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How will AI reshape the future of prostate cancer pathway?

Professor Bertrand Tombal, MD, PhD

Cliniques universitaires Saint-Luc
Université catholique de Louvain
Brussels, Belgium

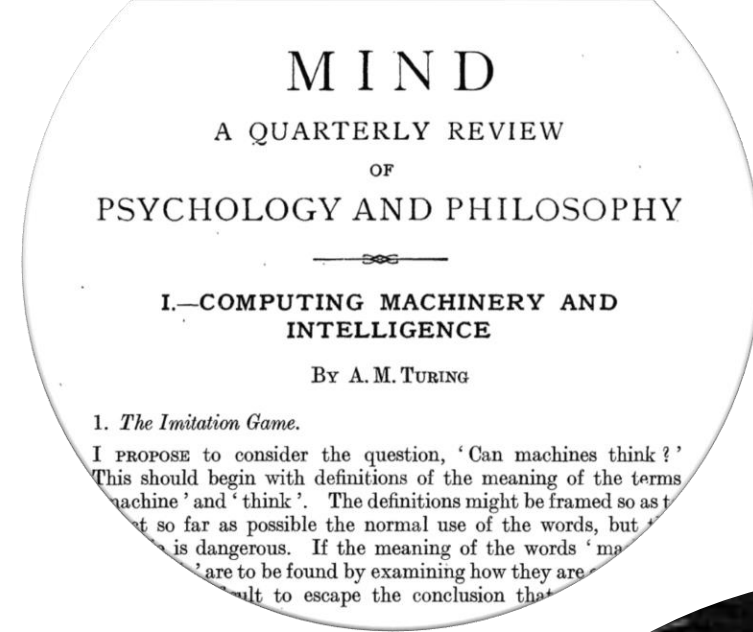
Credentials and conflict of interests

- Professor and Chairman, Division of Urology, Cliniques universitaires Saint Luc, Brussels, BE
- Past-President, European Organization Of Research and Treatment of Cancer (EORTC)
- Investigator and paid advisor for Accord, Amgen, Astellas, Bayer, Janssen, Ferring, Pfizer, Sanofi, Myovant.
- This presentation reflects the personal view of Bertrand TOMBAL

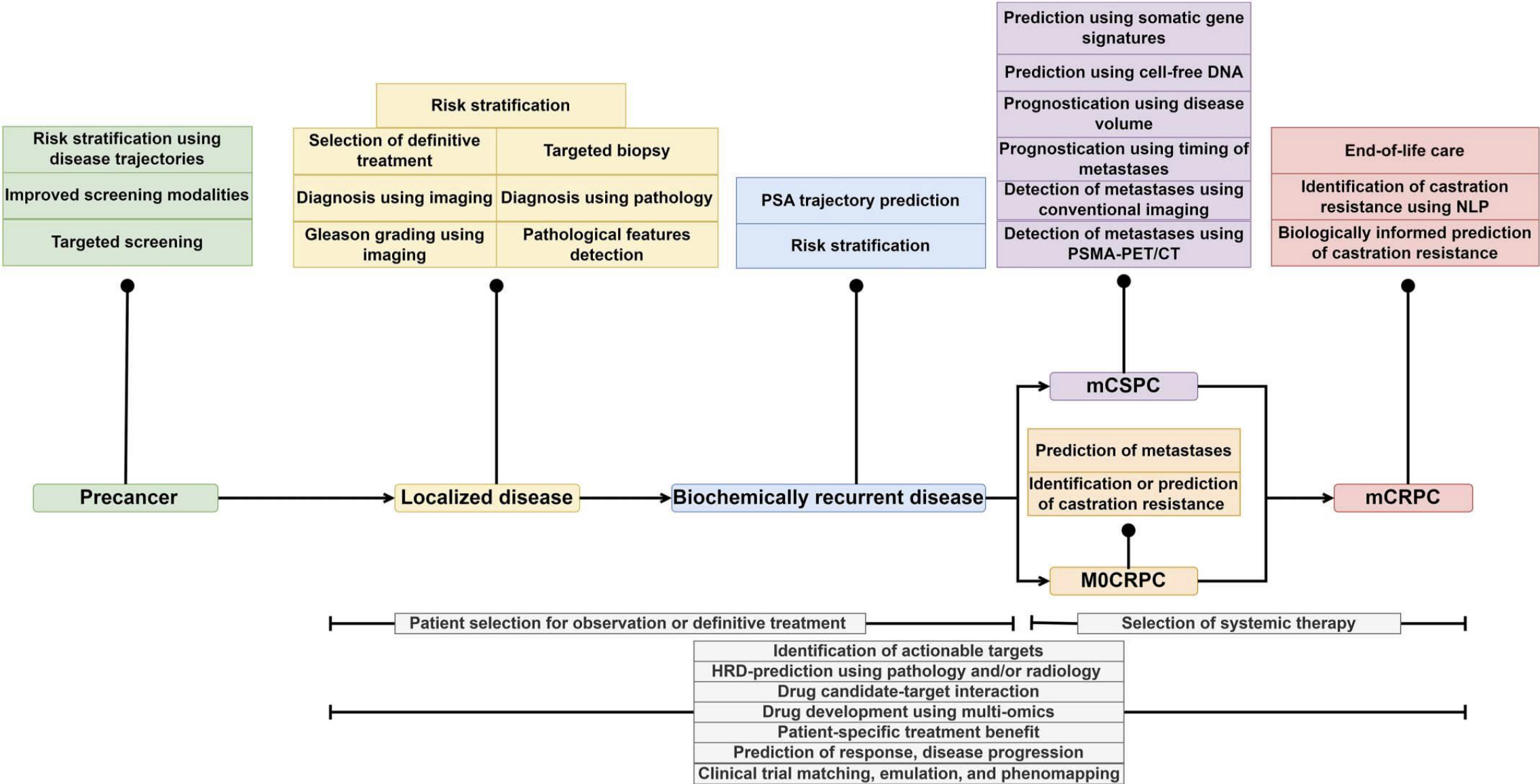
- "We normally associate punishments and rewards with the teaching process. Some simple child-machines can be constructed or programmed on this sort of principle. The machine has to be so constructed that events which shortly preceded the occurrence of a punishment-signal are unlikely to be repeated, whereas a reward-signal increased the probability of repetition of the events which led up to it."

- "An important feature of a learning machine is that its teacher will often be very largely ignorant of quite what is going on inside, although he may still be able to some extent to predict his pupil's behaviour."

- ***A.M. Turing (1950)***



Patient's journey in prostate cancer and AI opportunities



Localized Disease

Biochemically Recurrent Disease

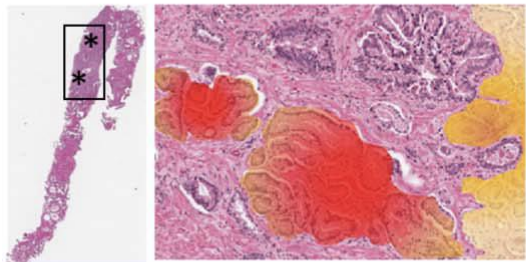
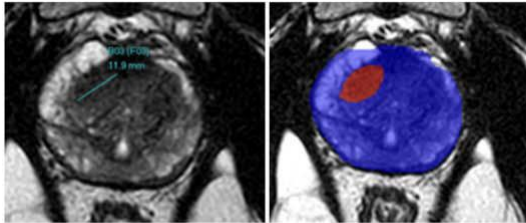
Metastatic Disease

Castrate-Sensitive

Castrate-Resistant

Detection and diagnosis

- Targeted biopsy
- Cancer detection
- Cancer grading
- Cancer staging

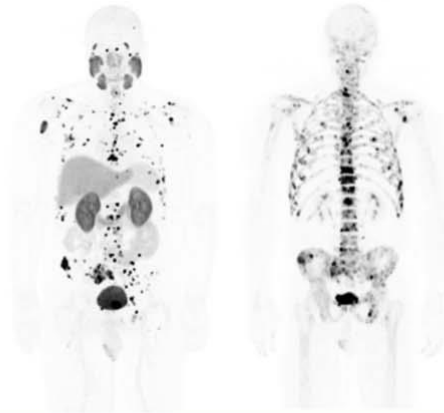


Treatment decision

- Need for treatment
- Selection of definitive treatment modality

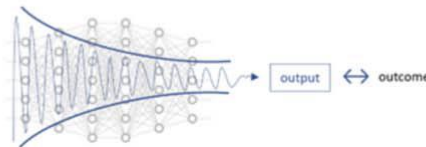
Risk prediction/prognostication

- Prediction of biochemical recurrence
- Prognostic categorization



Drug development

- Drug sensitivity
- Drug resistance



Diagnosis

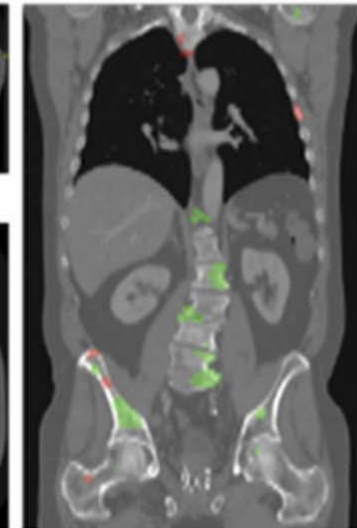
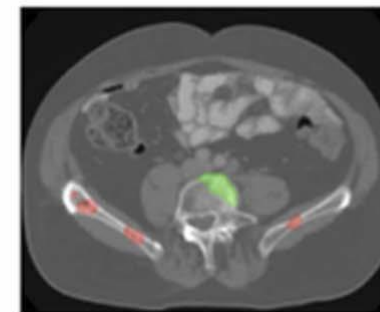
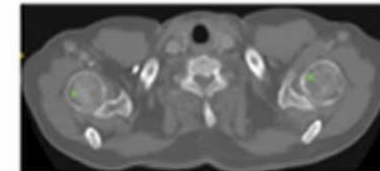
- Detection of metastases
- Detection of castration resistance

