AI in prostate cancer MRI

Matching the right treatment to the right patient

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Rome, Italy. 27th October 2025

Disclosures

- Speaker honoraria: GE Healthcare
- Consulting fees: Lucida Medical

Outline

Diagnostic challenges and AI assistance

Identifying prostate cancer lesions from MRI.

Multimodality imaging integration

MRI and PET-CT complementarity.

Treatment decision and radiotherapy planning

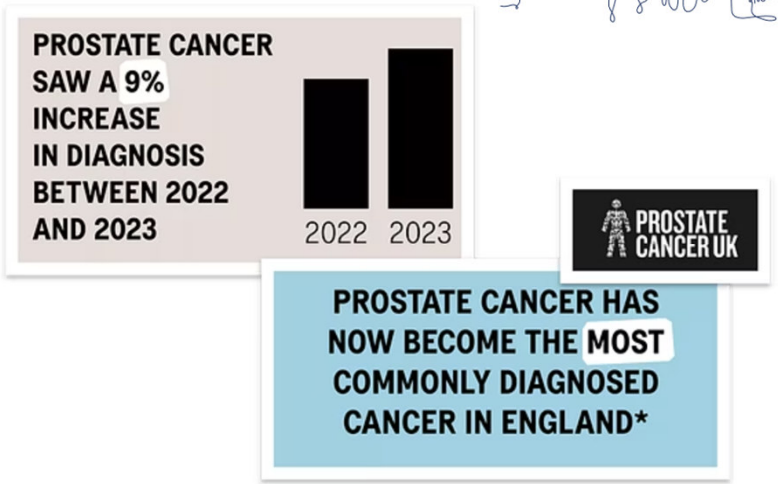
AI for optimizing radiation

Treatment monitoring

AI for tracking response and recurrence.

Clinical implementation

Integrating AI tools into oncology practice.



Current diagnostic challenges

Detection gaps

12% of clinically significant cancers missed by human readers, with high inter-reader variability.

Overdiagnosis problem

Up to 55% of men without significant cancer undergo unnecessary biopsy under standard practice.

Need for precision

Patients range from safe observation to multimodal therapy—we need better risk stratification tools.

Ahmed et al (PROMIS), Lancet 2017

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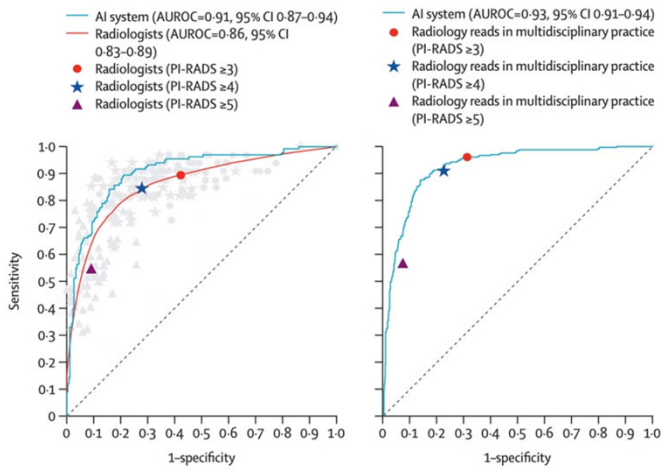
AI-assisted MRI detection

Augmenting radiologists' eyes

Deep learning AI outperformed radiologists (AUROC 0.91 vs 0.86, p<0.0001), catching 6.8% more significant tumours whilst halving false positives.

When radiologists used AI as a second reader, diagnostic accuracy rose significantly—AUC improved from 0.88 to 0.92 (p<0.001) with sensitivity increasing from 94% to 97%.



Saha et al, Lancet Oncol 2024

Automated risk scoring

AI tools assign risk scores (e.g. 1–5 scale) at lesion and patient level, correlating with likelihood of csPCa.

High AI risk flags aggressive cancer; low scores reassure to defer biopsy.

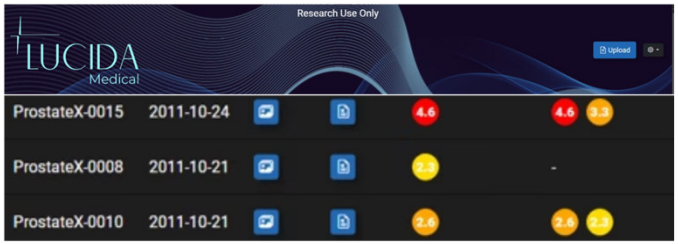


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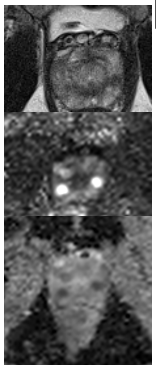
Image analysis in Pi

Integration with PACS, EMR, reporting UI & workflow



MRI DICOM data (bpMRI / mpMRI)

Optional PSA

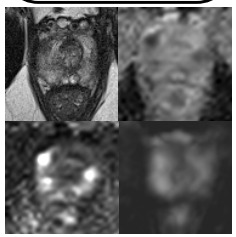
Optional clinical data

Clinical data & DICOM import, scanner & protocol adaptation

Standard, scanner-independent images

Quality checks

Co-registration & feature extraction



Spatially aligned 3D images

Proprietary radiomic features

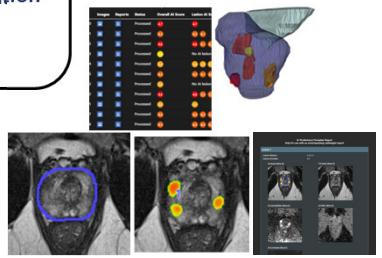
Multi-stage image processing, DL & ML models

Segmentations

Heatmaps

Lesions & risk scores

Data output & report generation



All major MRI vendors 1.5T & 3T

Trained on diverse real-world data spanning screening, diagnosis, active surveillance & treatment

