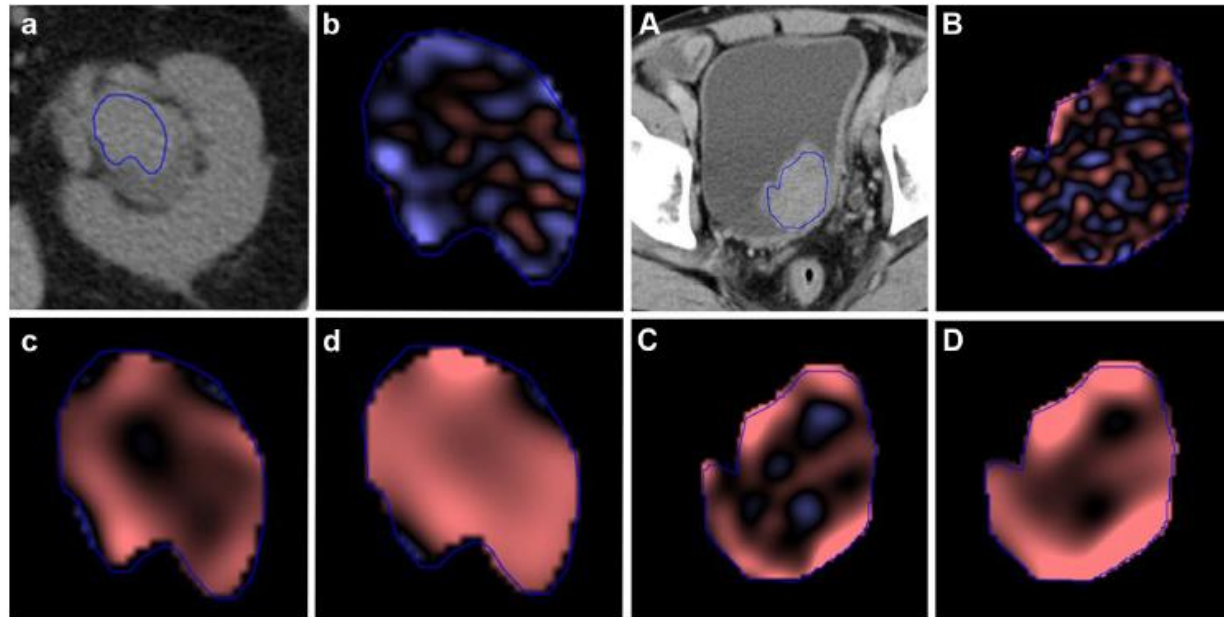
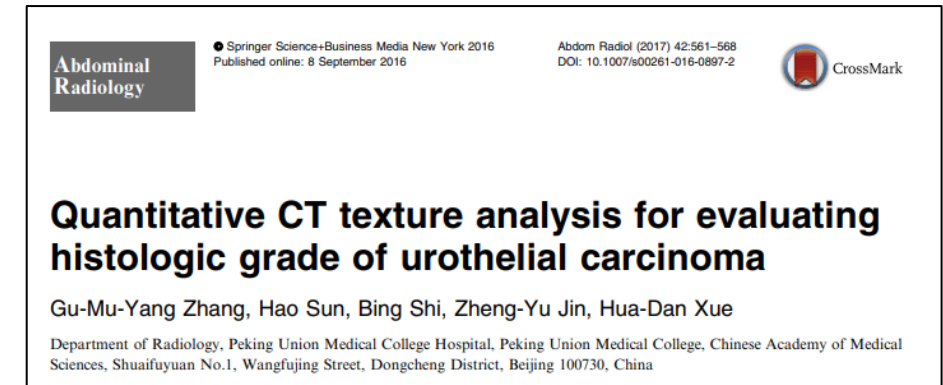


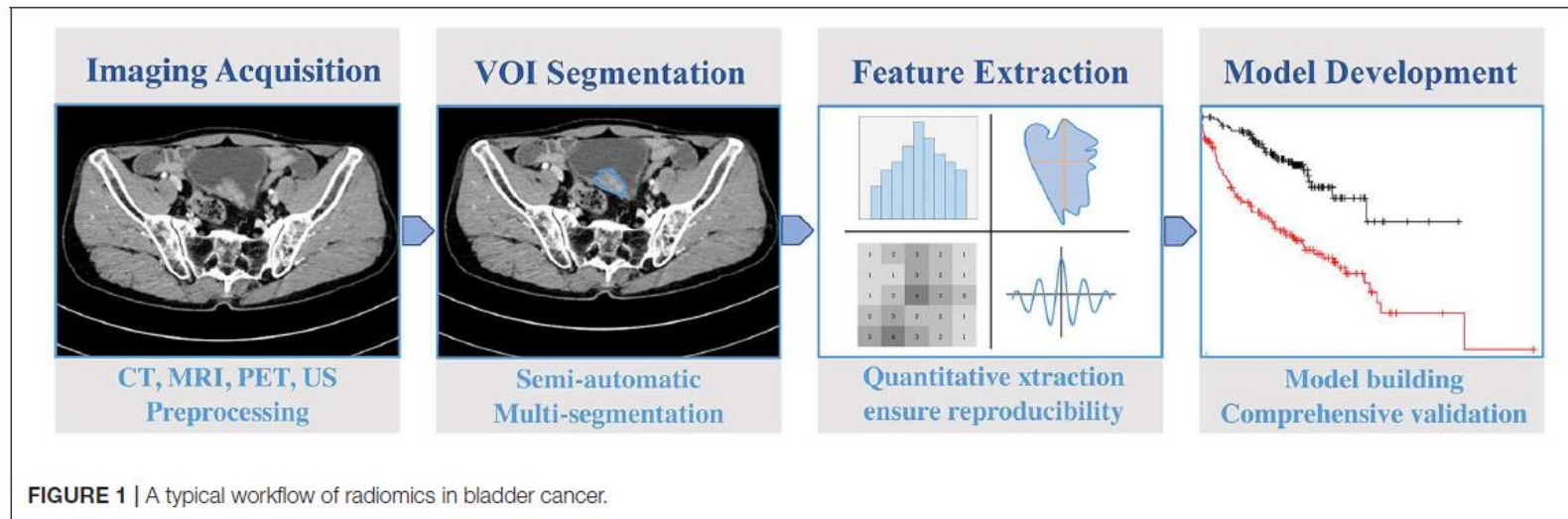
Fig. 1. Illustration of ROIs and corresponding texture images at different texture scales. The unenhanced image (a) showed an irregular lesion in the left renal pelvis of a 73-year-old man, which was histologically diagnosed as LGUC after the surgery. A HGUC of the bladder from a

67-year-old patient was demonstrated in image A. ROIs (blue contour) were delineated slightly within the border of lesions. Corresponding texture analysis images display fine (b, B), medium (c, C), and coarse (d, D) textures obtained using SSF 2, 4, and 6, respectively.