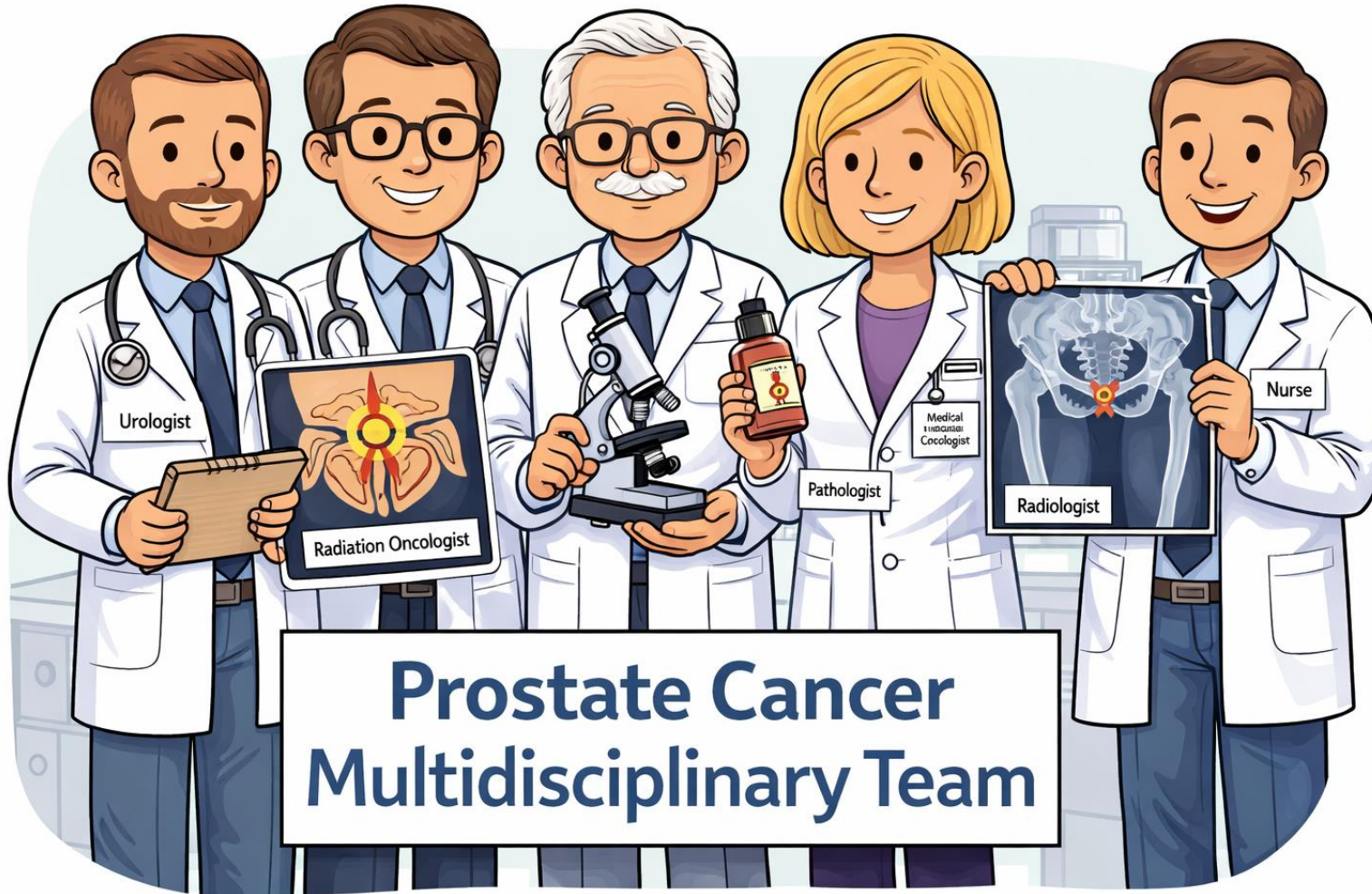
Prognostication

- Risk categorization using:
 - Volume of disease
 - Timing of metastatic presentation

Outcomes ascertainment

- PSA progression
- Radiographic progression
- Treatment response





Who will survive
the AI revolution?



PSA-based machine learning model improves prostate cancer risk stratification in a screening population

Marlon Perera^{1,2,3} · Rohan Mirchandani⁵ · Nathan Papa^{2,4} · Geoff Breemer⁵ · Anna Effeindzourou⁵ · Lewis Smith⁵ · Peter Swindle^{1,5} · Elliot Smith⁵

Can AI help identify who needs a prostate MRI?

- 4548 patients from the PLCO database
- A machine learning model was developed and trained using PSA, free-PSA, age, and the free-PSA-to-total PSA (FTR) ratio.

Can AI help identify who needs a prostate MRI?

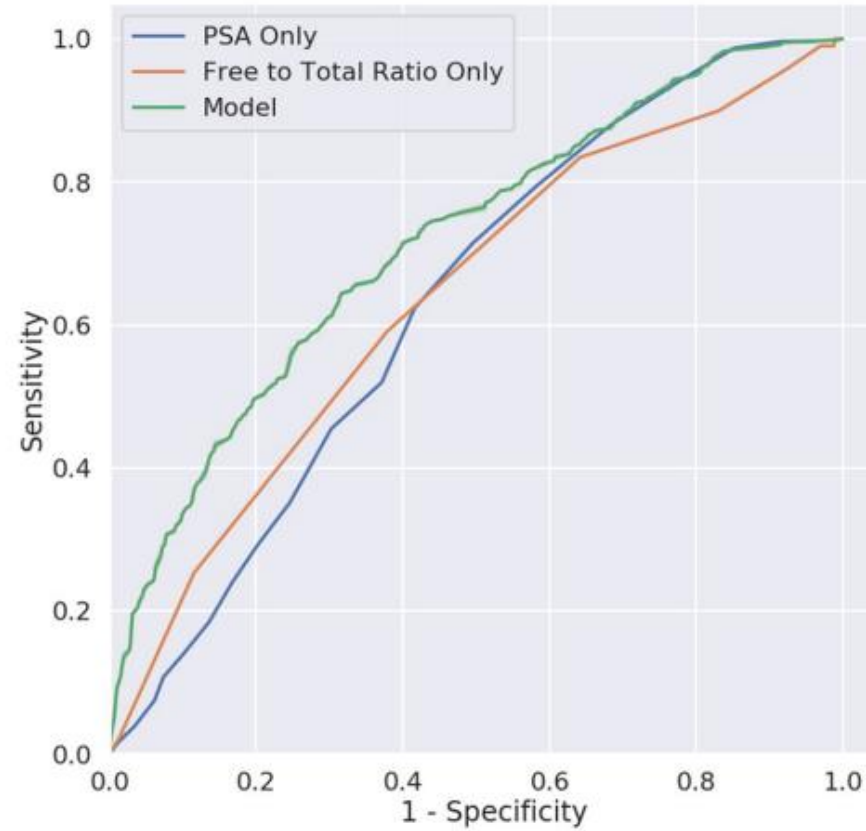


Fig. 2 Receiver operating characteristic curve for the model, PSA and the free-to-total ratio

Do you need a
radiologist to read the
MRI?

Original Investigation | Oncology

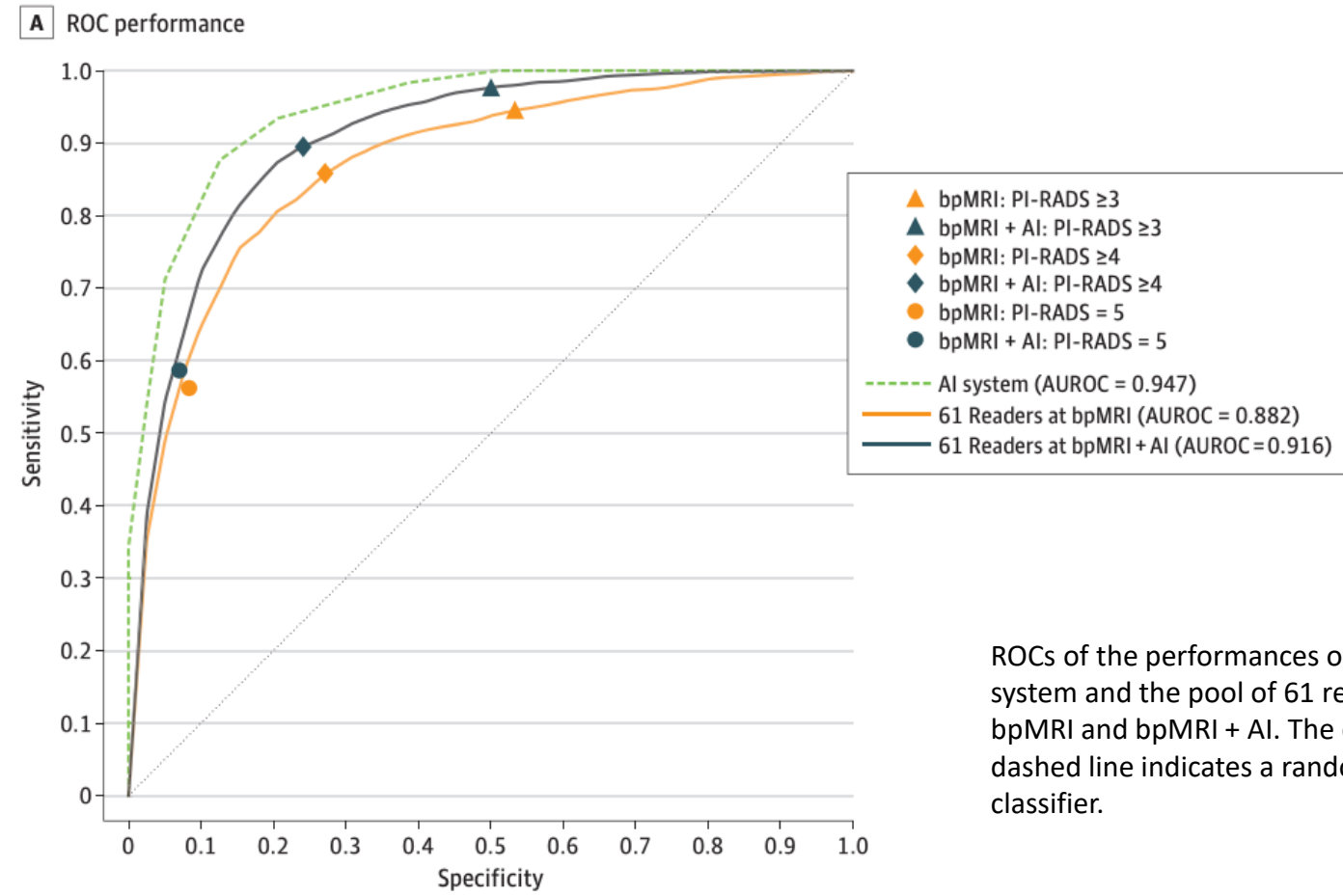
AI-Assisted vs Unassisted Identification of Prostate Cancer in Magnetic Resonance Images

Jasper J. Twilt, MSc; Anindo Saha, MSc; Joeran S. Bosma, MSc; Anwar R. Padhani, MD; David Bonekamp, MD; Gianluca Giannarini, MD; Roderick van den Bergh, MD; Veeru Kasivisvanathan, MD; Nancy Obuchowski, PhD; Derya Yakar, MD; Mattijs Elschot, PhD; Jeroen Veltman, MD; Jurgen Fütterer, MD; Henkjan Huisman, PhD; Maarten de Rooij, MD; for the PI-CAI Consortium

- 61 readers (34 experts and 27 nonexperts) from 53 centres across 17 countries
- Biparametric prostate MRI examinations were included for 780 men from the PI-CAI study who were included in the newly conducted observer study.

Do you need a radiologist to read the MRI?