Externally validated on independent, multi-centre, multi-vendor data

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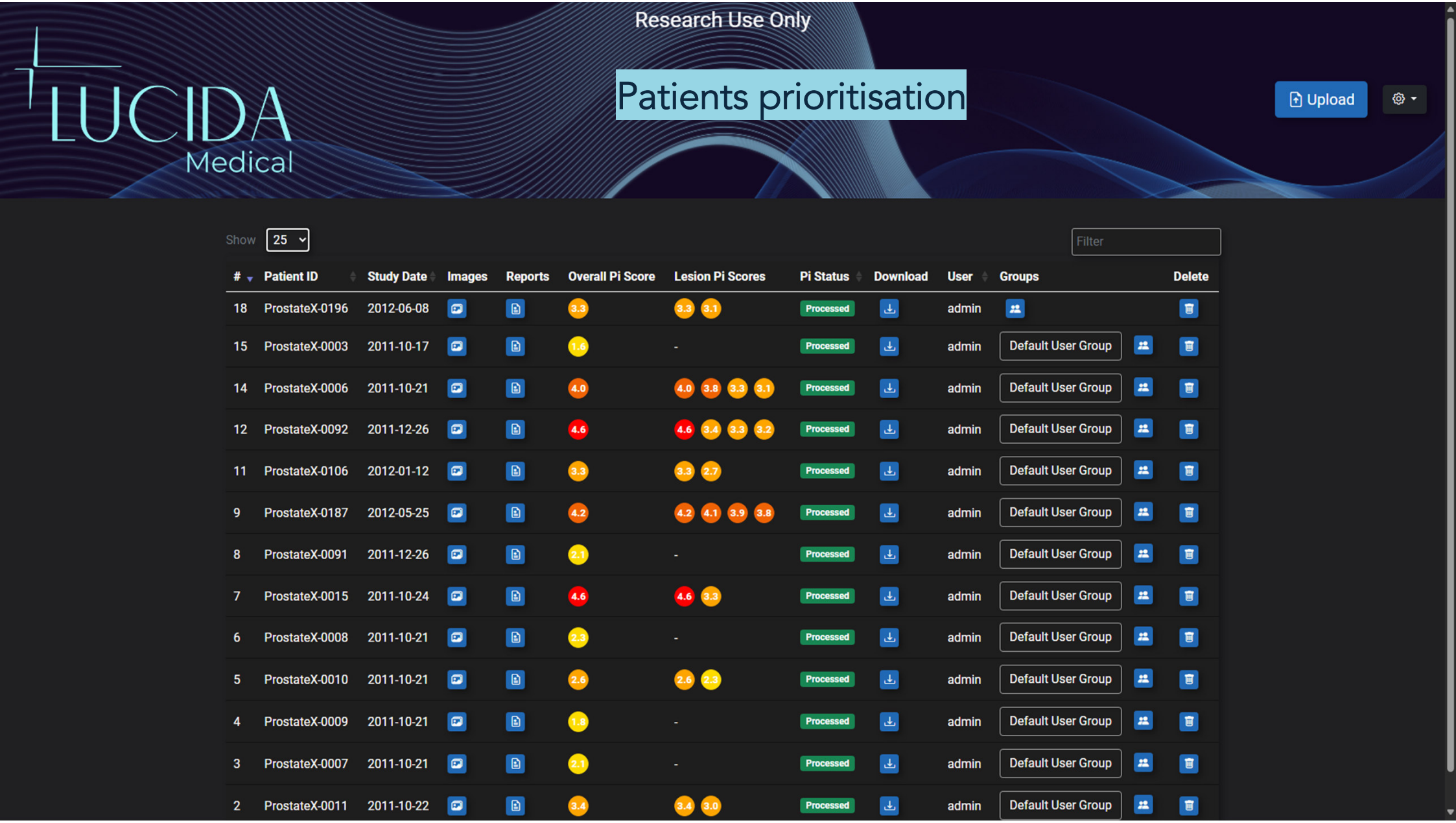
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Patients prioritisation
Upload
Show 25
Filter
Patient ID Study Date Images Reports Overall Pi Score Lesion Pi Scores Pi Status Download User Groups Delete
18 ProstateX-0196 2012-06-08 3.3 3.3 3.1 Processed admin
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14 ProstateX-0006 2011-10-21 4.0 4.0 3.8 3.3 3.1 Processed admin Default User Group
12 ProstateX-0092 2011-12-26 4.6 4.6 3.4 3.3 3.2 Processed admin Default User Group
11 ProstateX-0106 2012-01-12 3.3 3.3 2.7 Processed admin Default User Group
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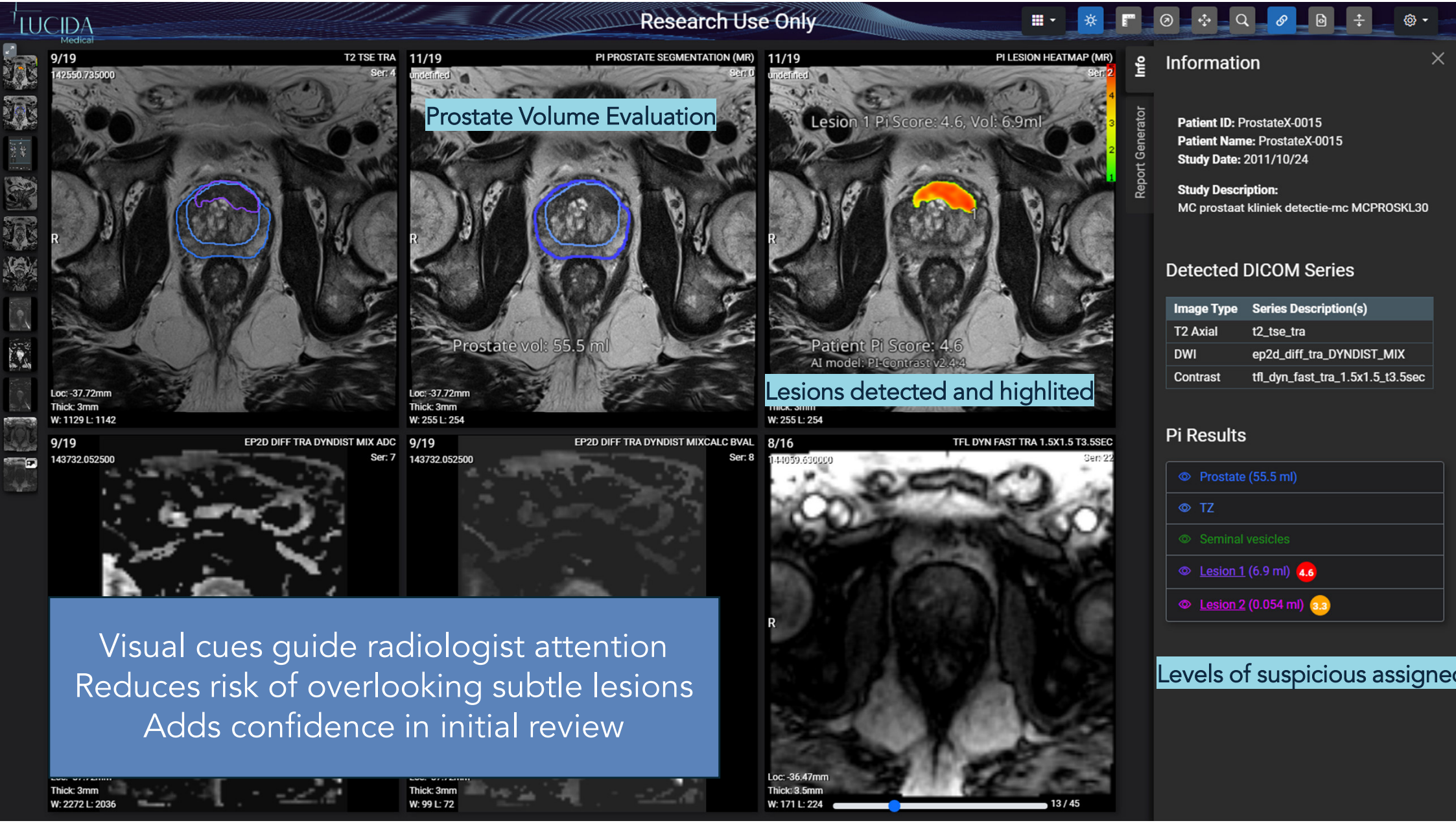
LUCIDA Medical
Research Use Only
9/19
T2 TSE TRA
142550.735000
Ser: 4
11/19
PI PROSTATE SEGMENTATION (MR)
undefined
Ser: 0
Prostate Volume Evaluation
Prostate vol: 55.5 ml
11/19
PI LESION HEATMAP (MR)
undefined
Ser: 2
Lesion 1 Pi Score: 4.6, Vol: 6.9ml
Patient Pi Score: 4.6
AI model: PI-Contrast v2.4.4
Lesions detected and highlited
9/19
EP2D DIFF TRA DYNDIST MIX ADC
143732.052500
Ser: 7
9/19
EP2D DIFF TRA DYNDIST MIXCALC BVAL
143732.052500
Ser: 8
8/16
TFL DYN FAST TRA 1.5X1.5 T3.5SEC
Visual cues guide radiologist attention
Reduces risk of overlooking subtle lesions
Adds confidence in initial review
Info
Report Generator
Information
Patient ID: ProstateX-0015
Patient Name: ProstateX-0015
Study Date: 2011/10/24
Study Description:
MC prostaat kliniek detectie-mc MCPROSKL30
Detected DICOM Series
Image Type
Series Description(s)
T2 Axial
t2_tse_tra
DWI
ep2d_diff_tra_DYNDIST_MIX
Contrast
tfl_dyn_fast_tra_1.5x1.5_t3.5sec
Pi Results
Prostate (55.5 ml)
TZ
Seminal vesicles
Lesion 1 (6.9 ml) 4.6
Lesion 2 (0.054 ml) 3.3
Levels of suspicious assigned

