

Hitting the Target:

MRI-Guided Biopsy Strategies for Prostate Cancer Detection

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College of Medicine at Case Western Reserve University

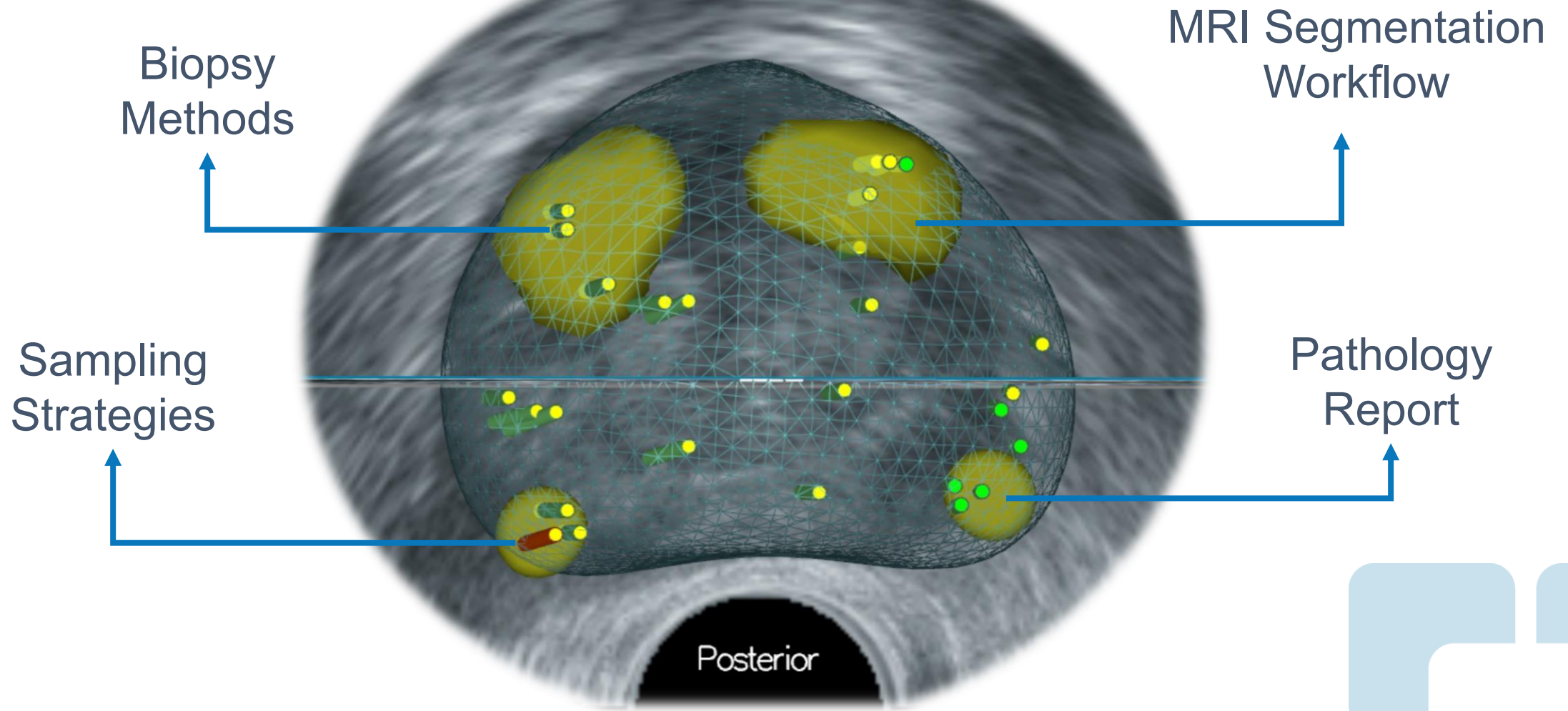
Section Head, Abdominal Imaging, Cleveland Clinic