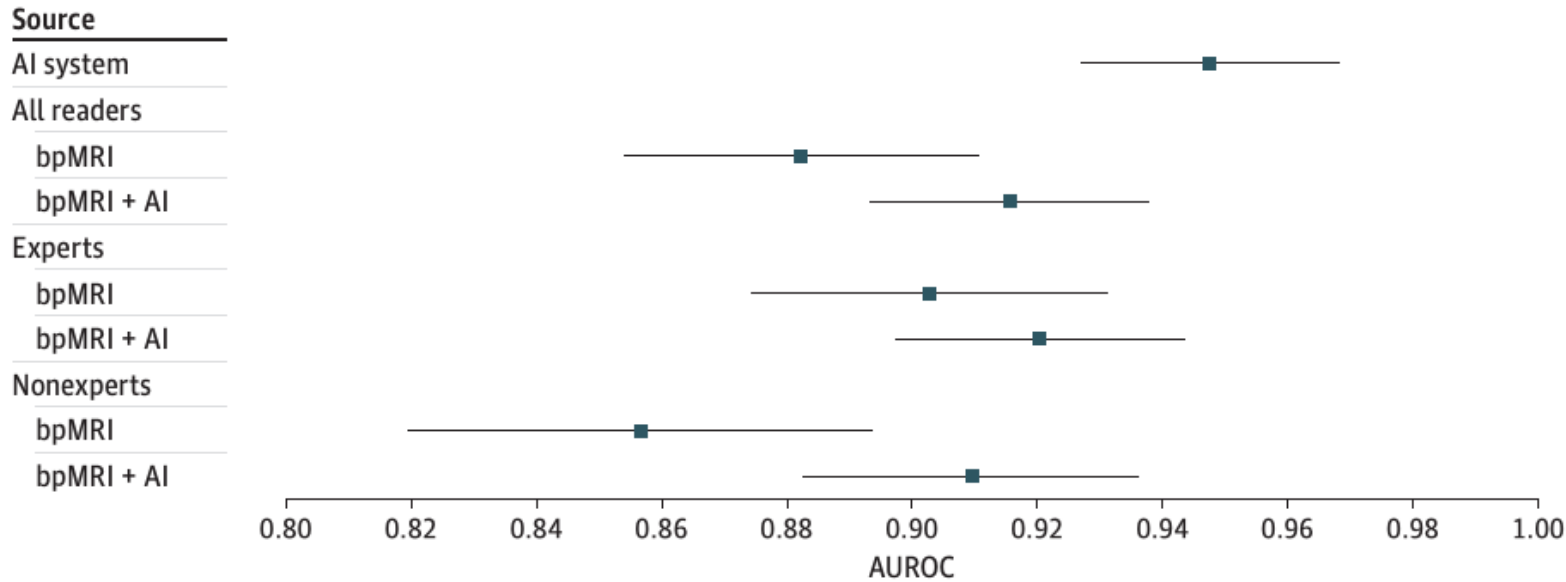
Figure 1. The Area Under the Receiver Operating Characteristic Curve (AUROC) Diagnostic Performance at Biparametric Magnetic Resonance Imaging (bpMRI) and at bpMRI With Artificial Intelligence Assistance (bpMRI + AI)



ROCs of the performances of the AI system and the pool of 61 readers at bpMRI and bpMRI + AI. The diagonal dashed line indicates a random classifier.

Do you need a radiologist to read the MRI?

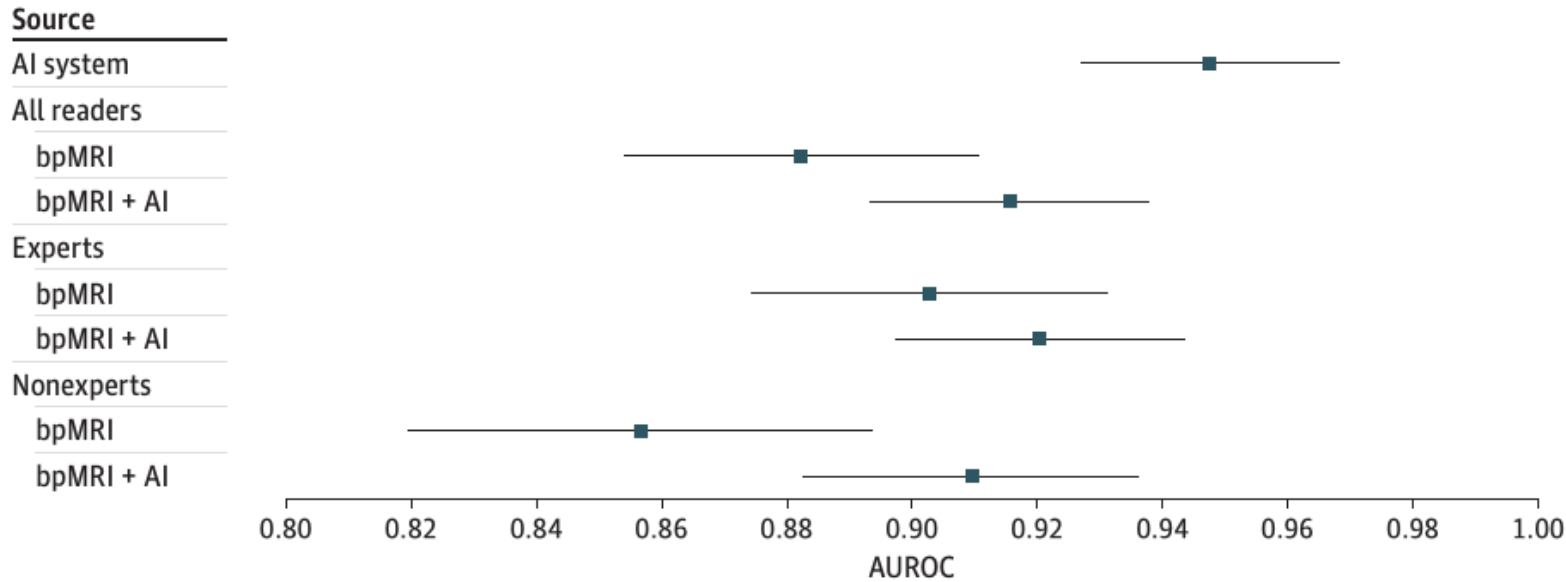
B AUROC performance



AUROC performance for the stand-alone AI system, all readers (N = 61), and subgroups considering expert (n = 34) and nonexpert (n = 27) readers for assessment made at bpMRI and bpMRI + AI at a Prostate Imaging Reporting and Data System (PI-RADS) score of 3 or more.

Do you need a radiologist to read the MRI?

B AUROC performance



AUROC performance for the stand-alone AI system, all readers (N = 61), and subgroups considering expert (n = 34) and nonexpert (n = 27) readers for assessment made at bpMRI and bpMRI + AI at a Prostate Imaging Reporting and Data System (PI-RADS) score of 3 or more.

Do you need a
radiologist to read the
MRI?

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

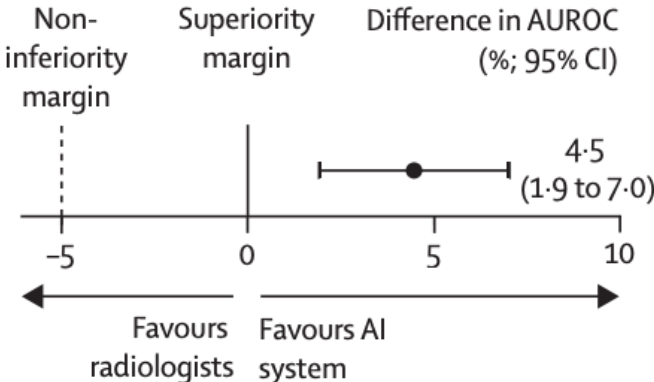
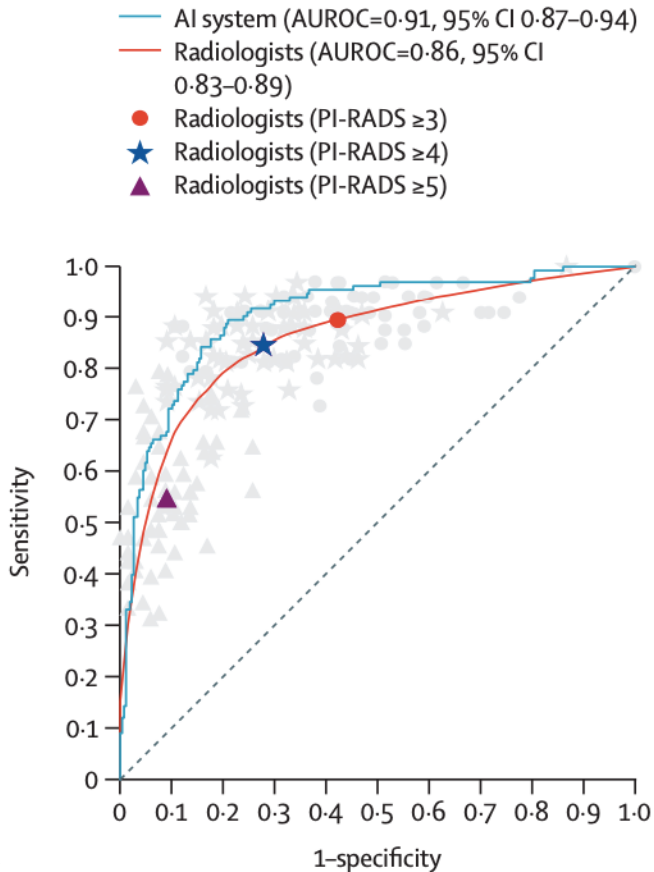
[Anindo Saha, MSc](#) ^{a,b,*}  · [Joeran S Bosma, MSc](#)^{a,*} · [Jasper J Twilt, MSc](#)^{b,*} · [Prof Bram van Ginneken, PhD](#)^a · [Prof Anders Bjartell, MD](#)^{d,e} · [Prof Anwar R Padhani, MD](#)^f · et al. [Show more](#)

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- Externally validated an AI system Gleason grade group 2 or greater cancers using a retrospective cohort of 10207 MRI examinations from 9129 patients.
- 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.
- Multireader, multcase 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) a

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

ROC curves of the AI system and the pool of 62 radiologists,

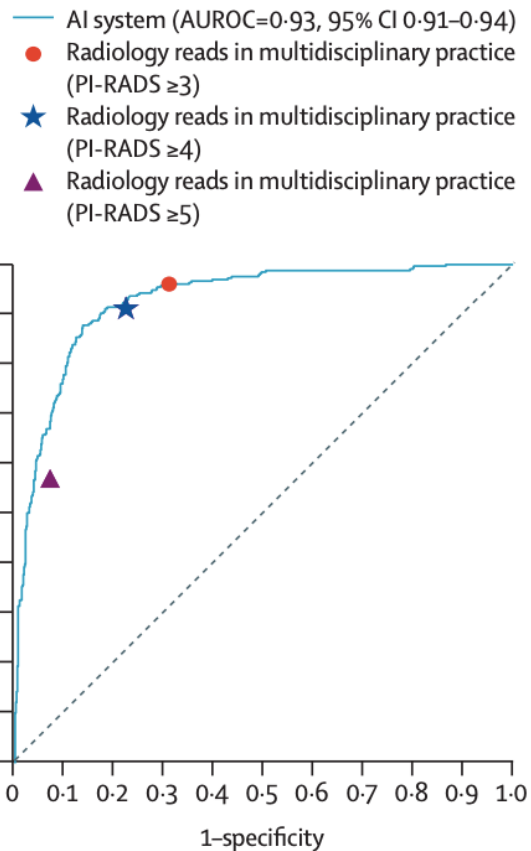


Difference in the AUROC metric between the AI system and the pool of 62 radiologists.