Radiomics

- Extract large number of quantitative features from digital medical images
- Identify imaging biomarkers by extracting data that are **not visible to the naked eye**
- Potentially helping to **predict tumor characteristics and outcomes**



 **frontiers**
in Oncology

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Study Progress of Radiomics With Machine Learning for Precision Medicine in Bladder Cancer Management

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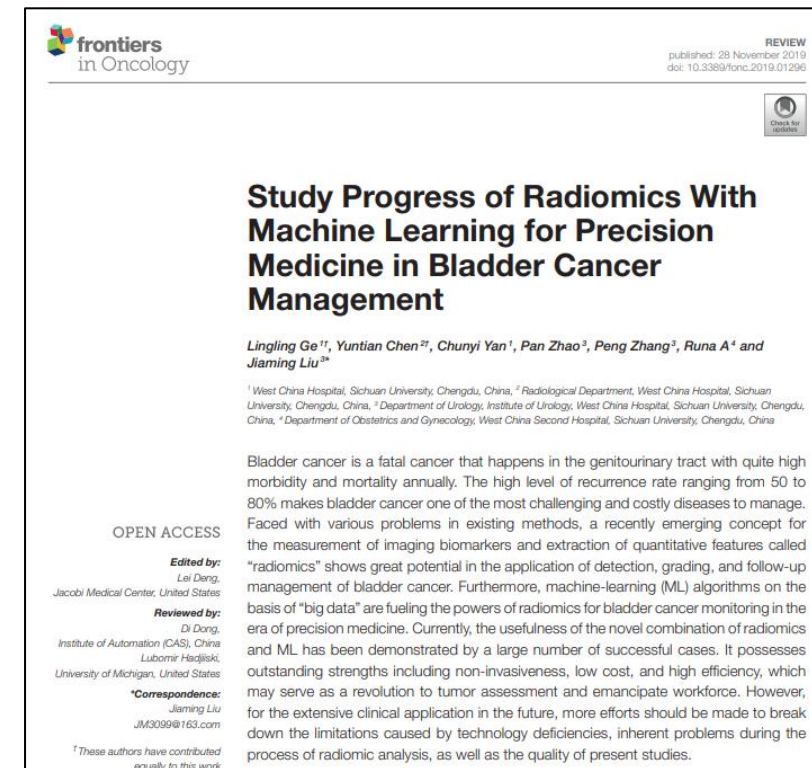
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Bladder cancer is a fatal cancer that happens in the genitourinary tract with quite high morbidity and mortality annually. The high level of recurrence rate ranging from 50 to 80% makes bladder cancer one of the most challenging and costly diseases to manage. Faced with various problems in existing methods, a recently emerging concept for the measurement of imaging biomarkers and extraction of quantitative features called "radiomics" shows great potential in the application of detection, grading, and follow-up management of bladder cancer. Furthermore, machine-learning (ML) algorithms on the basis of "big data" are fueling the powers of radiomics for bladder cancer monitoring in the era of precision medicine. Currently, the usefulness of the novel combination of radiomics and ML has been demonstrated by a large number of successful cases. It possesses outstanding strengths including non-invasiveness, low cost, and high efficiency, which may serve as a revolution to tumor assessment and emancipate workforce. However, for the extensive clinical application in the future, more efforts should be made to break down the limitations caused by technology deficiencies, inherent problems during the process of radiomic analysis, as well as the quality of present studies.

Radiogenomics

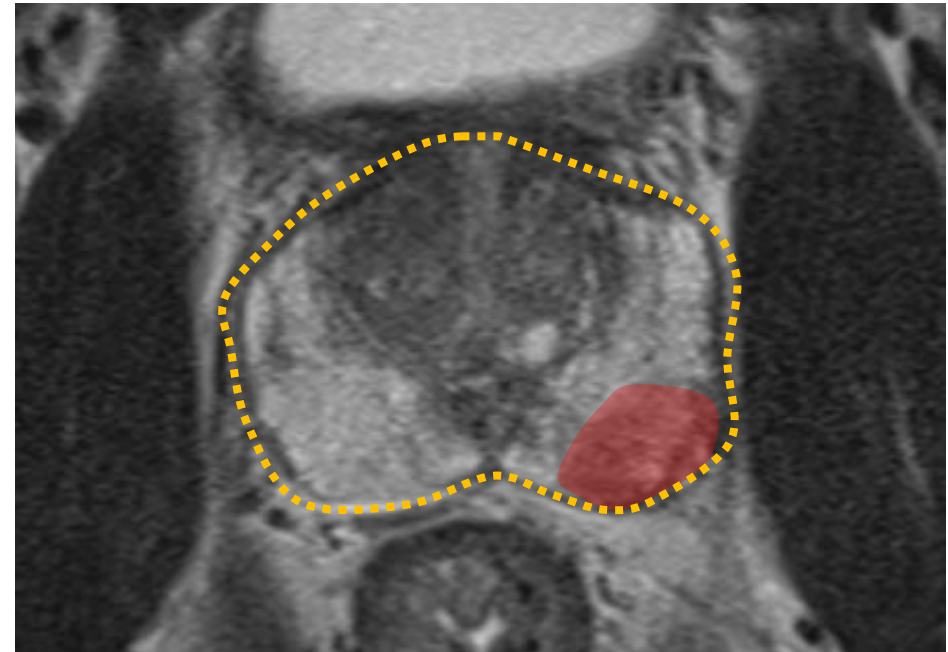
- Radiomics that **aim to predict molecular and genetic tumor characteristics**
 - Could lead to fast and noninvasive detection of gene-expression patterns of a tumor
 - May avoid biopsy/histology that currently is needed



AI in imaging: improved user experience

- Annotation of suspicious foci ("red flag")
- Delineation or segmentation of organs (radiotherapy preparation)
- Automatic measurements
- Automatic generation of structured reports

→ faster workflow
→ improved diagnostics



Bone age

- **Left hand radiograph** to determine bone age:
 - **Growth prediction:** full length obtained or still growing?
 - Young criminals: are they **adult or not**?
- The (meta)phalanges grow and the **epiphyses 'close' in a well-defined order**
 - At birth, only metaphyses are present
 - As child grows, epiphyses become calcified and visible on RX
 - The cartilaginous space between metaphyses and epiphyses becomes obliterated
 - When epiphyses is 'closed', no further lengthening will occur



Greulich-Pyle atlas:
Male standard 25
(Skeletal age: 14 years)