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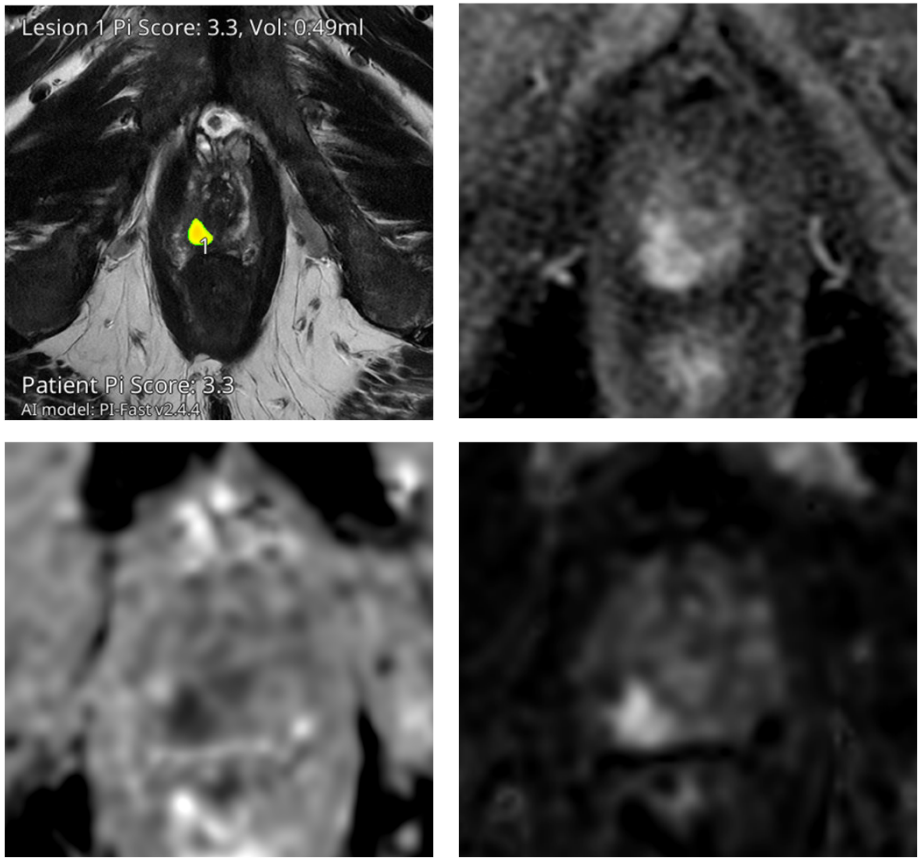
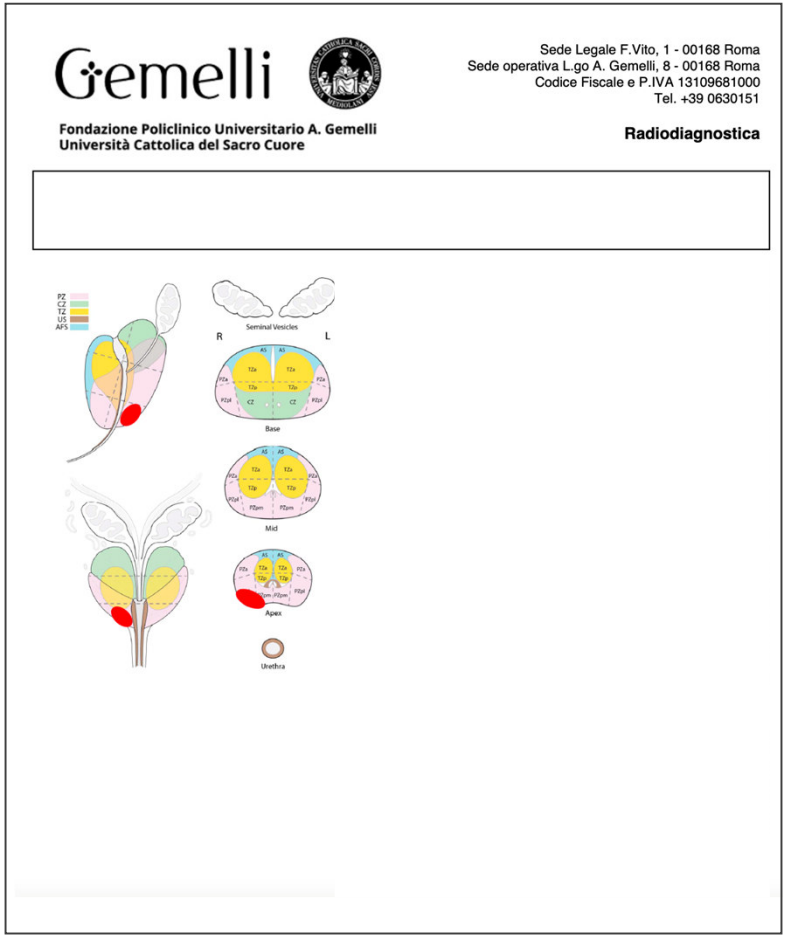
AI images and findings directly integrated into radiological reports