Staff, Nuclear Medicine and Glickman Urological and Kidney
Institute

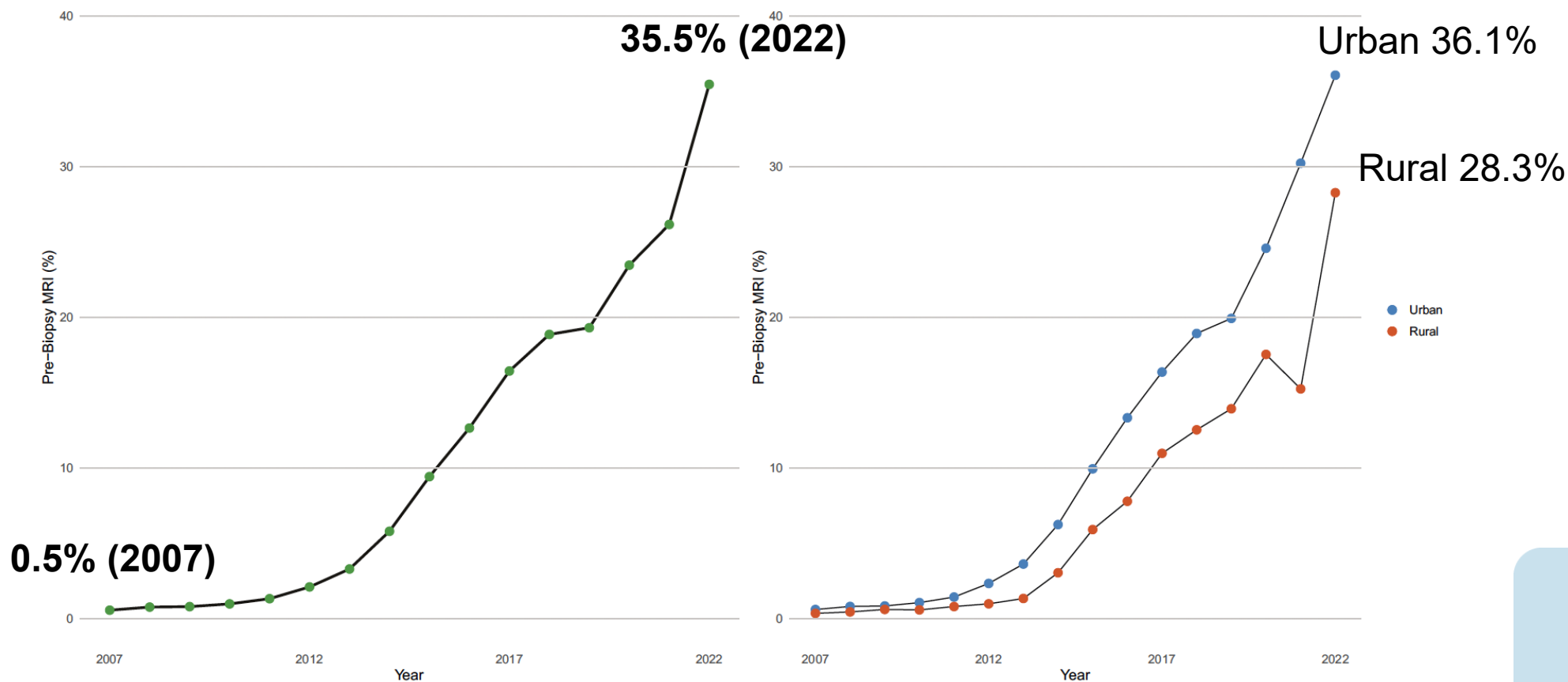
Disclosures

- Research Support: DoD, NIH, ACR, Lantheus, Blue Earth Medical, Siemens Healthineers.





Pre-biopsy Prostate MRI Utilization in the US



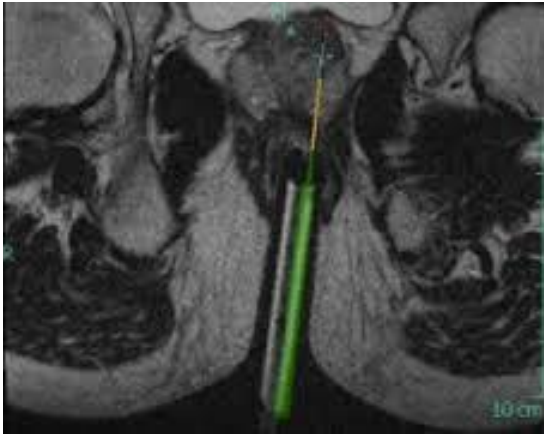
2026 Prostate Biopsy CPT Code Updates

Nine new codes will be created, and one existing code will be revised to differentiate and properly reimburse for the more accurate MRI-targeted fusion biopsy and other new technologies.