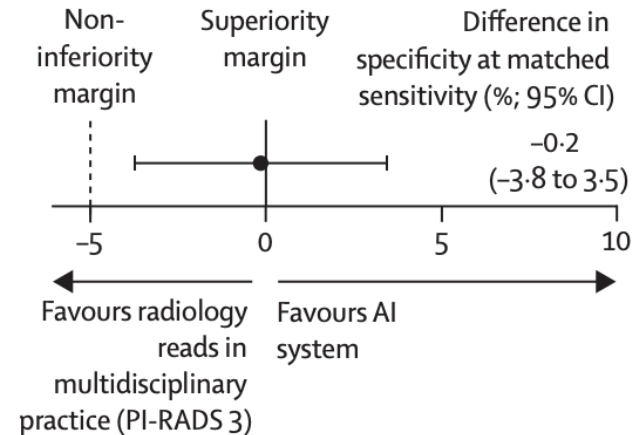
- The AI system showed a statistically superior and non-inferior AUROC of 0.91 (95% CI 0.87–0.94; $p < 0.0001$), in comparison to the pool of 62 radiologists with an AUROC of 0.86 (0.83–0.89).
- At the mean PI-RADS ≥ 3 operating point of all readers, the AI system detected 6.8% more cases with Gleason grade group ≥ 2 at the same specificity (57.7%, 95% CI 51.6–63.3), or 50.4% fewer false-positive results and 20.0% fewer cases with Gleason grade group 1 cancer at the same sensitivity (89.4%, 95% CI 85.3–92.9).

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

ROC curve of the AI system and the PI-RADS operating points of the radiology routine



D



- When the AI system was compared with the radiology readings made during multidisciplinary practice, non-inferiority was not confirmed; lower specificity (68.9% [95% CI 65.3–72.4] vs 69.0% [65.5–72.5]) at the same sensitivity (96.1%, 94.0–98.2) as the PI-RADS 3 or greater operating point.
- The lower boundary of the two-sided 95% Wald CI for the difference in specificity (-0.04) was greater than the non-inferiority margin (-0.05) and a p value below the significance threshold was reached ($p < 0.001$).

Do you need
a biopsy?

RESEARCH

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Automated machine learning for prostate cancer detection and Gleason score prediction using T2WI: a diagnostic multi-center study

Liang Jin^{1,2,3†}, Zhuangxuan Ma^{1†}, Feng Gao¹, Ming Li^{1*}, Haiqing Li^{2*} and Daoying Geng^{2*}

- Single-modality T2-weighted imaging (T2WI) with an automatic machine-learning (ML) approach, MLJAR.
- The internal MRI dataset included 198 non-PCa and 291 PCa patients with histopathological results obtained through biopsy or surgery. External and public challenge datasets included 45 and 68 PCa patients, respectively.

Do you need
a biopsy?

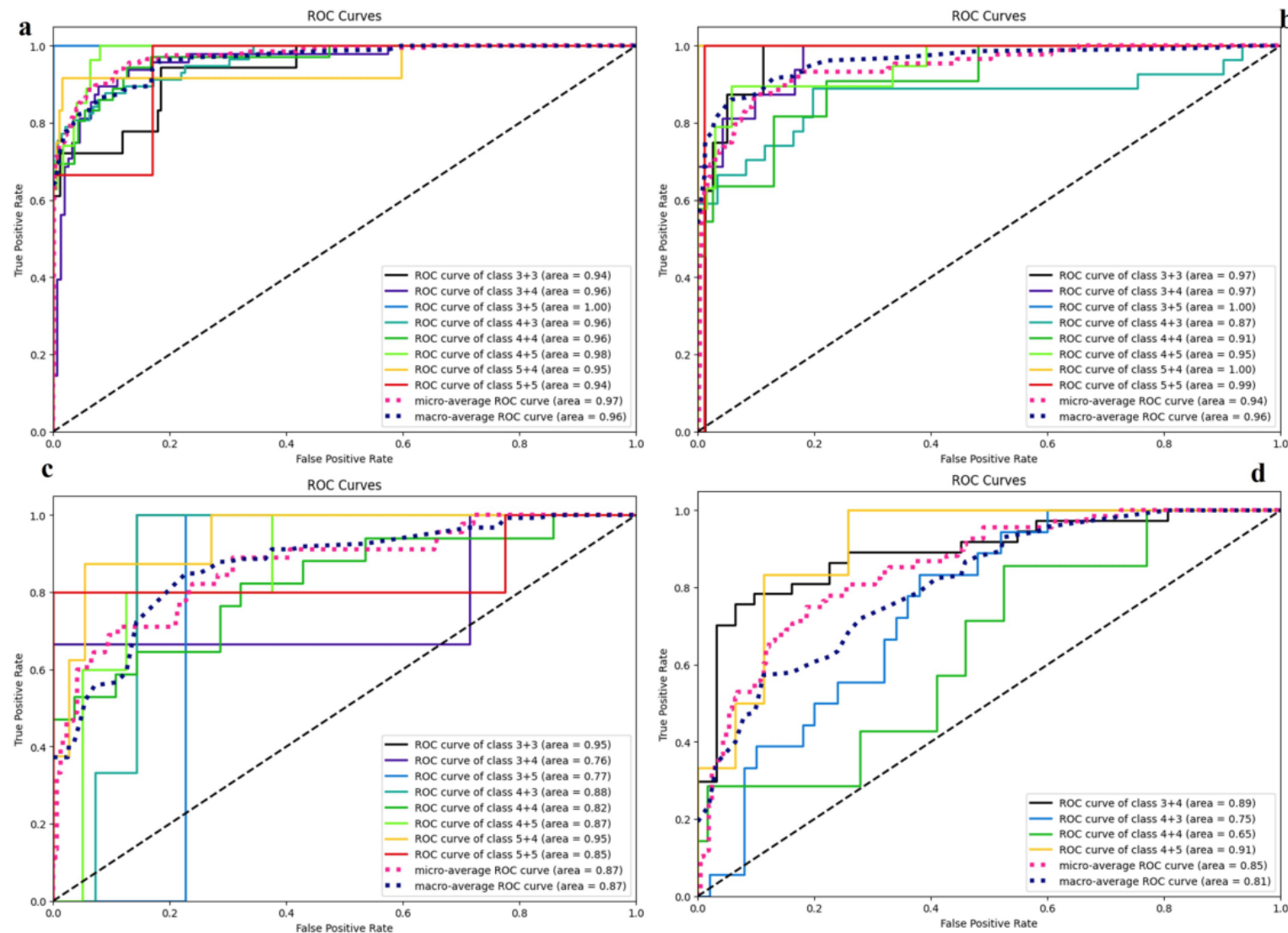


Fig. 5 ROC curves of the GS prediction model. **a** Internal training dataset (PCa=203), **(b)** internal test dataset (PCa=88), **(c)** external test dataset (PCa=45), and **(d)** public challenge test dataset (PCa=68). PCa, prostate cancer; ROC, receiver operating characteristic; GS, Gleason score

Can you automate
the biopsy ?



Do you need the
pathologist ?

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Artificial intelligence assistance significantly improves Gleason grading of prostate biopsies by pathologists

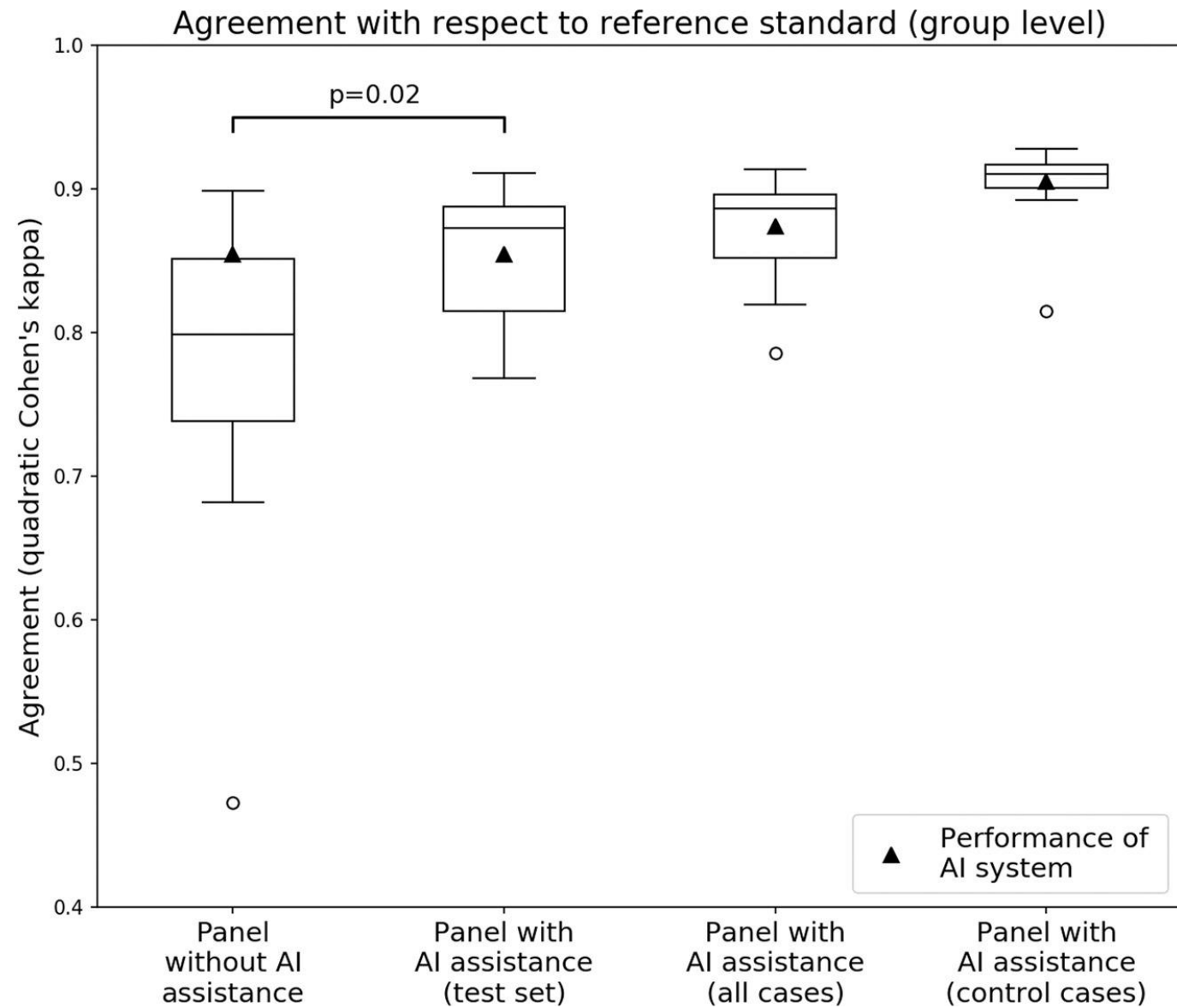
[Wouter Bulten](#)¹  · [Maschenka Balkenhol](#)¹ · [Jean-Joël Awoumou Belinga](#)² · ... · [John R. Srigley](#)³⁸ · [Hiroyuki Takahashi](#)³⁹ · [Theo van der Kwast](#)²¹ ... [Show more](#)