Gemelli

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Radiodiagnostica

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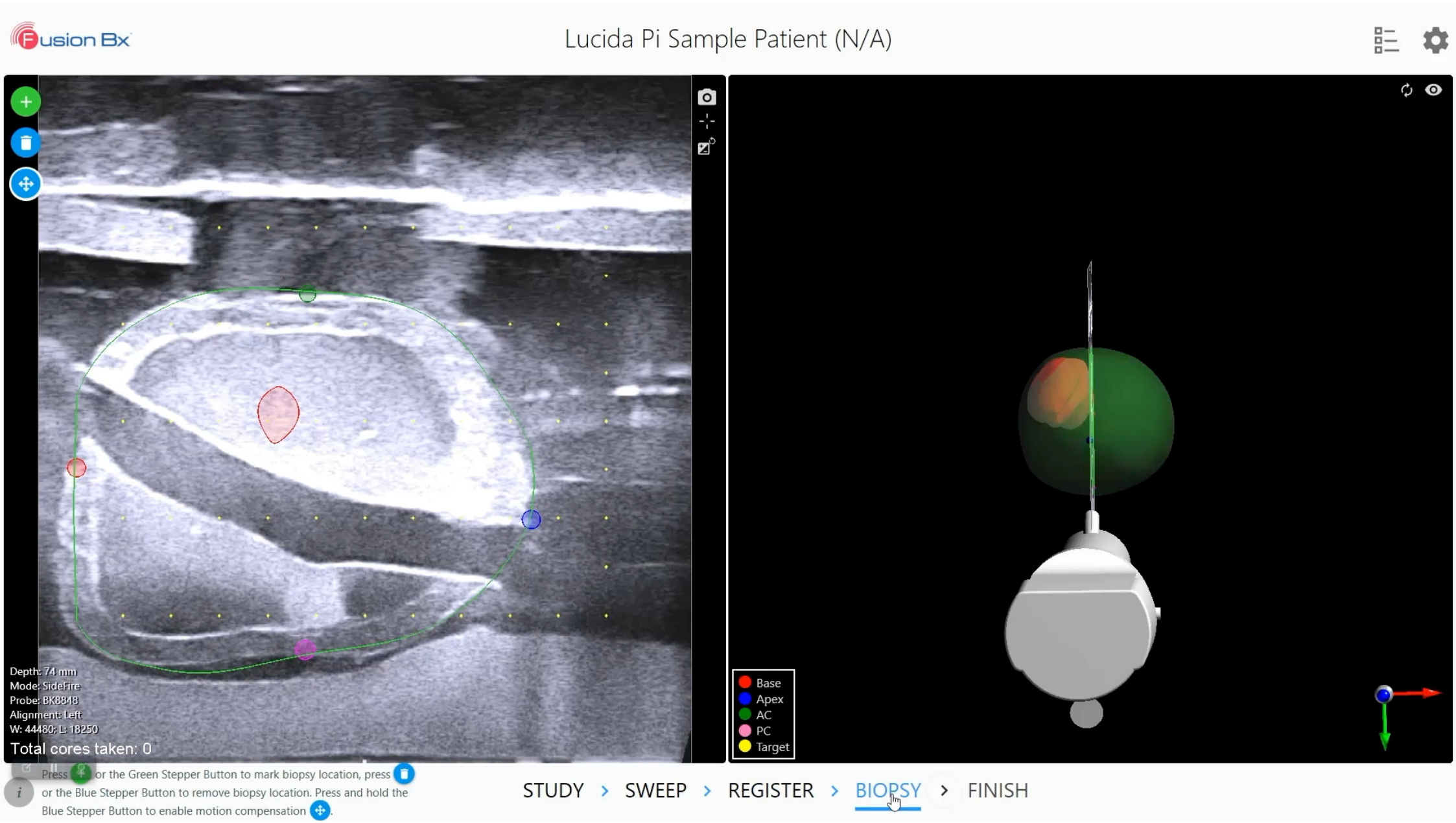
Fusion Bx
Lucida Pi Sample Patient (N/A)
Depth: 74 mm
Mode: SideFire
Probe: BK8848
Alignment: Left
W: 44480; L: 18250
Total cores taken: 0
Base
Apex
AC
PC
Target
Press or the Green Stepper Button to mark biopsy location, press
or the Blue Stepper Button to remove biopsy location. Press and hold the
Blue Stepper Button to enable motion compensation
STUDY
SWEEP
REGISTER
BIOPSY
FINISH

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Impact on treatment decisions

01

Better detection = better decisions

AI cuts MRI miss rate for significant tumours roughly in half (from ~12% to ~6%), ensuring timely treatment.

02

Avoiding unnecessary biopsies

Proportion of biopsy-negative men sent for biopsy drops from ~55% to ~43% when AI triages MRI findings.

03

Personalised risk stratification

Adding AI predictions outperforms traditional PI-RADS+PSA density models in identifying significant cancer.

Ahmed et al (PROMIS), Lancet 2017

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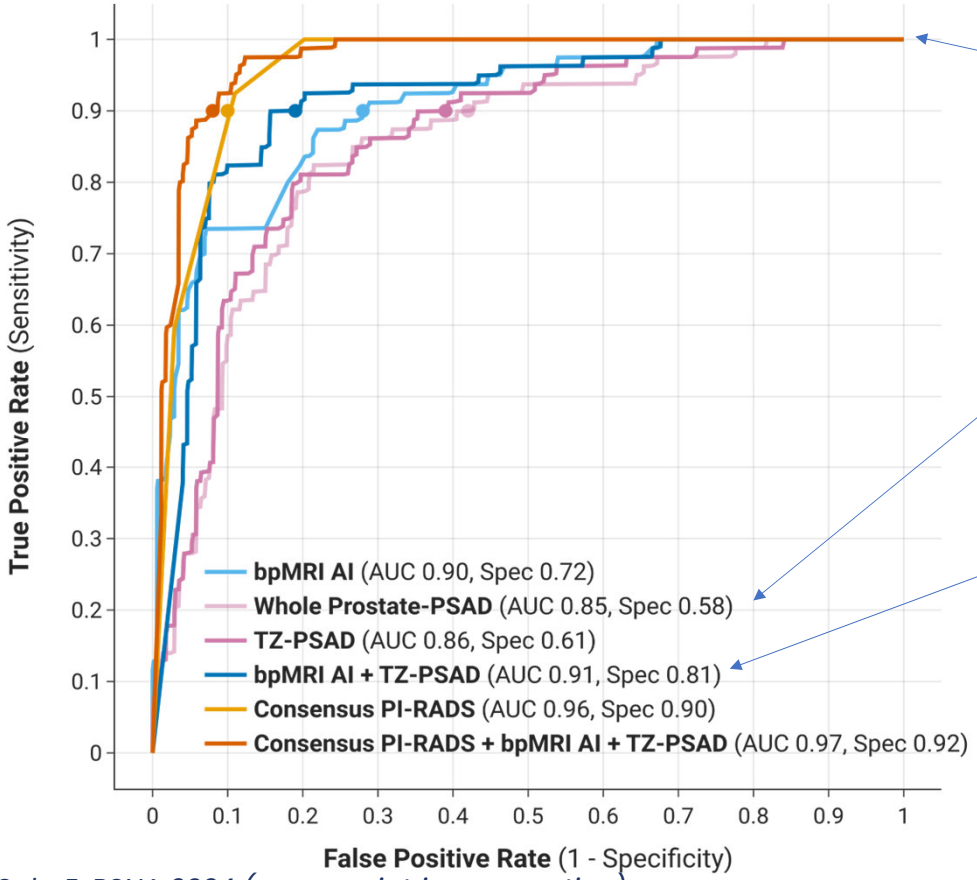
Image Interpretation: the added value of data integration