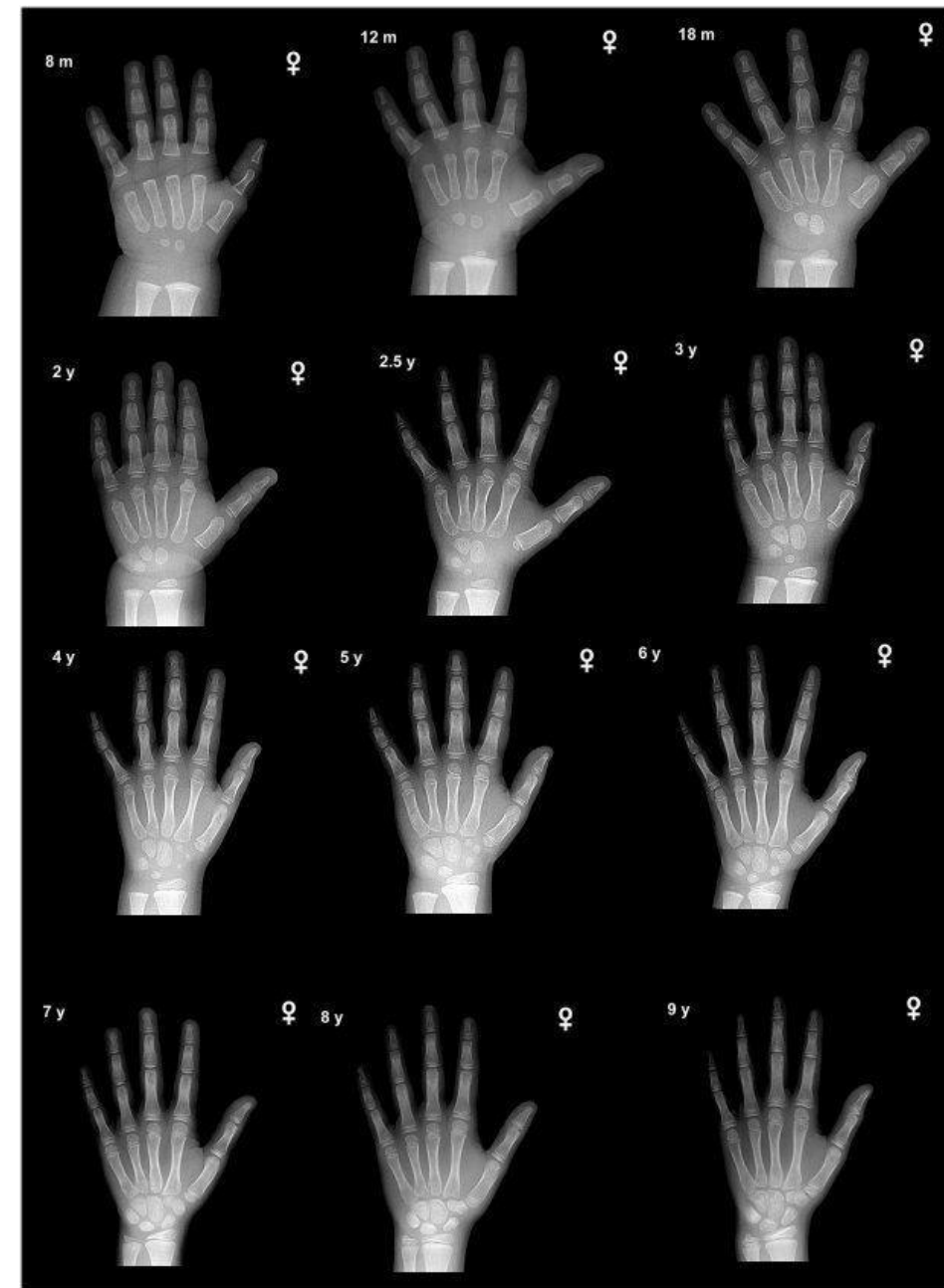


Hand radiograph to compare
with atlas standards
(Chronological age: 14 years)



Greulich-Pyle atlas:
Male standard 26
(Skeletal age: 15 years)

Radiologists visually
compare the RX of the
patient with a hand atlas
A boring time-consuming task