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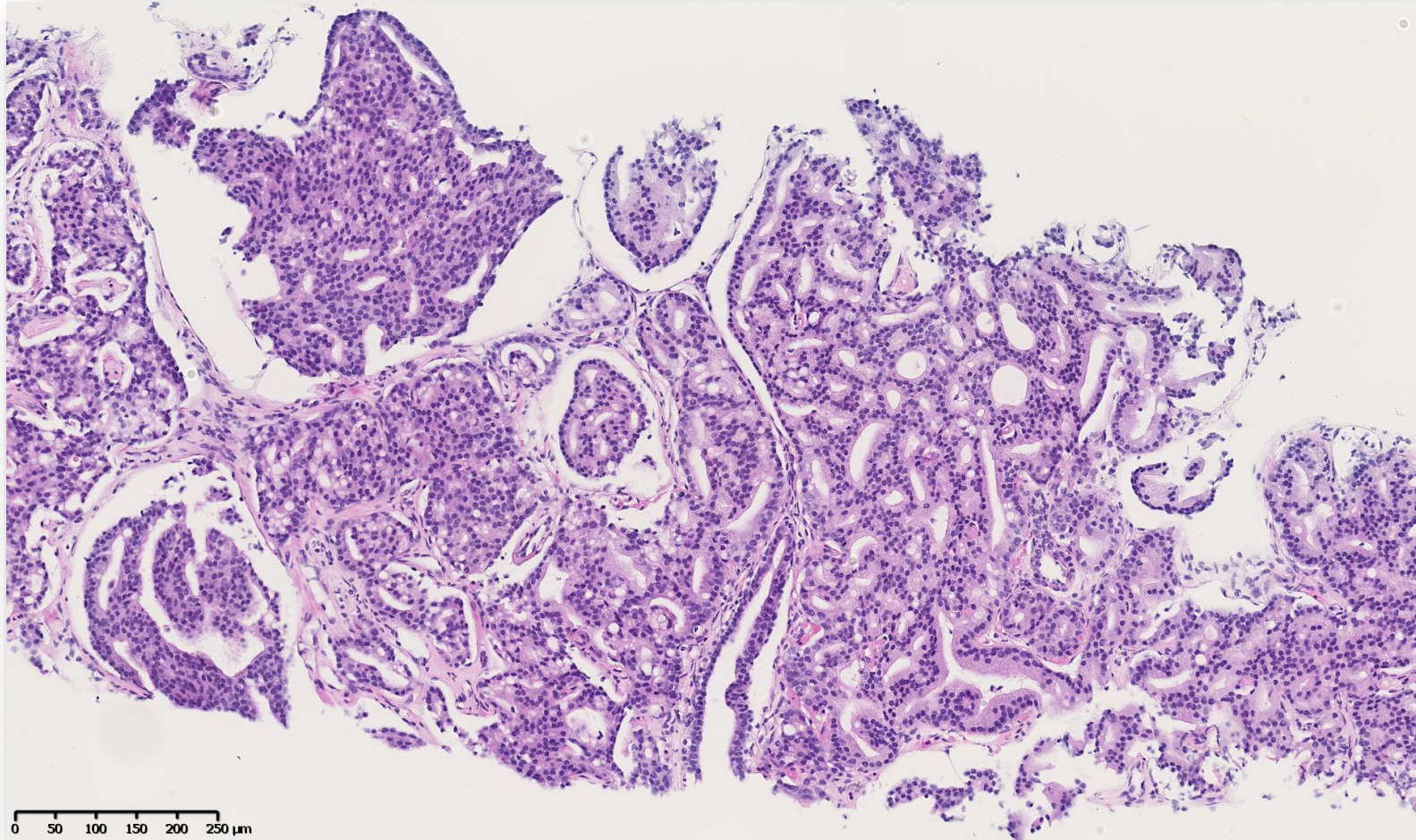
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- A panel of 14 observers have graded 160 biopsies with and without AI assistance.

Do you need the pathologist ?



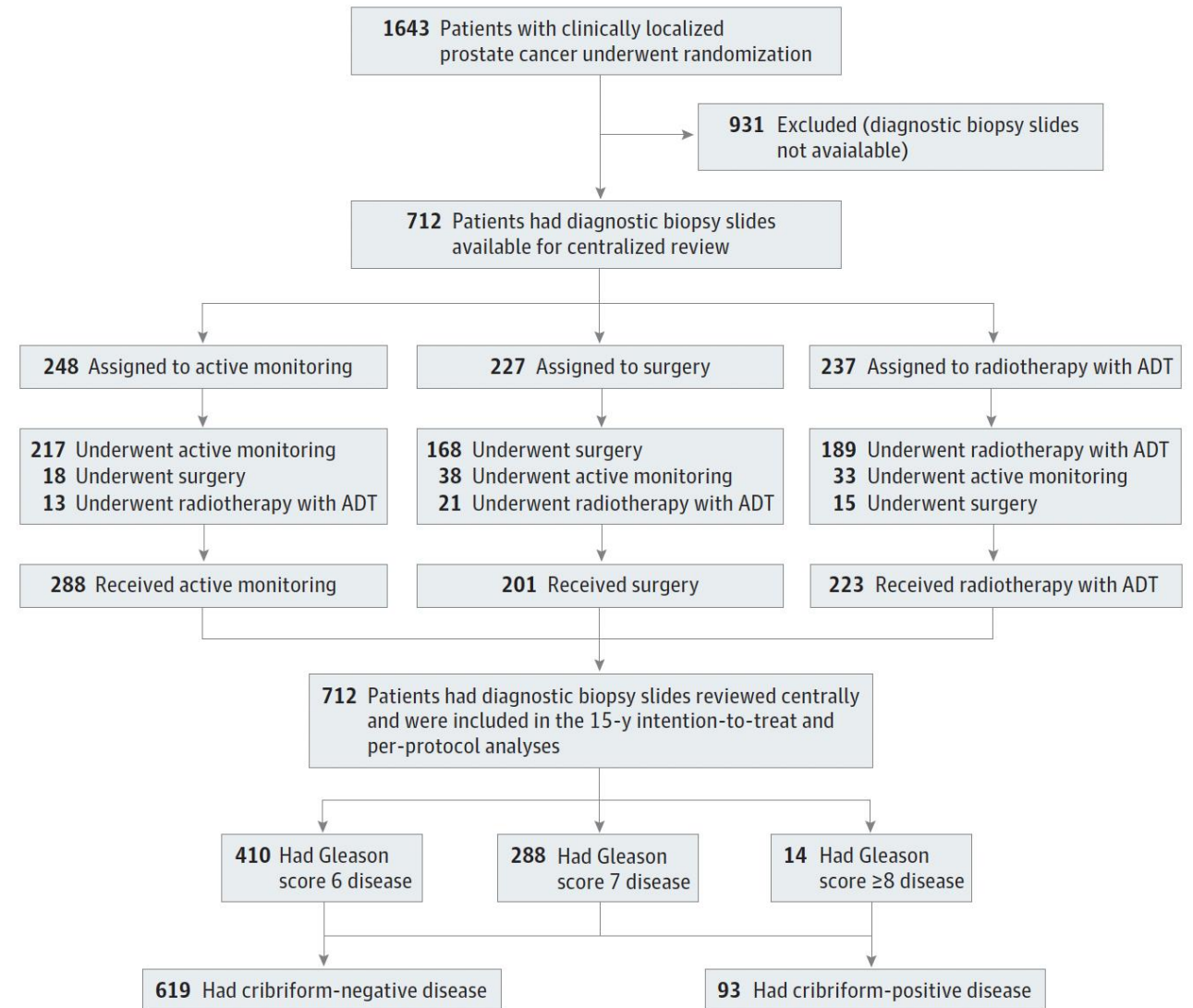
The cribriform pattern



- Originally described by Gleason in his seminal paper⁽¹⁾.
- Later associated to poor outcome⁽²⁾

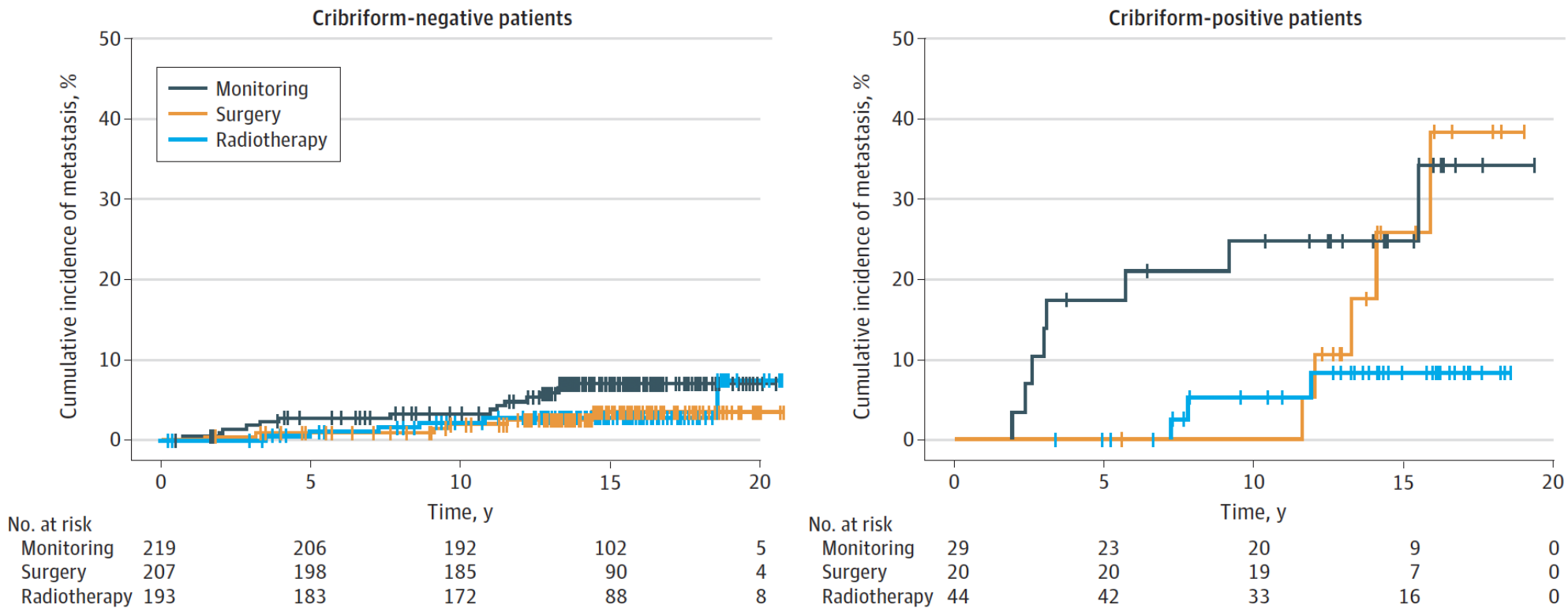
Active Monitoring, Surgery, and Radiotherapy for Cribriform-Positive and Cribriform-Negative PCa; A Secondary Analysis of the PROTECT Randomized Clinical Trial