Per-patient sensitivity vs. false positive rate, identifying patients with any GG ≥2 cancer

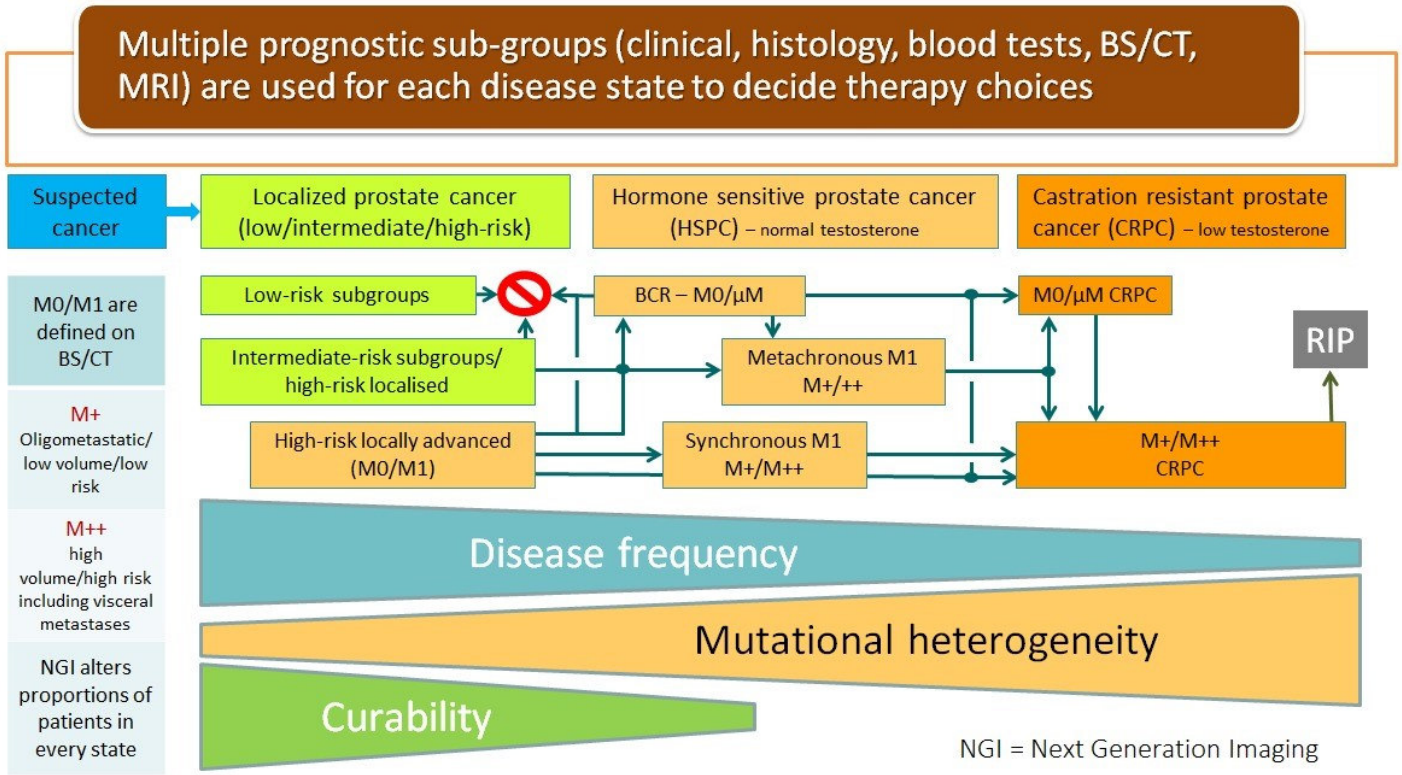


- Same CDR as NICE NG131 – 20% fewer biopsies, 50% less GG1
- 1% lower CDR – 35% fewer biopsies, 67% less GG1

Statistically significant increase in specificity (p<0.001) compared to PI-RADS alone

Giganti F, … Sala E. RSNA 2024 (manuscript in preparation)

Integrating PSMA PET-CT and whole-body MRI



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Integrating PSMA PET-CT and whole-body MRI

Complementary strengths

PSMA PET offers high sensitivity for small nodal and bone metastases. WB-MRI provides multi-parametric tissue assessment without tracer dependence.

PSMA-negative disease

Up to 16% of patients have metastases that are PSMA-PET negative but MRI positive—often aggressive neuroendocrine differentiation or treatment-resistant clones.

Complete disease mapping

Combining both modalities ensures nothing is missed. Concordant lesions give confidence; discordant findings alert to heterogeneous disease requiring adjusted management.

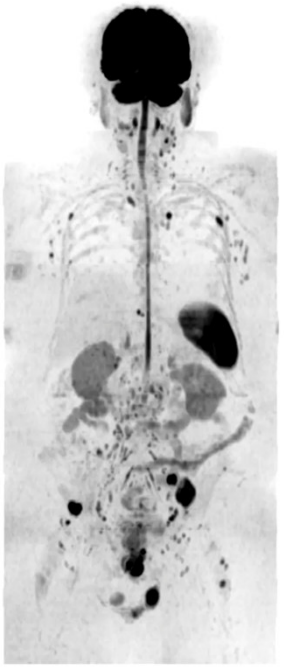
Integrating PSMA PET-CT and whole-body MRI

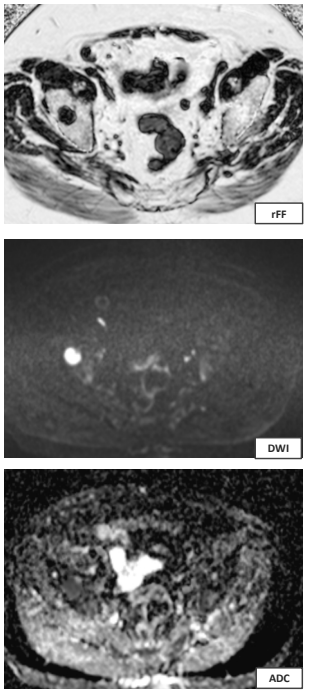
Whole-body MRI

- Multiparametric assessment
  - **T1 DIXON / %rFF** *anatomical*
  - **DWI-ADC** *cellularity*

Sensitivity 75% (para-aortic nodes) to 100% (pelvic nodes, bone)
Specificity 90-100%

WBMRI showed high diagnostic accuracy for detecting and evaluating treatment response in advanced prostate cancer



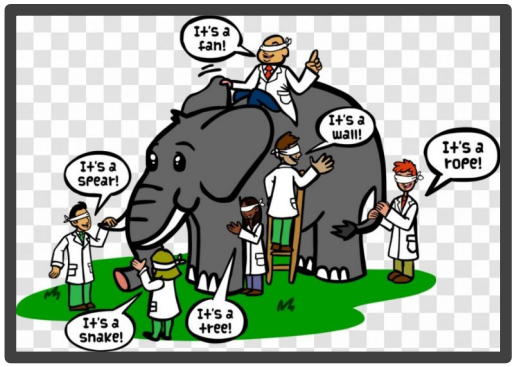


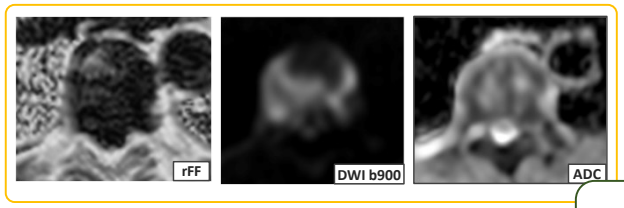
Johnston et al. Eur Urol 2018, Lecouvet et al. Skeletal Radiol 2024, Padhani et al. Eur Urol 2017