Bone age

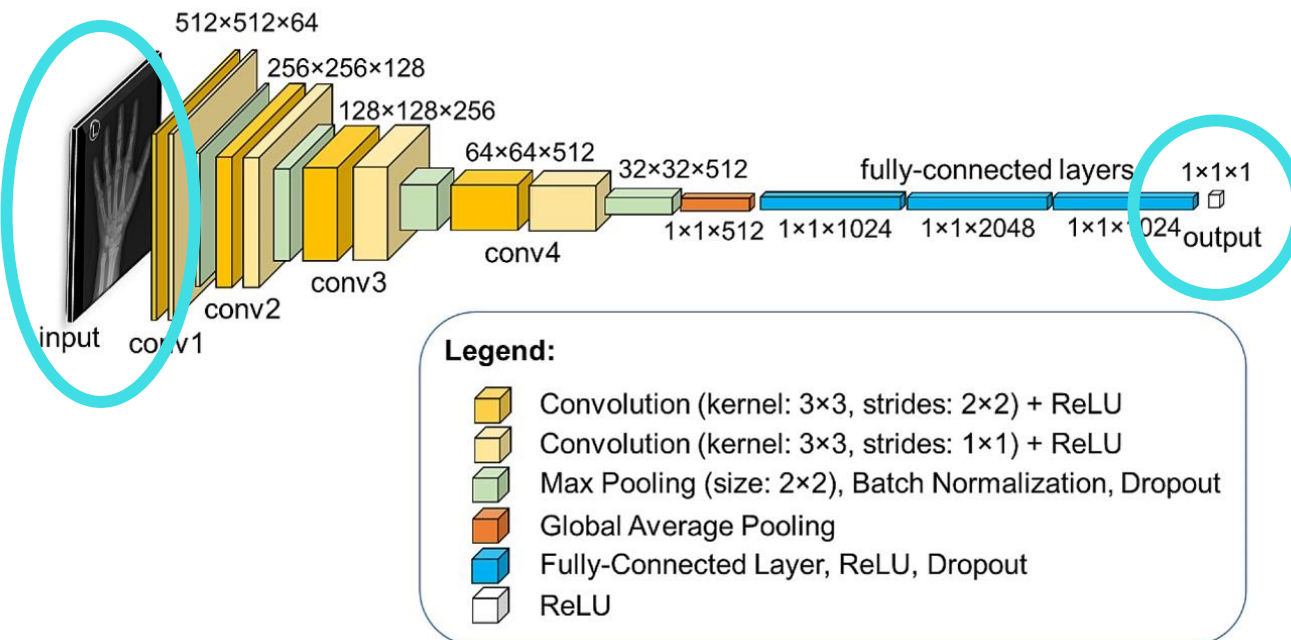
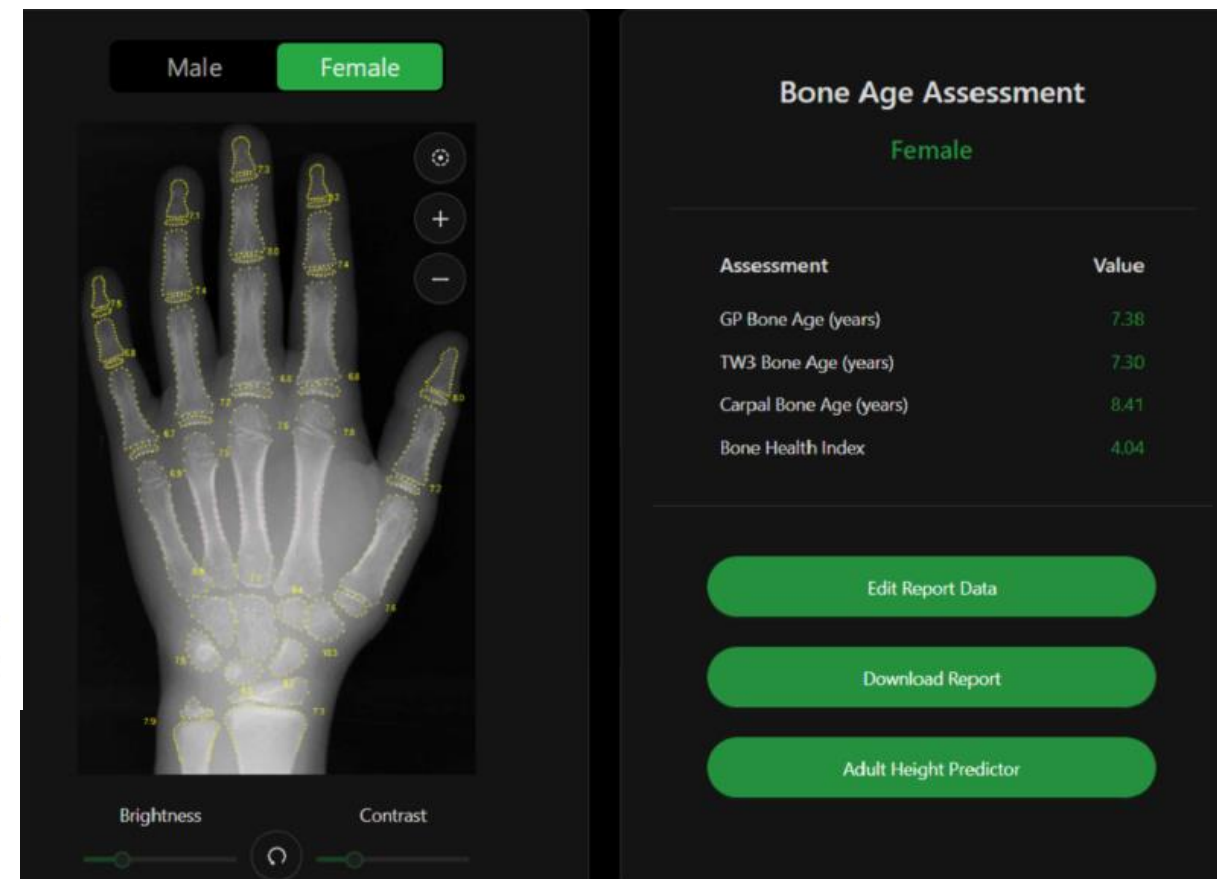


Fig. 2 Network architecture of our proposed bone age prediction model. Boxes indicate a set of feature maps (64–1024) obtained over different operations



Radiologists completely trust the AI report and don't look at the radiographs any more!

AI in imaging

Radiologists need help!

01 Late detection of cancers

Up to 50% of cancers were detected in a previous mammogram

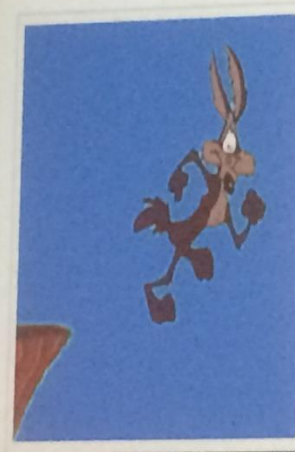
02 They get tired

03 Lack of breast experienced radiologists

04 Lack of quality control



Radiologist-Coyote



Radiologists are like the coyote in the cartoon: They are already over the edge but they haven't yet looked down. There's no ground underneath

It is obvious that in 5 years Deep Learning is going to do better than Radiologists

Seen at @ESGO 2019!

AI in imaging

Obstacles



- **Huge amount of data needed**

- for training, validation and testing (eg.: 100.000 annotated retinal images needed for AI-detection of diabetic retinopathy)
- “synthetic data”: slightly transformed images (distorted, extra noise, ...) can add many data points, but rather technically interesting, not clinically
- relevant for any population (not only Caucasian)
- relevant for any clinical need
 - diagnosis
 - follow-up
 - staging



Obstacles

- **Curated data difficult to obtain** (supervised AI training)
 - very labor intensive
 - limited availability of gold standard
 - E.g. in prostate:
 - transrectal biopsy does not sample the whole prostate (false negatives!)
 - “normal MR” does not proceed to biopsy
 - lesion delineation is man-made without direct pathologic proof