Figure 1. Study Flow Diagram



PROTECT: risk of metastasis

B Cumulative incidence analysis



A, Multivariable Cox proportional hazards regression analysis of the intention-to-treat cohort. Prostate-specific antigen (PSA) values were log-transformed. To convert PSA to $\mu\text{g/L}$, multiply by 1.0. B, Cumulative

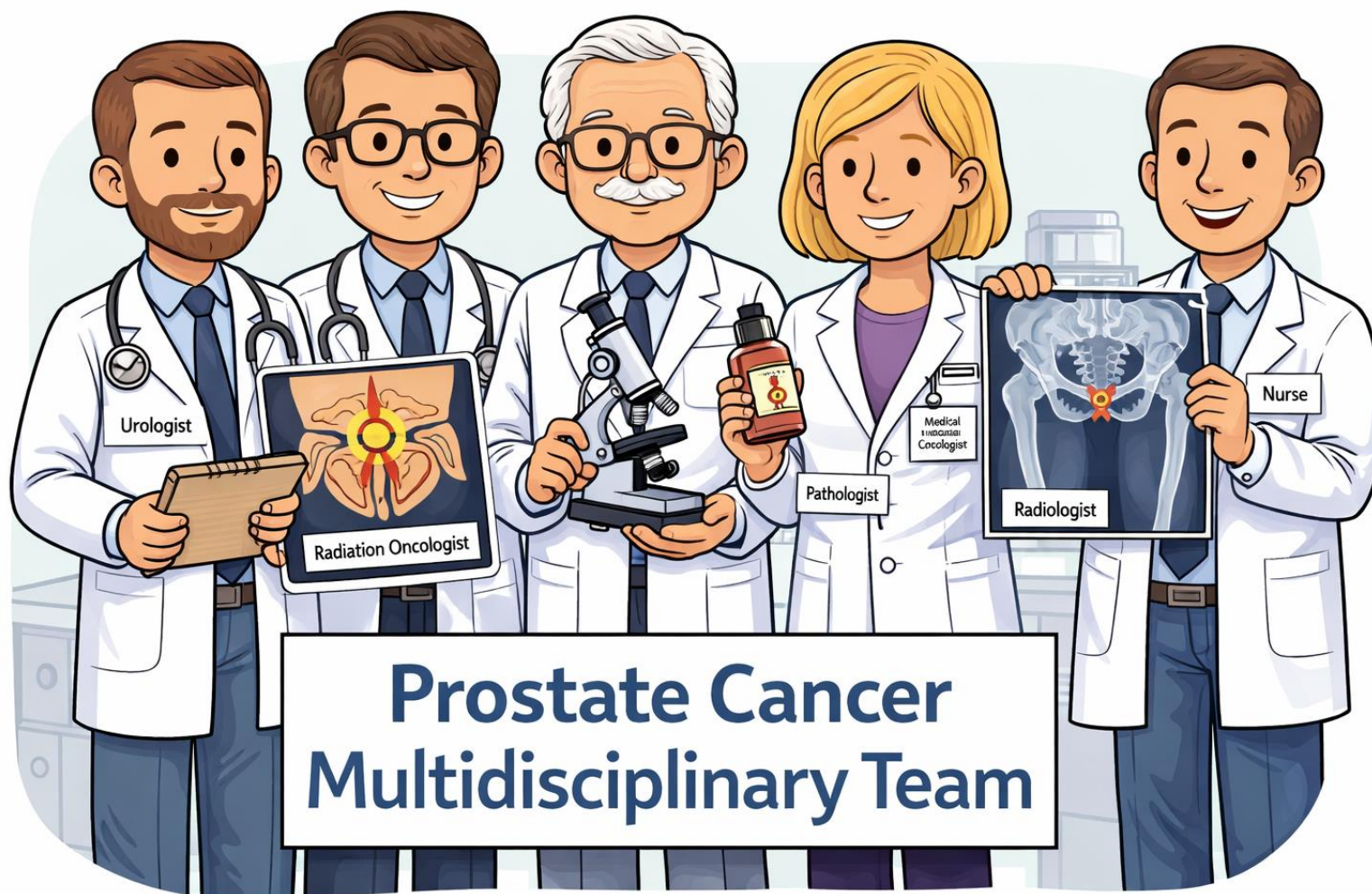
incidence analysis of the intention-to-treat cohort. Cumulative incidence curves for individual groups are provided in eFigure 4 in Supplement 2. ADT indicates androgen deprivation therapy; HR, hazard ratio.

Inter-observer variability of cribriform architecture and percent Gleason pattern 4 in prostate cancer: relation to clinical outcome.

From: Inter-observer variability of cribriform architecture and percent Gleason pattern 4 in prostate cancer: relation to clinical outcome

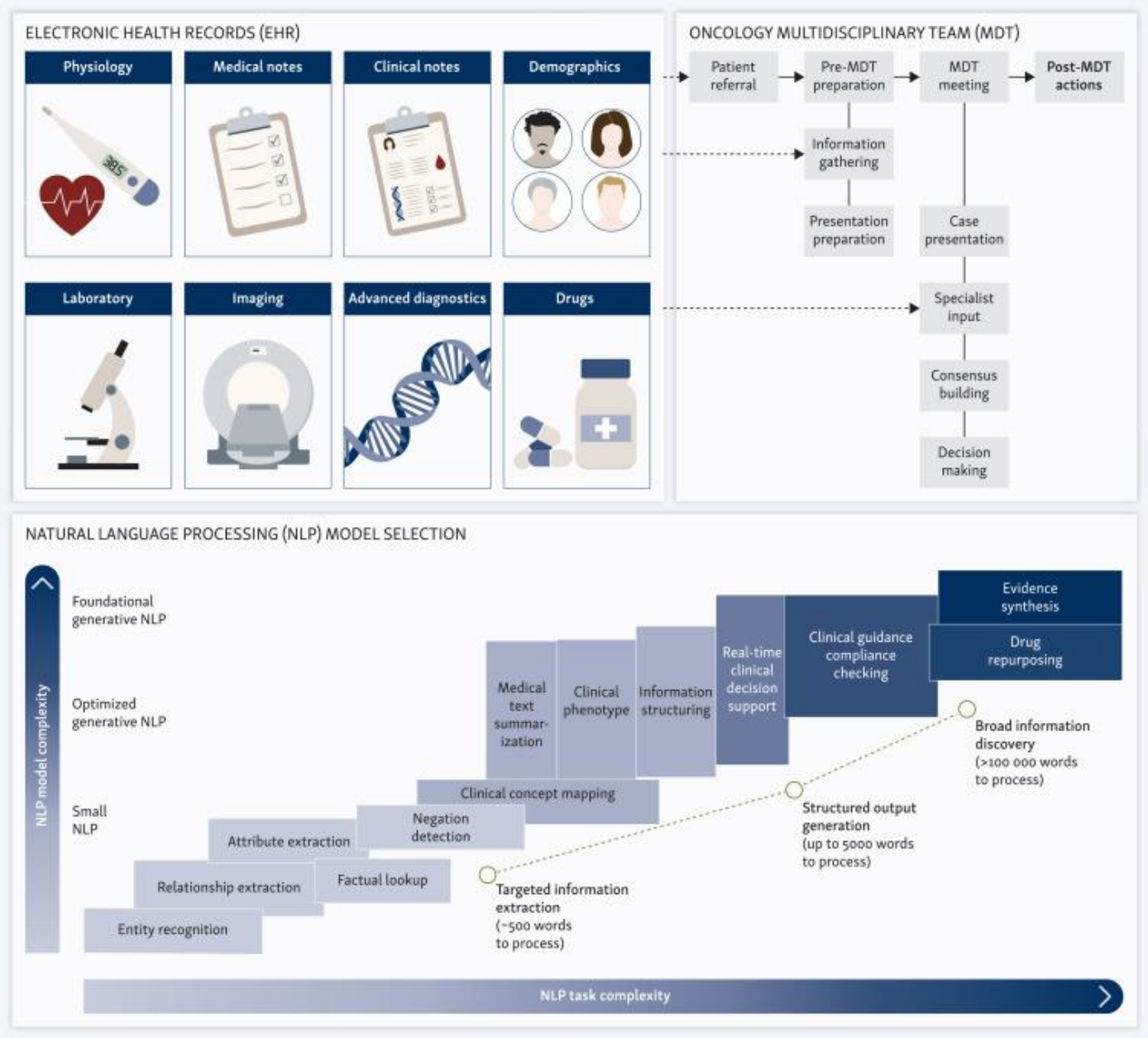
Pathologic parameter	Observer agreement					α
	2/6	3/6	4/6	5/6	6/6	
Grade group	1 (1%)	22 (28%)	29 (36%)	20 (25%)	8 (10%)	0.626
CR/IDC	–	3 (4%)	15 (19%)	22 (28%)	40 (50%)	0.507
Percent pattern 4	8 (10%)	26 (33%)	12 (15%)	13 (16%)	21 (26%)	0.551
Percent pattern 5	–	5 (6%)	13 (16%)	12 (15%)	50 (63%)	0.455
EPE	–	5 (6%)	6 (8%)	12 (15%)	57 (71%)	0.622
Surgical margin	–	6 (8%)	5 (6%)	5 (6%)	64 (80%)	0.526
IQ-Gleason	6 (8%)	25 (31%)	12 (15%)	10 (8%)	27 (34%)	0.597
cGrade	4 (5%)	20 (25%)	25 (31%)	13 (16%)	18 (23%)	0.629

CR/IDC invasive cribriform and/or intraductal carcinoma, EPE extra-prostatic extension, α Krippendorff's α



Do you still need
the MDT meeting

Do you need the MDT meeting.



Do you need the
MDT meeting.