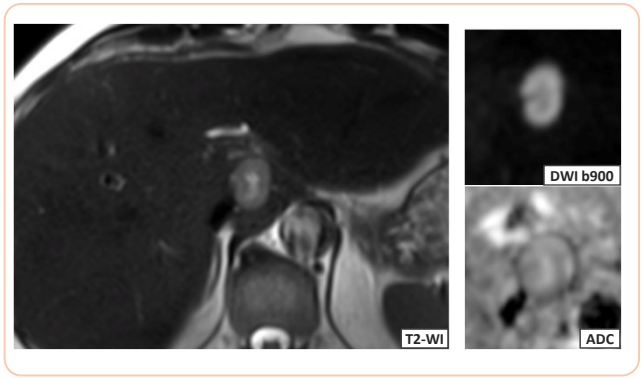
Seeing the full picture

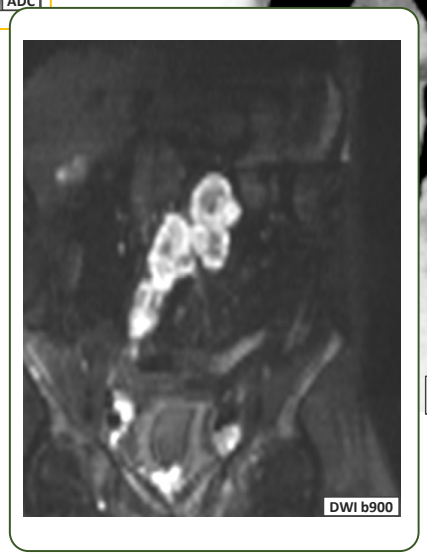
In advanced cases, approximately one in six patients had metastases visible on WB-MRI with no PSMA uptake—the more aggressive lesions that don't respond to PSMA-targeted therapies.

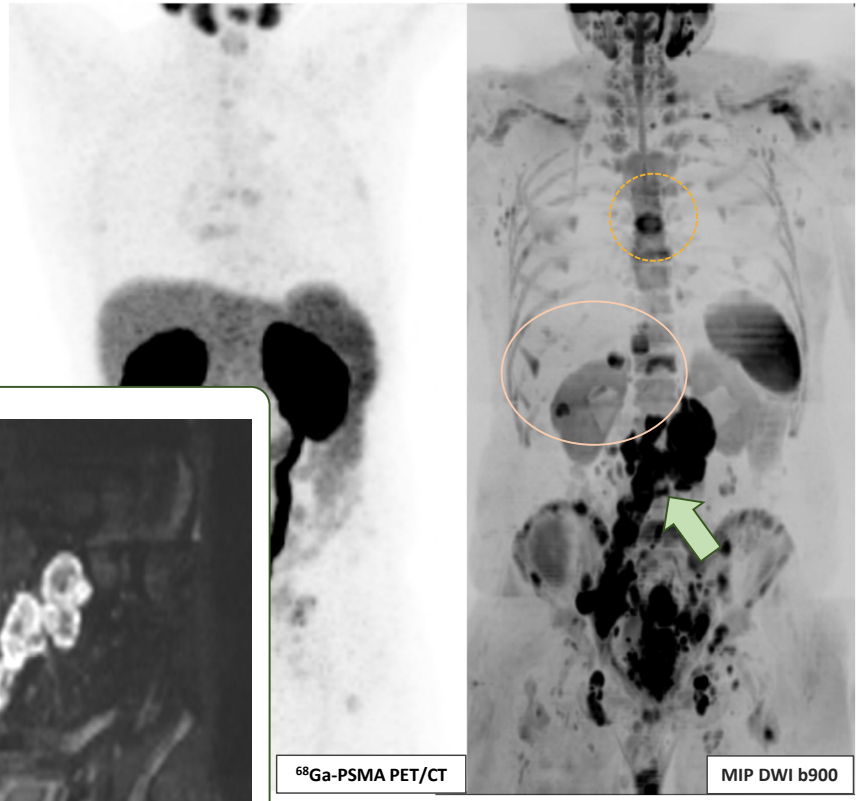
68 y.o. man
T2 N1 M1b low volume Gleason 4+5. Presenting PSA 5.5 ug/l
Recent mCRPC. Actual PSA <0.01











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AI in radiotherapy planning

MRI for planning

Direct visualisation of prostate tumour and critical structures like neurovascular bundles, enabling nerve-sparing radiotherapy to preserve erectile function.

Auto-contouring

AI-driven segmentation achieves human-level accuracy (Dice scores 0.8–0.9), reducing contouring time from 17–24 minutes to 3–7 minutes.

Structure sparing

AI auto-contours neurovascular bundles on high-resolution MR, enabling neurovascular-sparing SBRT planning to reduce erectile dysfunction rates.

Schubert et al. Phys Imaging Radiat Oncol 2025, Polymeri et al. Adv Radiat Oncol 2023, Palazzo et al. Phys Imaging Radiat Oncol 2023

AI-optimised treatment plans

17%

Lower rectal dose

AI-driven IMRT plans achieved equivalent target coverage with 17% lower mean rectal dose compared to manual plans.

<1min

Brachytherapy planning

ML algorithms produce implant plans in under 1 minute that experts found indistinguishable from human plans.

70%

Time savings

Using AI can cut contouring time by 70–80%, standardising quality across institutions.

Sprouts et al. Biomed Phys Eng Express 2022, Nicolae et al. Adv Radiat Oncol 2017

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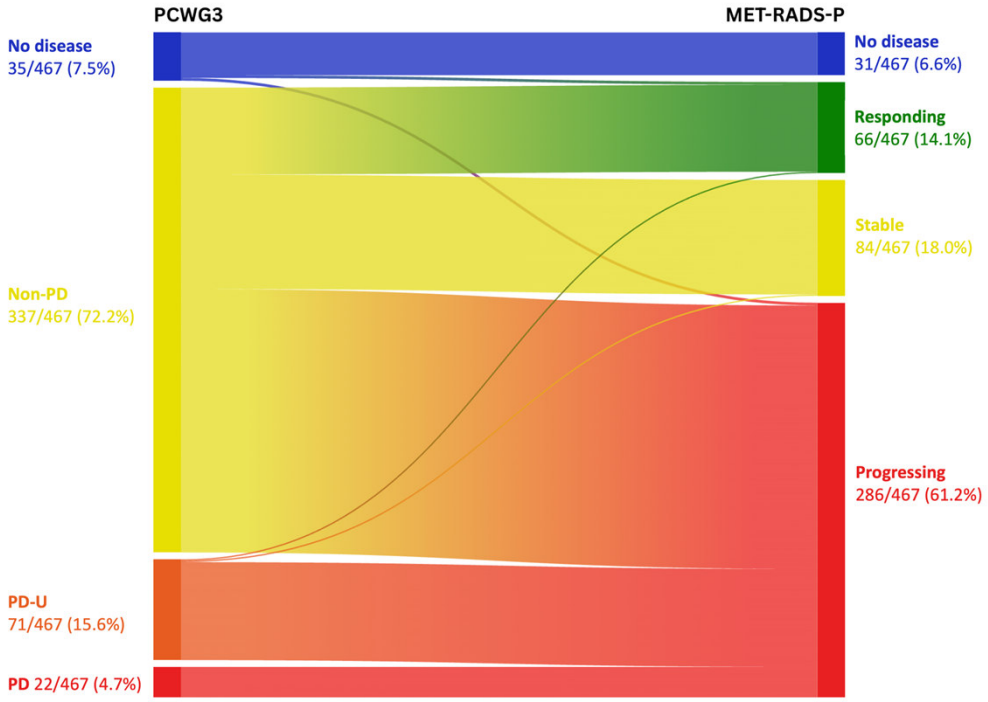
Monitoring Treatment Response