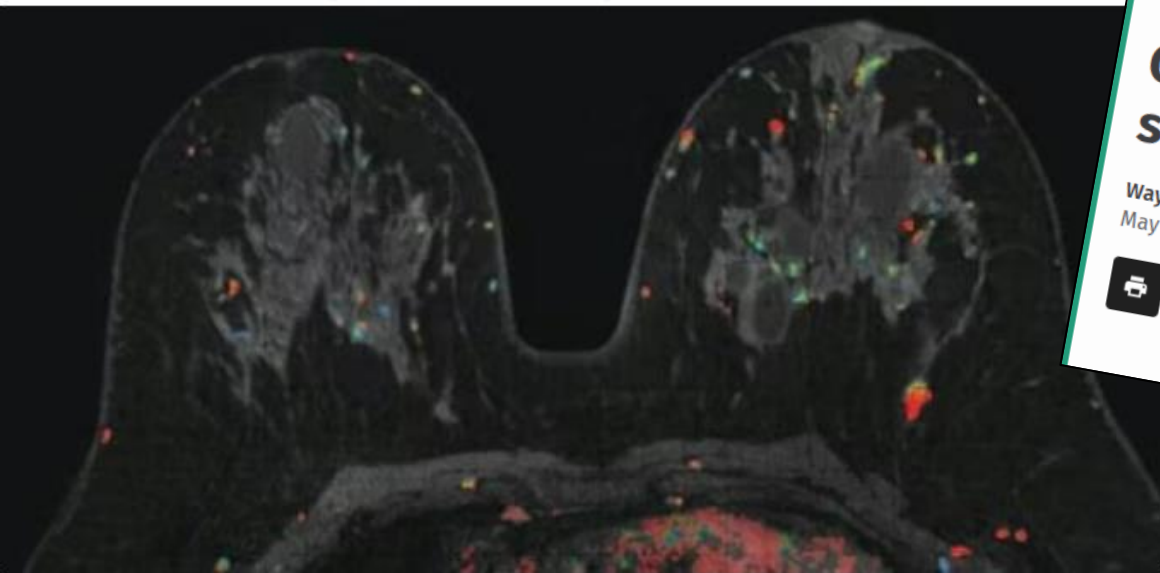
Obstacles

- **Lack of standardized methods** for analysis.
- **Universal applicability of the AI software**
 - images of all possible vendors (Siemens, General Electric, Canon, Philips, ...)
 - in all possible radiologic departments
 - with different puls sequences (TR, TE, flip angle, ...)
 - with diverse protocol variations (eg. bpMRI and mpMRI)



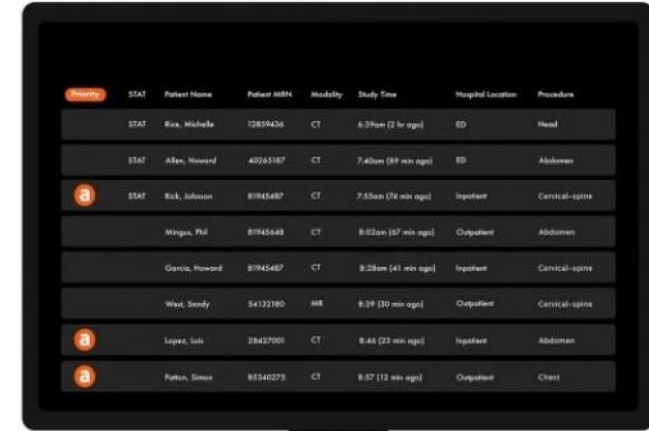
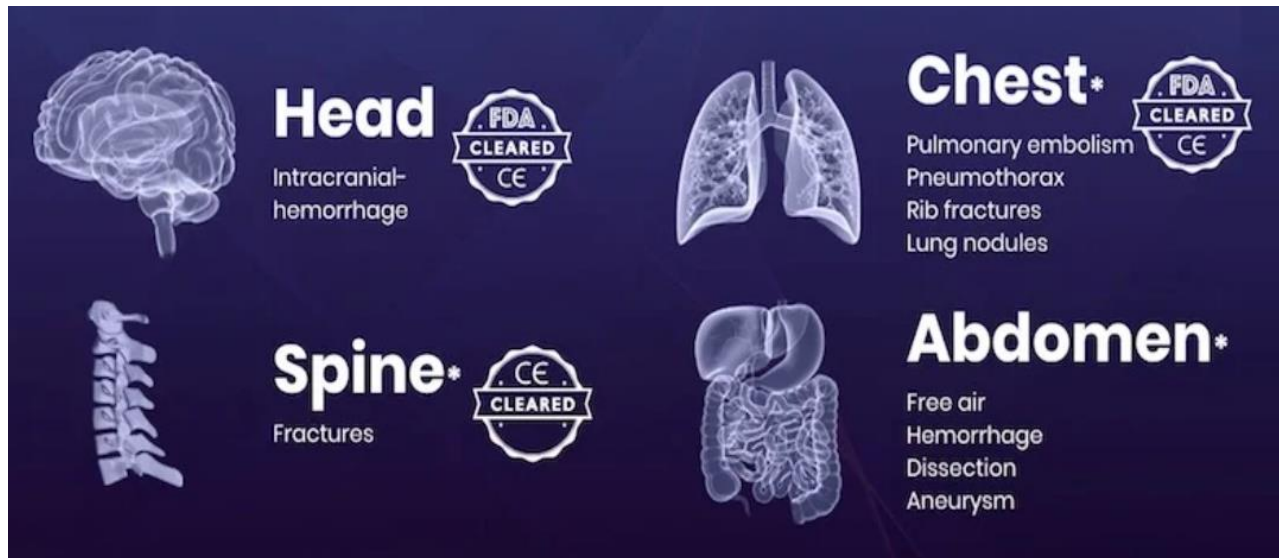
Obstacles

- **Who takes the responsibility?** Legal accountability
- AI companies don't want to miss a single tumor
 - → tendency of overdiagnosis

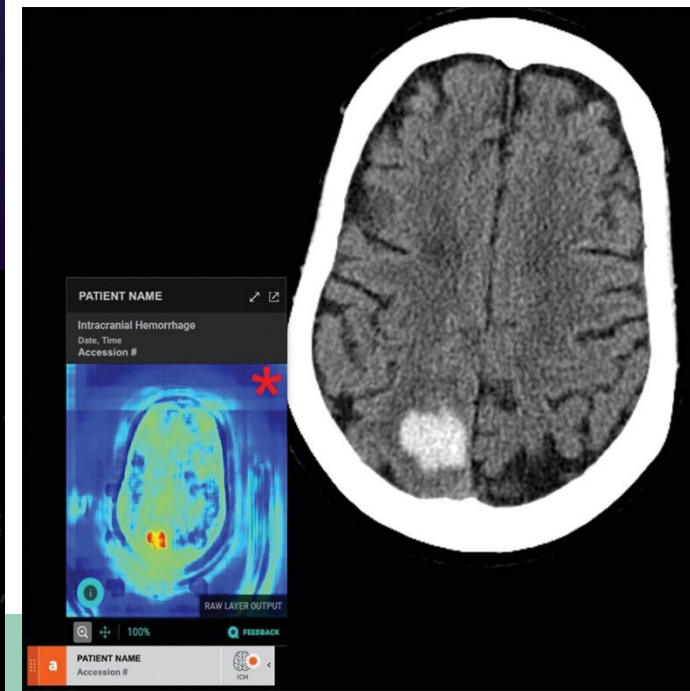
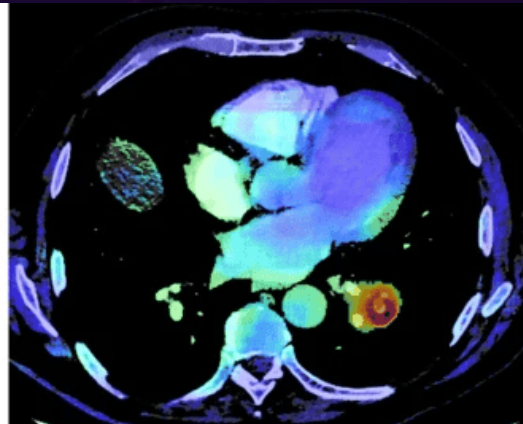