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Article

Evaluating the Concordance Between ChatGPT and Multidisciplinary Teams in Breast Cancer Treatment Planning: A Study from Bosnia and Herzegovina

by Sefika Umihanic¹ ✉, Hedim Osmanovic² ✉ , Nejra Selak^{3,*} ✉ , Dijana Kopric¹ ✉, Asija Huseinbasic¹ ✉, Erna Sehic-Kozica⁴ ✉, Belma Babic¹ ✉  and Fadil Umihanic⁵ ✉

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² Faculty of Natural Sciences and Mathematics, University of Tuzla, 75000 Tuzla, Bosnia and Herzegovina

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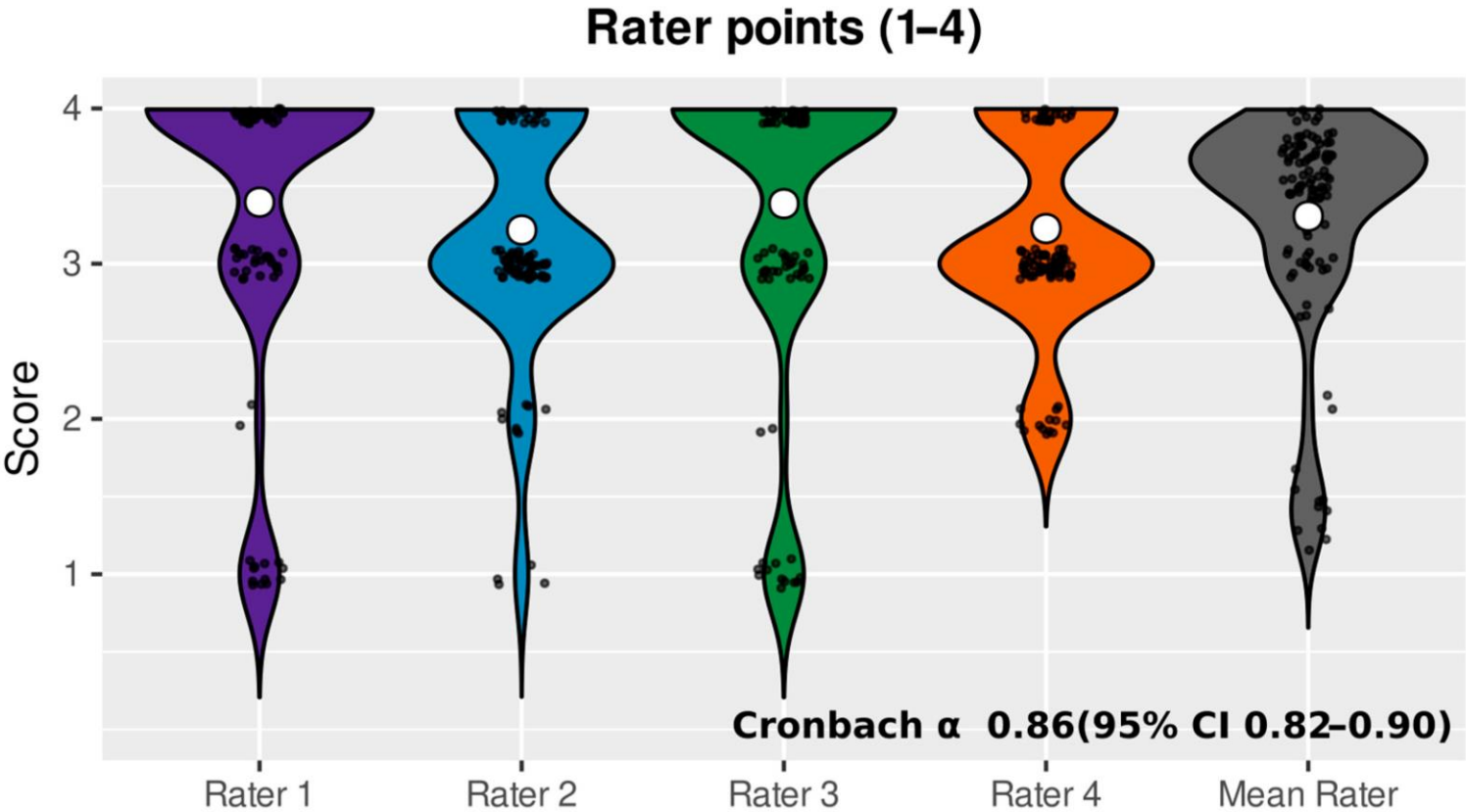
⁴ Department of Oncology and Radiotherapy, Cantonal Hospital Zenica, 72000 Zenica, Bosnia and Herzegovina

⁵ Cerrahpaşa Faculty of Medicine, Istanbul University-Cerrahpaşa, 34390 Istanbul, Turkey

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J. Clin. Med. **2025**, *14*(18), 6460; <https://doi.org/10.3390/jcm14186460>

Do you need the MDT meeting.



Violin plots display the distribution of agreement scores for each of the four raters and their average. Scores ranged from 1 (strongly disagree) to 4 (strongly agree). White dots indicate the mean score for each rater. Most scores clustered around 3 and 4, suggesting a general trend toward high agreement with the ChatGPT recommendations. The high internal consistency among raters is confirmed by a Cronbach's alpha of 0.86 (95% CI: 0.82–0.90), indicating very good inter-rater reliability.

A clinical case

- 78 y.o
- Parkinson disease
- Myocardial infarction
- On Prolopa, Bisoprolol, Eliquis
- Prostate radiotherapy and 18 months ADT in 2009 for high-risk localised PCa (PSA 14 ng/ml, T3a N1M0, Gleason 7(4+3). PSA < 0,2 since then.
- TURP for LUTS 15% invasion by Gleason 8(4+4)

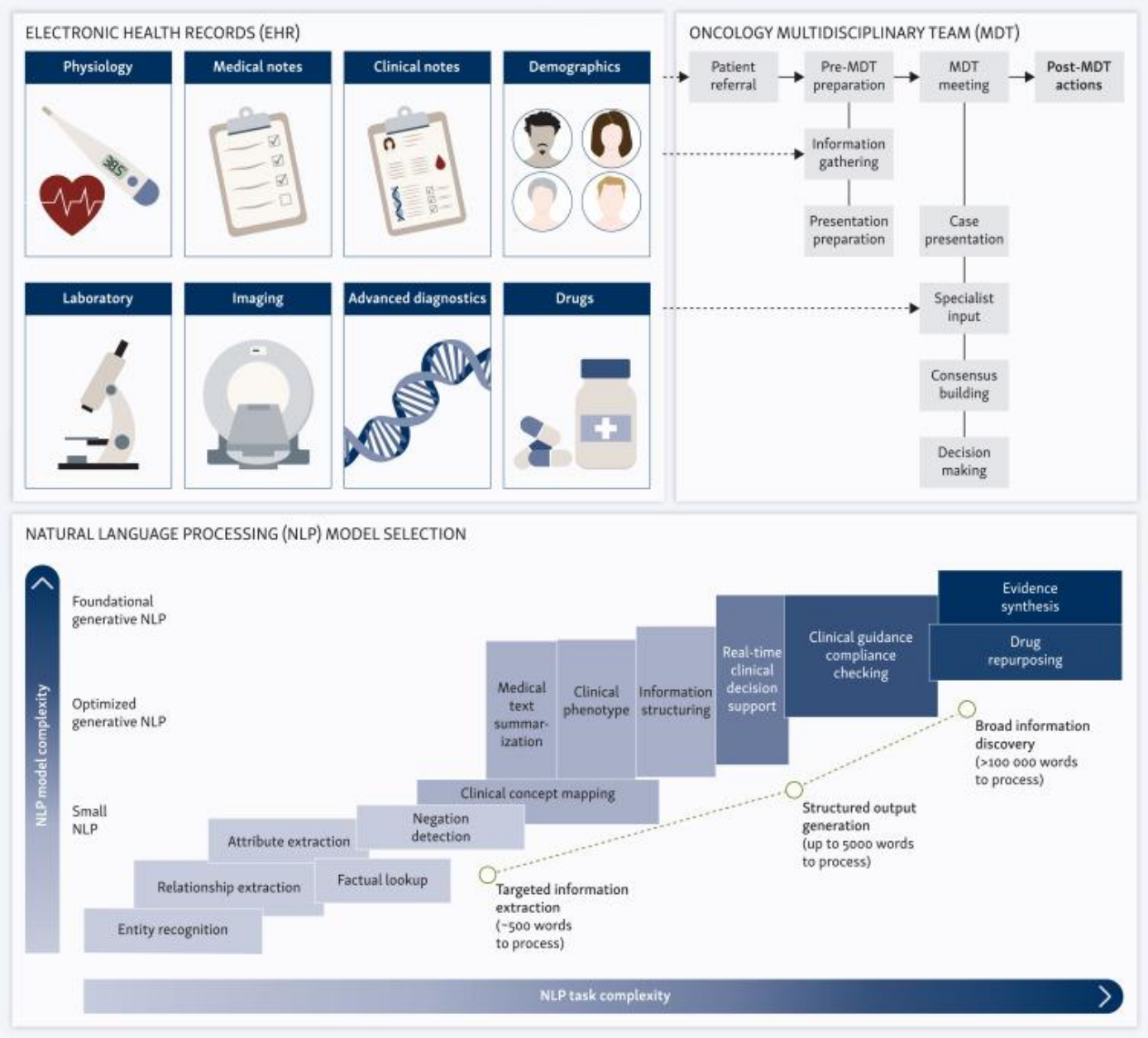
MDT:

- Recurrence of prostate cancer previously treated with radiotherapy
- Given the age, and the low PSA level, proposal to carry out an extension assessment by PET-PSMA
- If negative, biological monitoring of PSA
- If metastatic lesion described, systemic androgen deprivation therapy and next-generation hormone therapy



- In a patient treated with radiation therapy for localized prostate cancer, it is not unusual for residual (non-necrotic) prostate tissue to still be present several years after treatment.
- This tissue may sometimes contain irradiated benign cells (radiation-induced atypia), or, more rarely, viable residual cancer cells (histological residual cancer).
- Given the age of the patient and the discovery on the basis of a TURP of cells that do not reflect neoplastic activity
- ==> PSA monitoring.

Do you need the MDT meeting.



- I have a 62 years old patients, with no comorbidity. He has just been diagnosed with ISUP 2 PCa, T1c, PSA 7,5 ng/ml, no cribriform, PET-PSMA normal.
- Could you ask an avatar to discuss the different options

Clinical basis

This patient falls into the favorable intermediate-risk category per both EAU 2026 and NCCN 2025 guidelines: ISUP 2 with PSA 7.5 ng/mL, single positive lesion, no cribriform/intraductal features mentioned, and a negative PSMA PET scan.

The video covers the four main options in a warm, reassuring tone:

1. Active surveillance — supported by EAU guidelines for selected favorable ISUP GG2 patients (PSA <10, low core positivity, no cribriform/IDC), with honest framing about the commitment to follow-up and the debate around long-term safety
2. Radical prostatectomy — robotic-assisted, nerve-sparing, with cancer control and side-effect profile
3. Radiation therapy — EBRT and brachytherapy, noting comparable cancer-specific survival to surgery
4. Focal therapy (HIFU) — available in specialized centers with good short-to-intermediate-term data on functional preservation, though long-term results are still being collected

The patient choose
for radiotherapy,
does he need
hormones...