Whole-Body MRI for systemic therapy

WB-MRI directly visualises changes in tumour morphology and cellularity (DWI/ADC) even when lesions remain structurally the same size.

Resolution of tumour high-signal on diffusion or normalisation of marrow signal correlates with good therapeutic response.



Non-PD bone-disease patients by PCWG3 are:

- Responding in 18.7%
- Stable in 24.6%
- Progressing in **56.7%**

Russo, Tunariu et al. Under review

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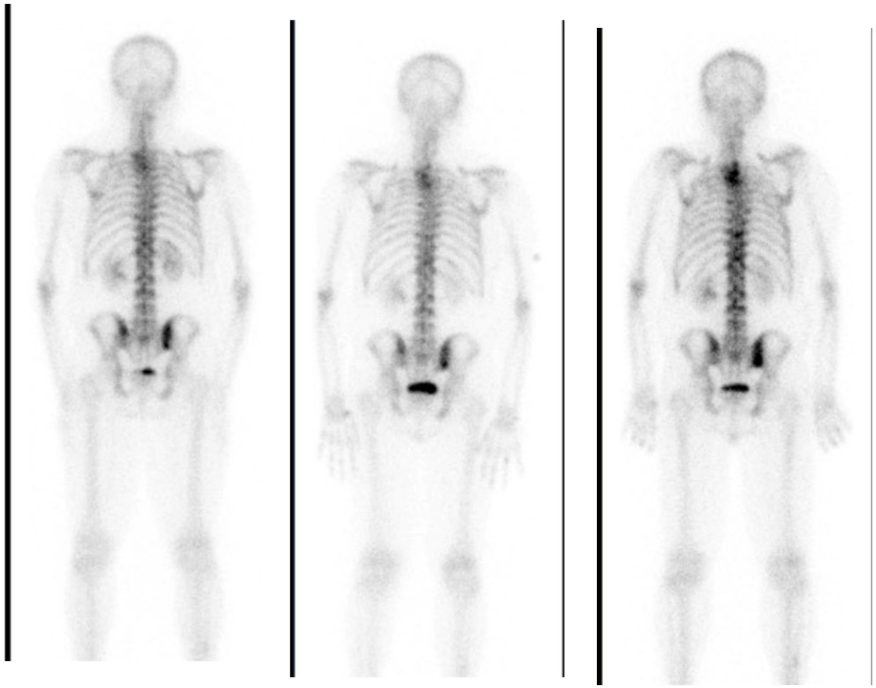
Monitoring Treatment Response

Non-PD

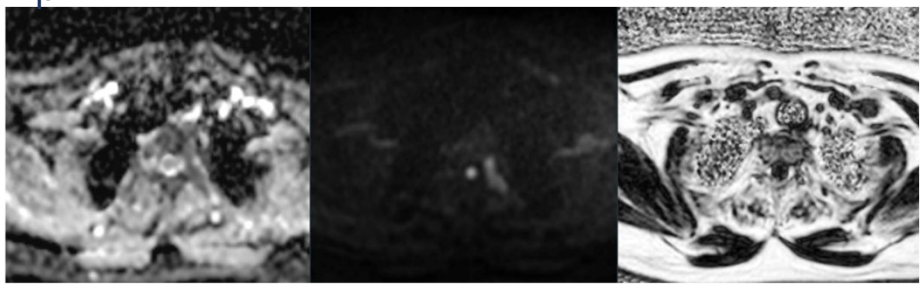
PD-U

Bone scintigraphy

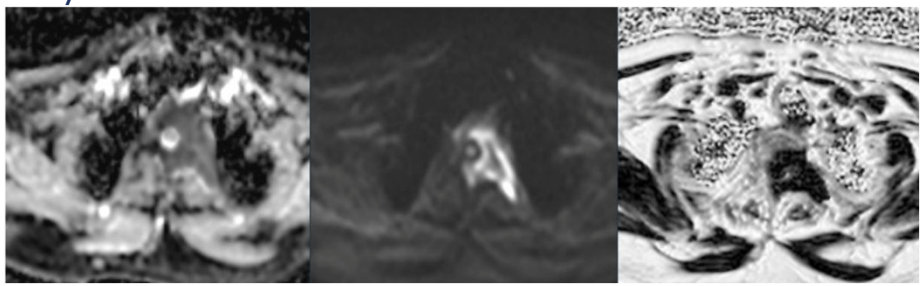


WBMRI

April



July



PSA [ug/l]: 0.23 April 3.3 - July 11 - September

RAC 5 – highly likely progressive disease

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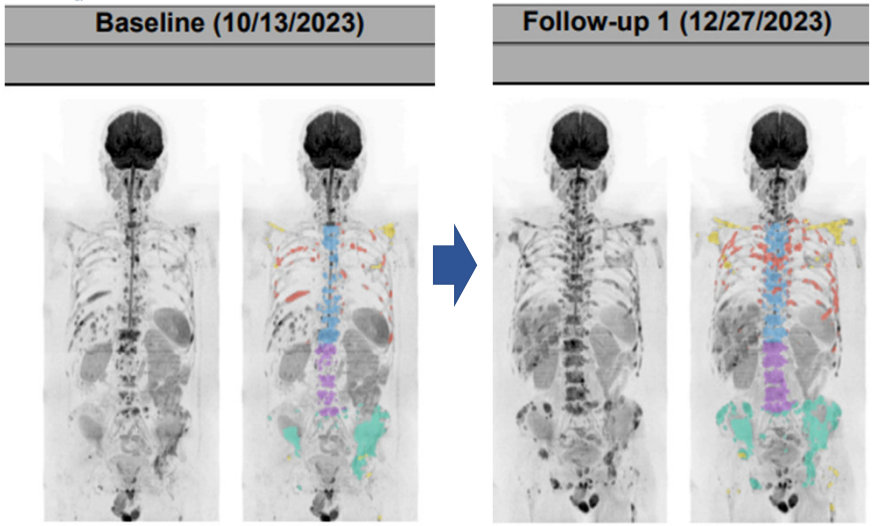
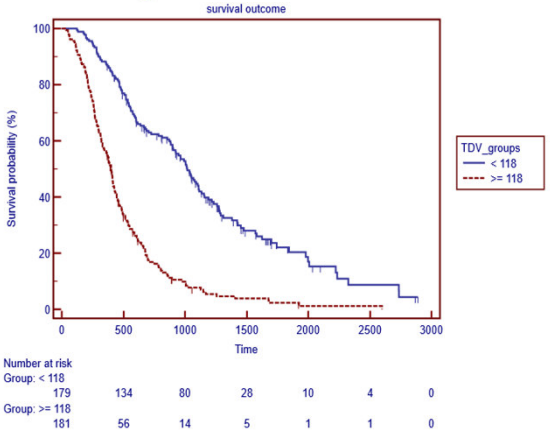


Automatic disease volume segmentation before and during treatment



AI for longitudinal assessment

AI algorithms can automate identification and measurement of lesions on serial WB-MRIs, tracking dozens of metastases across timepoints and calculating volumetric tumour burden (TDV).