AI in imaging @ UZ Gent

- **FDA approved AI algorithm for flagging of priority exams**
 - AI analyzes the medical images directly after the patient is scanned
 - Radiologists are notified of cases with suspected findings
 - Assist with prioritization of time-sensitive and potentially life-threatening cases

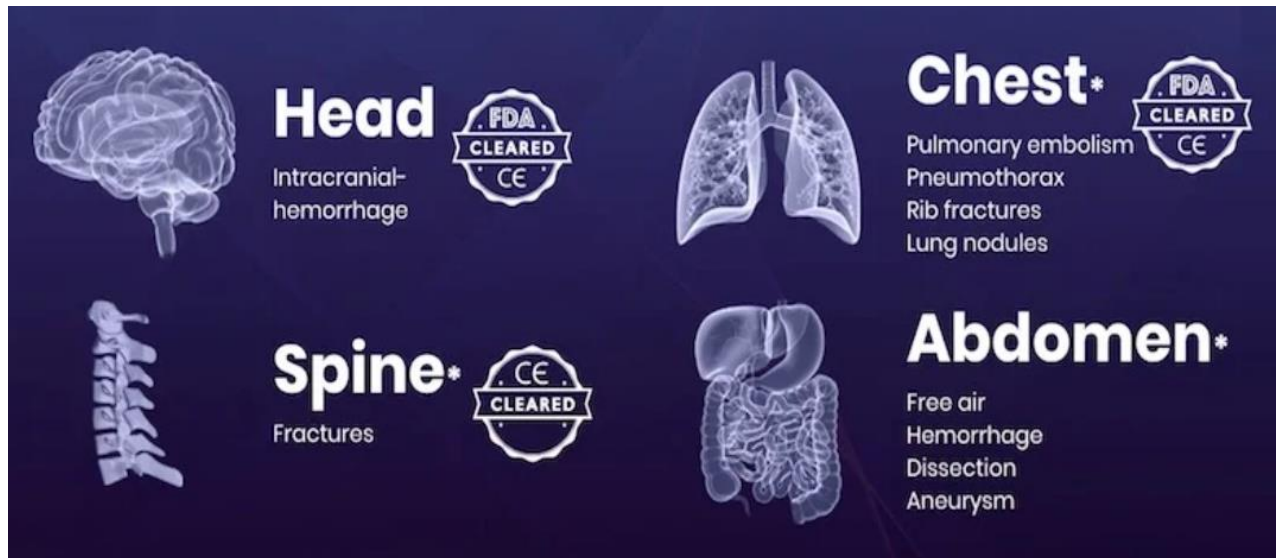


Priority	STAT	Patient Name	Patient MRN	Modality	Study Time	Hospital Location	Procedure
	STAT	Kiss, Michelle	12679436	CT	6:37pm (2 hr ago)	ED	Head
	STAT	Allen, Howard	40265167	CT	7:46am (89 min ago)	ED	Abdomen
2	STAT	Risk, Johnson	81945487	CT	7:55am (78 min ago)	Inpatient	Cervical-spine
		Wagner, Phil	81945448	CT	8:02am (57 min ago)	Outpatient	Abdomen
		Garcia, Howard	81945487	CT	8:28am (41 min ago)	Inpatient	Cervical-spine
		West, Sandy	54132180	MR	8:38 (30 min ago)	Outpatient	Cervical-spine
2		Lopez, Luis	28427001	CT	9:48 (22 min ago)	Inpatient	Abdomen
2		Patton, Simon	83340275	CT	9:57 (12 min ago)	Outpatient	Chest

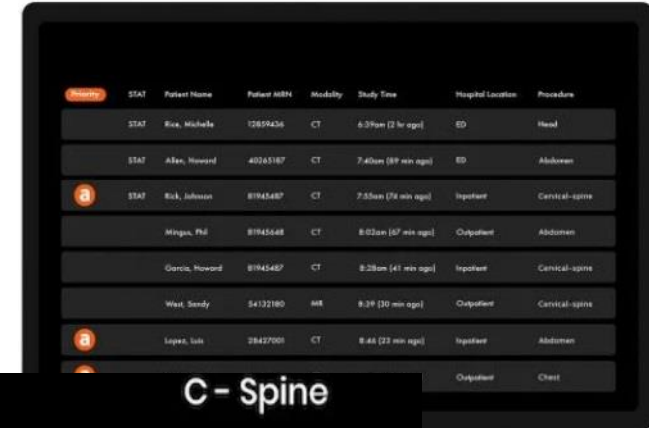


AI in imaging @ UZ Gent

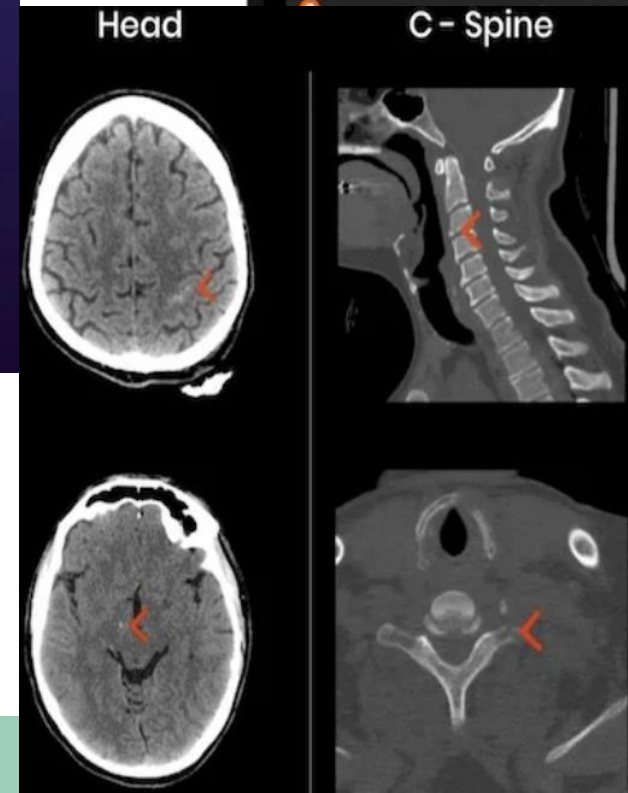
- FDA approved AI algorithm for **flagging of priority exams**



- False positives
- False negatives
- Expensive!
 - Annual fee
 - Limited licences (staff, residents, ...)