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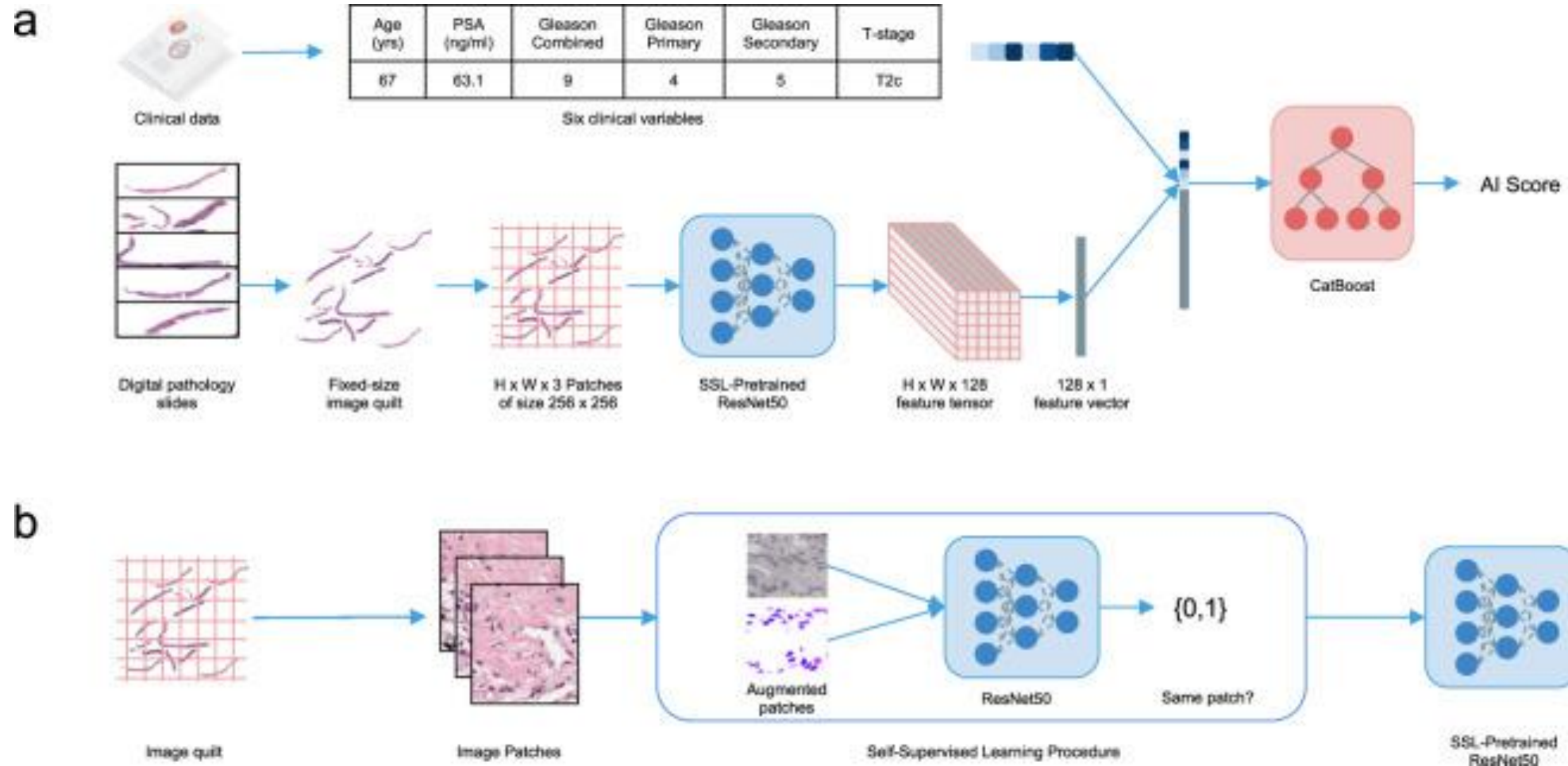
AI in Cancer Therapy For Clinicians For Patients Company News & Insights

Cancer is personal. Cancer therapy should be, too.

Prognostic and predictive cancer testing enabled by AI and digitized pathology.

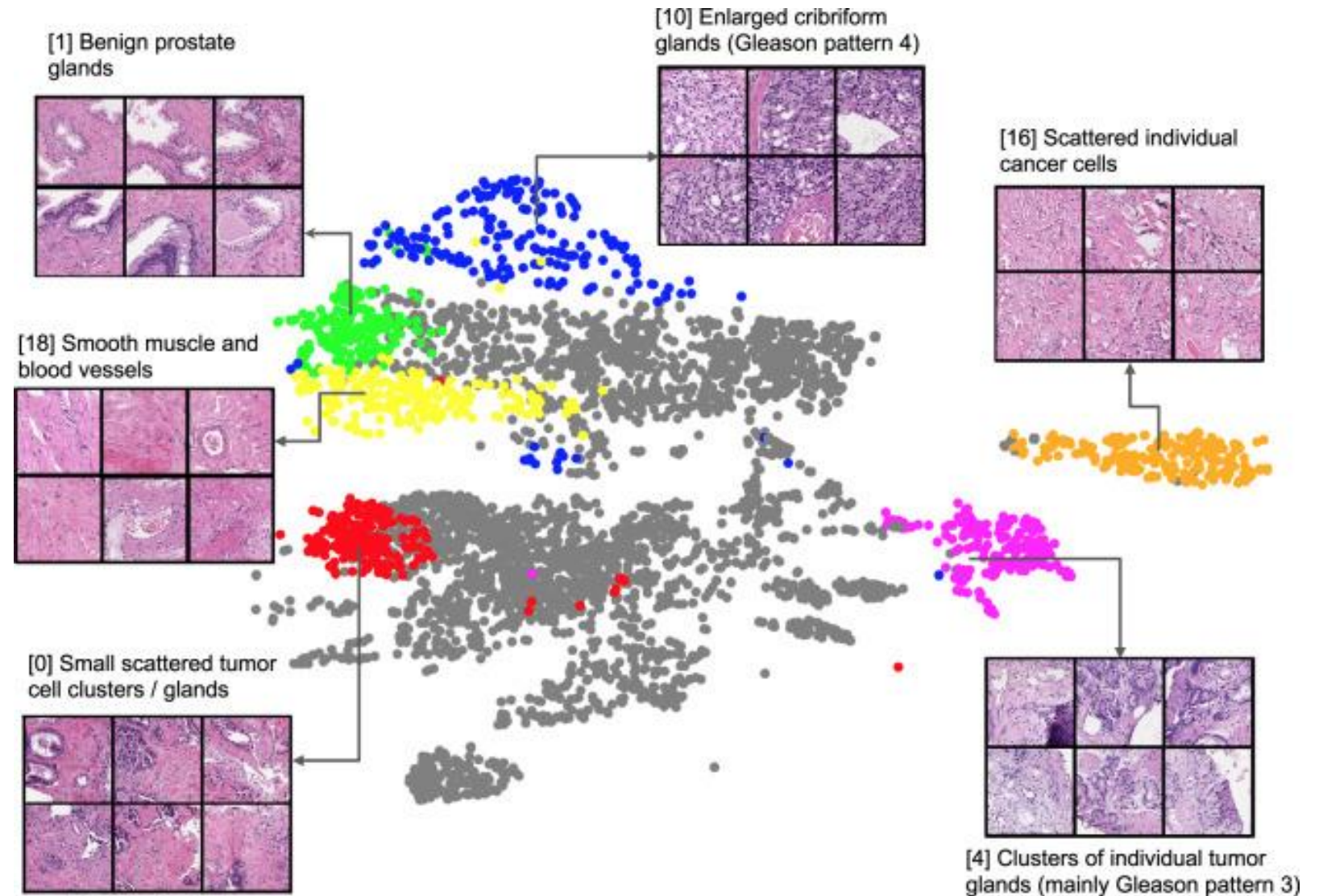
Biopsy → Post-Radical Prostatectomy →

PCa therapy personalization via multi-modal deep learning on randomized phase III clinical trials



a The multimodal architecture comprises two parts: a tower stack to parse a variable number of digital histopathology slides and another to merge the resultant features and predict binary outcomes. **b** The training of the self-supervised model of the image tower stack. A. Esteva. NPJ Digit Med. 2022 Jun 8;5:71.

Pathologist interpretation of self-supervised model tissue clusters.



a The multimodal architecture comprises two parts: a tower stack to parse a variable number of digital histopathology slides and another to merge the resultant features and predict binary outcomes. **b** The training of the self-supervised model of the image tower stack. A. Esteva. NPJ Digit Med. 2022 Jun 8;5:71.

Artificial Intelligence Predictive Model for Hormone Therapy Use in PCa

- NRG/RTOG 9408: low, intermediate, or high-risk PCa randomly assigned to radiotherapy with or without 4 months of ADT.

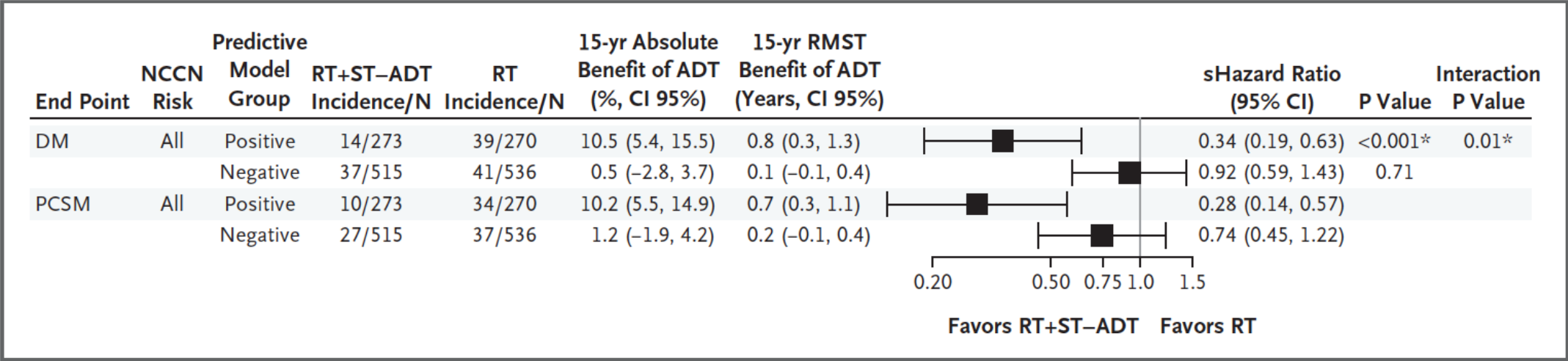


Figure 3. Forest Plots for All End Points in Positive and Negative Predictive Model Groups of NRG/RTOG 9408 (Validation Set) for All Patients.

The patient choose
for radiotherapy,
does he need
hormones...

Do we still need a
radiation oncologist

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Clinical evaluation of a deep learning CBCT auto-segmentation software for prostate adaptive radiation therapy

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The patient choose
for radiotherapy,
does he need
hormones...

Do we still need a
radiation oncologist



We always going to need a radiation oncologist,
... to hug and to bill



"Machines won't make us obsolete, our complacency might....and intelligent machines can help us turn our grandest dreams into reality."

Garry Kasparov

Deep Blue, Feng-Hsiung Hsu