Combining PSA kinetics with AI-quantified imaging changes may yield a highly sensitive composite marker of treatment efficacy, enabling earlier detection of progression.

Perez-Lopez, Koh, Tunariu et al., Radiology 2018. D'Erme, Koh et al., under review

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Real-world implementation

Regulatory approval

Multiple AI systems (Lucida Medical's Pi™, Siemens, Quantib) now CE-marked and deployed in European health systems.

Clinical integration

AI runs automatically as MRI completes, pre-highlighting areas of concern with risk scores before radiologist review.

Pathway impact

UK NHS pilots project cutting biopsy wait times from 2–3 weeks to under 7 days using AI triage.

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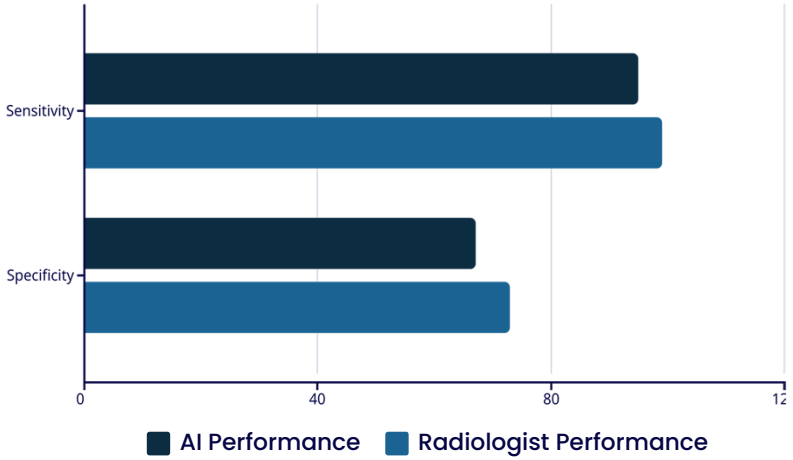
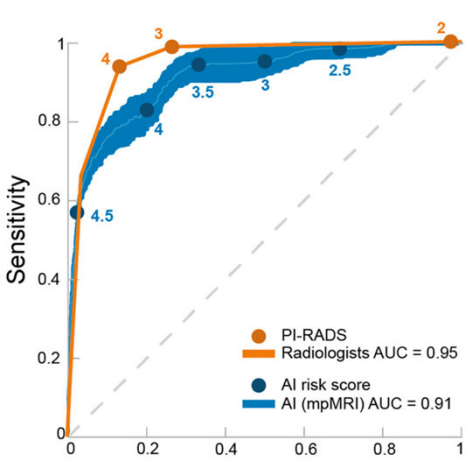
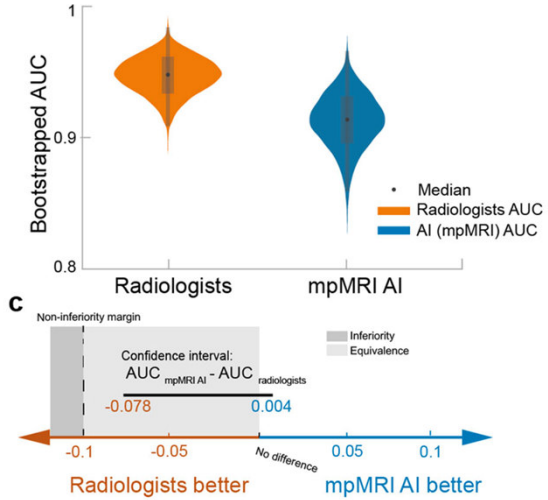
Performance in clinical practice







- Multicentre multiscanner Pi validation
- 252 patients – 6 UK centres
- AI performance not inferior than that of the radiologist (TB/MDT decision)

A dedicated AI medical tool matches the performance of multidisciplinary team-supported radiologists in prostate cancer detection and generalises to multiple sites and scanners.

Giganti F, … Sala E. Eur Radiol 2025

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Multidisciplinary uptake

Radiologists

Use AI to enhance reports with objective risk scores and automated lesion detection.

Urologists

Leverage AI-marked lesion maps to guide targeted biopsies and surgical planning.

Radiation Oncologists

Utilise 3D reconstructions for focal boost planning and treatment approach decisions.

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AI as a clinical partner

Matured technology

AI has evolved from experimental to essential aid—improving diagnostic accuracy, consistency, and speed across the care pathway.

Tailoring treatment

By integrating MRI, AI, and advanced imaging, we craft personalised treatment plans matching the right therapy to the right patient at the right time.

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Future directions

Ongoing trials

PARADIGM trial testing AI-driven pathways head-to-head against standard care, with results expected in 2026-2027.

Radiogenomic models

AI predicting tumour aggressiveness and therapy response from images, linking MRI with digital pathology and genomics.

Multi-modal integration

AI integrating MRI, PET, genomics, and blood biomarkers into cohesive decision support systems.

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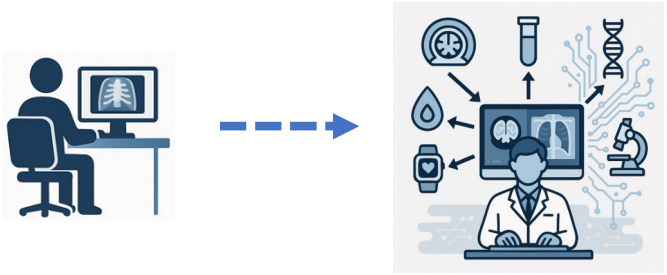
Conclusions



> "AI won't replace human expertise, but it will augment it—acting as a tireless assistant that helps us deliver the right treatment to the right patient."

Improved detection

Catching more significant cancers whilst reducing false positives and unnecessary biopsies.

Enriched planning

Precise tumour mapping and auto-contouring enable safer, more efficient radiotherapy with better organ sparing.

Better outcomes

Personalised treatment decisions leading to improved cancer control and quality of life for patients.

Aknowledgements

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Alessandra Iacono
Luca Tagliaferri
Bernardo Rocco
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Sam Withey
Johann De Bono
Ossian Longoria
Matthew Blackledge
Antonio Candito

Anwar Padhani
Andrea Ponsiglione
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