Priority	STAT	Patient Name	Patient MRN	Modality	Study Time	Hospital Location	Procedure
	STAT	Kiss, Michelle	12679436	CT	6:37pm (2 hr ago)	ED	Head
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		Lopez, Luis	28427001	CT	9:48 (22 min ago)	Inpatient	Abdomen
						Outpatient	Chest



Obstacles

- Most studies **small sample sizes and single institution**

European Radiology (2021) 31:9567–9578
<https://doi.org/10.1007/s00330-021-08021-6>

UROGENITAL



ESUR/ESUI position paper: developing artificial intelligence for precision diagnosis of prostate cancer using magnetic resonance imaging

Tobias Penzkofer^{1,2}  • Anwar R. Padhani³ • Baris Turkbey⁴ • Masoom A. Haider⁵ • Henkjan Huisman⁶ • Jochen Walz⁷ • Georg Salomon⁸ • Ivo G. Schoots^{9,10} • Jonathan Richenberg¹¹ • Geert Villeirs¹² • Valeria Panebianco¹³ • Olivier Rouviere^{14,15} • Vibeke Berg Logager¹⁶ • Jelle Barentsz⁶

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Abstract

Artificial intelligence developments are essential to the successful deployment of community-wide, MRI-driven prostate cancer diagnosis. AI systems should ensure that the main benefits of biopsy avoidance are delivered while maintaining consistent high specificities, at a range of disease prevalences. Since all current artificial intelligence / computer-aided detection systems for prostate cancer detection are experimental, multiple developmental efforts are still needed to bring the vision to fruition. Initial work needs to focus on developing systems as diagnostic supporting aids so their results can be integrated into the radiologists' workflow including gland and target outlining tasks for fusion biopsies. Developing AI systems as clinical decision-making tools will require greater efforts. The latter encompass larger multicentric, multivendor datasets where the different needs of patients stratified by diagnostic settings, disease prevalence, patient preference, and clinical setting are considered. AI-based, robust, standard operating

PI-CAI: AI versus radiologist

- Training of a cutting-edge stand-alone AI-system on 10.207 MRI-exams, including 2440 prostate cancers
- Detection of csPC on bpMRI
- Performance of AI versus 62 radiologists from 45 centers in 20 countries:
 - **AI beats radiologists in testcase without clinical info** (AUROC 0.91 versus 0.86)
 - **Radiologists beat AI when clinical info available** (medical history, clinical exam, PSA...)

Articles

Artificial intelligence and radiologists in prostate cancer detection on MRI (PI-CAI): an international, paired, non-inferiority, confirmatory study



Anindo Saha*, Joeran S Bosma*, Jasper J Twilt*, Bram van Ginneken, Anders Bjartell, Anwar R Padhani, David Bonekamp, Geert Villeirs, Georg Salomon, Gianluca Giannarini, Jayashree Kalpathy-Cramer, Jelle Barentsz, Klaus H Maier-Hein, Mirabela Rusu, Olivier Rouvière, Roderick van den Bergh, Valeria Panebianco, Veeru Kasivisvanathan, Nancy A Obuchowski, Derya Yakar, Mattijs Elschot, Jeroen Veltman, Jorgen J Fütterer, Maarten de Rooij†, Henkjan Huisman†, on behalf of the PI-CAI consortium‡

Summary

Background Artificial intelligence (AI) systems can potentially aid the diagnostic pathway of prostate cancer by alleviating the increasing workload, preventing overdiagnosis, and reducing the dependence on experienced radiologists. We aimed to investigate the performance of AI systems at detecting clinically significant prostate cancer on MRI in comparison with radiologists using the Prostate Imaging—Reporting and Data System version 2.1 (PI-RADS 2.1) and the standard of care in multidisciplinary routine practice at scale.

Methods In this international, paired, non-inferiority, confirmatory study, we trained and externally validated an AI system (developed within an international consortium) for detecting Gleason grade group 2 or greater cancers using a retrospective cohort of 10 207 MRI examinations from 9129 patients. Of these examinations, 9207 cases from three centres (11 sites) based in the Netherlands were used for training and tuning, and 1000 cases from four centres (12 sites) based in the Netherlands and Norway were used for testing. In parallel, we facilitated a multireader, multicase observer study with 62 radiologists (45 centres in 20 countries; median 7 [IQR 5–10] years of experience in reading prostate MRI) using PI-RADS (2.1) on 400 paired MRI examinations from the testing cohort. Primary endpoints were the sensitivity, specificity, and the area under the receiver operating characteristic curve (AUROC) of the AI system in comparison with that of all readers using PI-RADS (2.1) and in comparison with that of the historical radiology readings made during multidisciplinary routine practice (ie, the standard of care with the aid of patient history and peer consultation). Histopathology and at least 3 years (median 5 [IQR 4–6] years) of follow-up were used to establish the reference standard. The statistical analysis plan was prespecified with a primary hypothesis of non-inferiority (considering a margin of 0.05) and a secondary hypothesis of superiority towards the AI system, if non-inferiority was confirmed. This study was registered at ClinicalTrials.gov, NCT05489341.

Lancet Oncol 2024; 25: 879–87

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See [Comment](#) page 827

*Joint first authors

†Contributed equally

‡For the complete list of the PI-CAI consortium members see the appendix (pp 1–2)

Diagnostic Image Analysis Group (A Saha MSc, J S Bosma MSc, Prof B van Ginneken PhD, Prof H Huisman PhD) and **Minimally Invasive Image-Guided Intervention Center** (A Saha, JJ Twilt MSc, Prof J J Fütterer MD), **Department of Medical Imaging** (M de Rooij MD), Radboud University Medical Center, Nijmegen, Netherlands

PARADIGM: AI in prostate cancer diagnosis on MRI

- Prostate MRI Analysis by Radiologists and Artificial intelligence – Disease Identification and Guided Management
- a 500-patient, prospective, international, within-patient, multicentre, level 1–evidence clinical trial
- **to evaluate whether AI is noninferior to radiologists in the diagnosis of clinically significant prostate cancer**
- will help to understand how radiologists might best interact with AI

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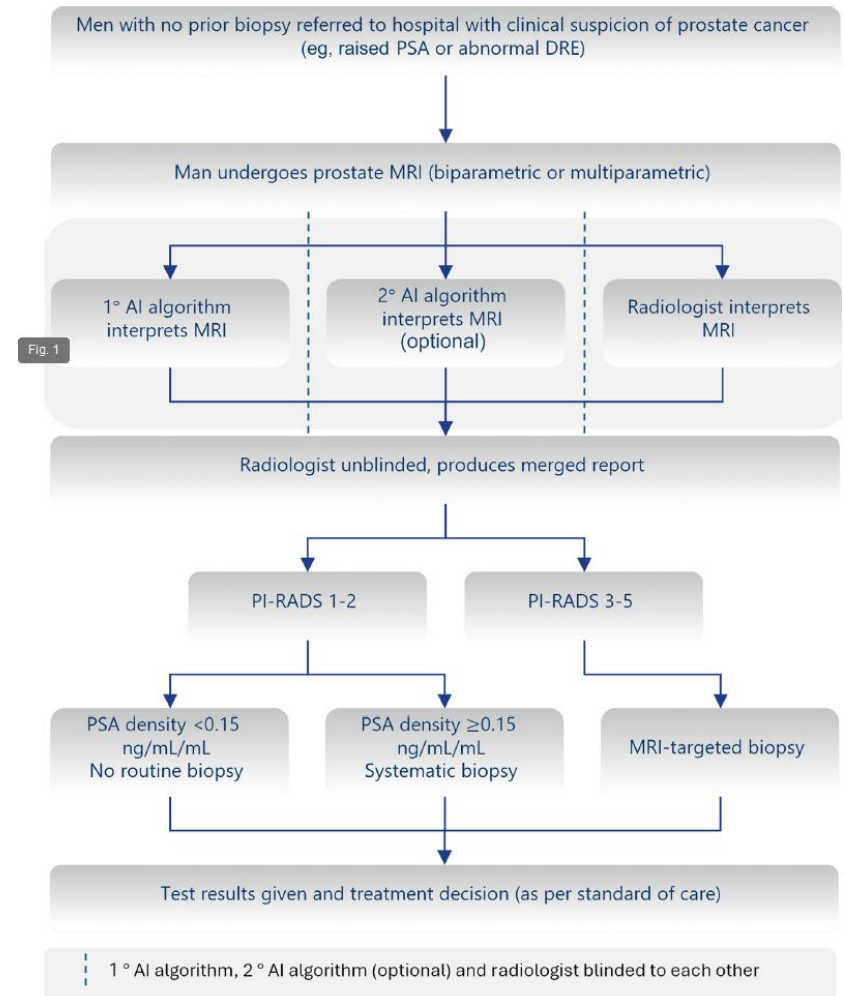
 **EAU**
European Association of Urology

Editorial

Artificial Intelligence in Prostate Cancer Diagnosis on Magnetic Resonance Imaging: Time for a New PARADIGM

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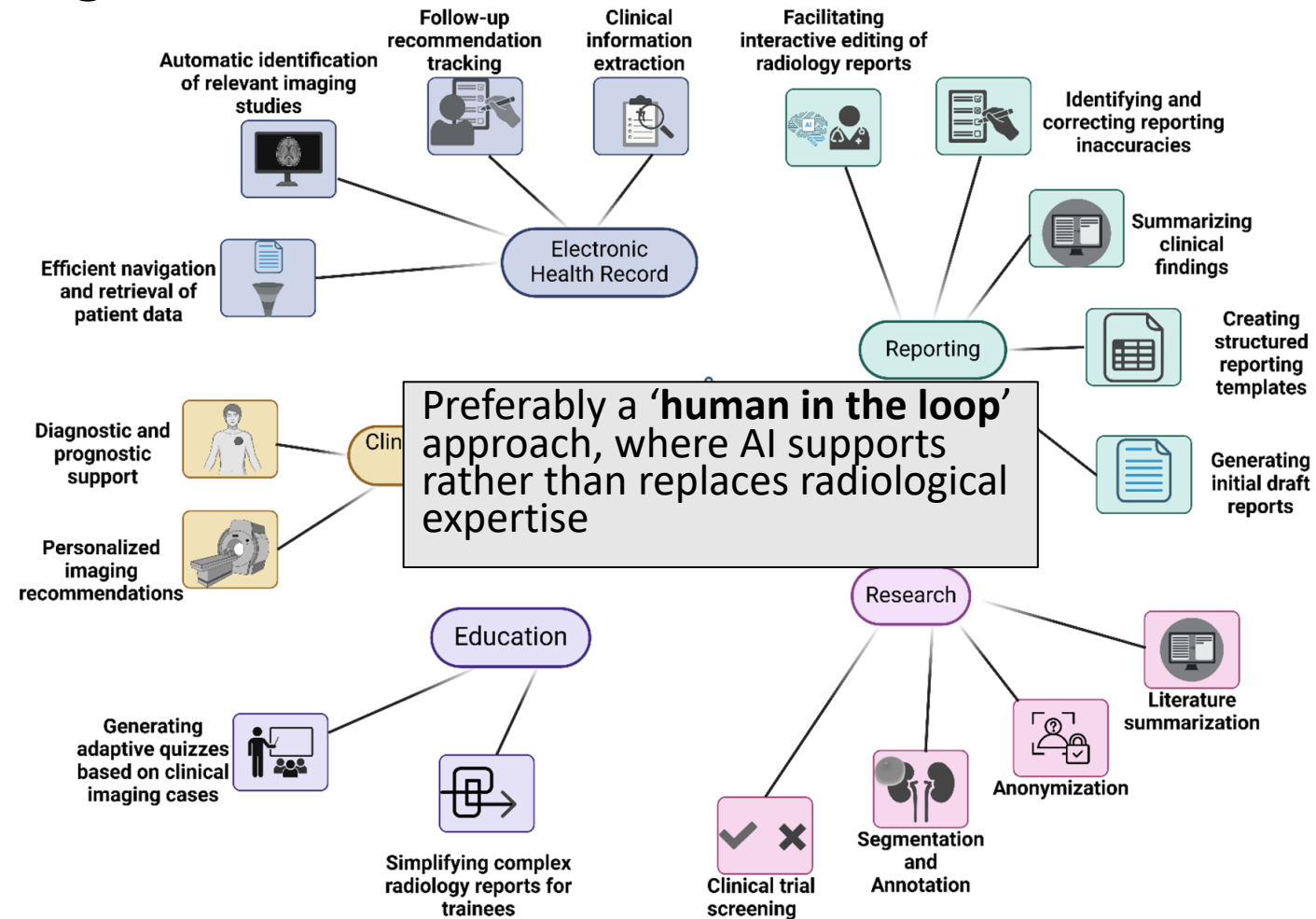
Focus on AI in imaging

Conclusion



Conclusion

- AI in medical imaging is promising
 - better image quality
 - faster workflow
 - but still many obstacles before radiologist can be sent to



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MY

AWESOME

RADIOLOGIST

Focus on AI in imaging



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