CPT Code	Descriptor
55707	Systematic prostate biopsy, transrectal, with ultrasound guidance
55708	Systematic prostate biopsy + MRI-US fusion, transrectal — first targeted lesion
55709	Systematic prostate biopsy, transperineal, with ultrasound guidance
55710	Systematic prostate biopsy + MRI-US fusion, transperineal — first targeted lesion
55711	MRI-US fusion biopsy, transrectal targeted lesions only — first lesion
55712	MRI-US fusion biopsy, transperineal targeted lesions only — first lesion
55713	In-bore CT/MRI-guided systematic ± targeted lesion — first lesion
55714	In-bore CT/MRI-guided targeted lesions only — first lesion
+55715	Add-on: each additional MRI-fusion or in-bore targeted lesion

MRI-Guided Biopsy Methods

In-bore Bx



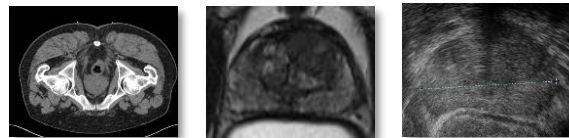
Pro: Direct visualization of the MRI Target
Cons: Time-consuming, limited availability

Fusion Bx

US , CT, MRI and PET

Cognitive

Software based



MRI-US Fusion Biopsy Systems



Uronav – Philips



Artemis – Eigen Health



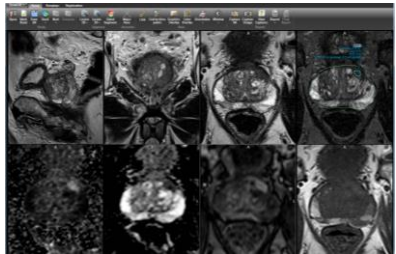
Trinity – Koelis



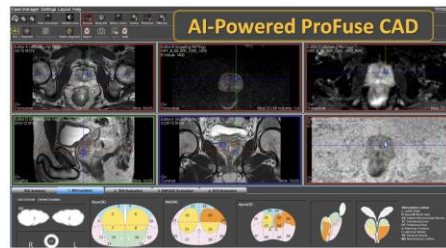
BkFusion – GE HealthCare



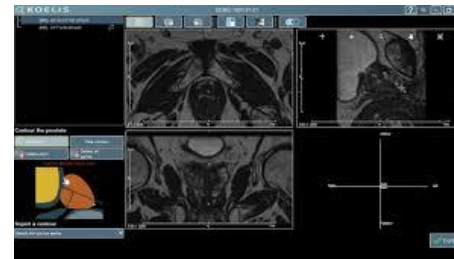
ExactVu – Exact Imaging



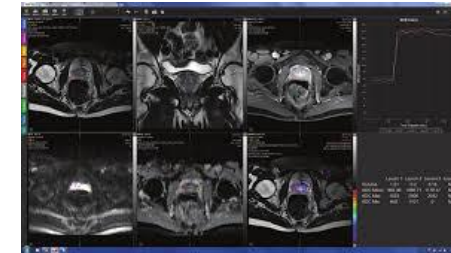
DynaCAD



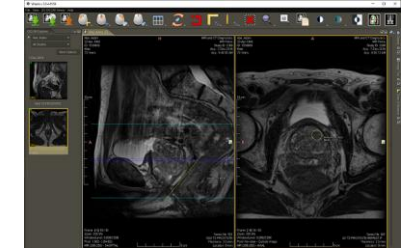
ProFuse



ProMap

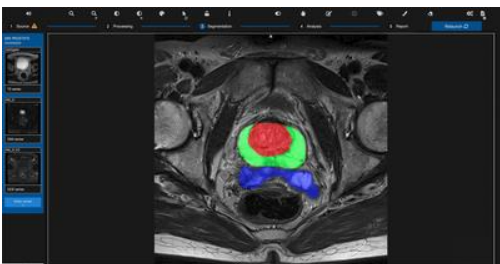


MIM Symphony



Weasis

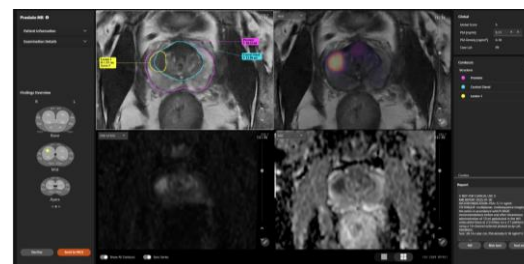
Artificial Intelligence



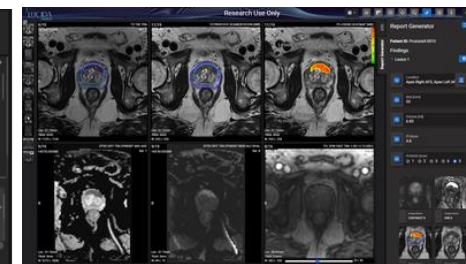
QP-Prostate – Quibim



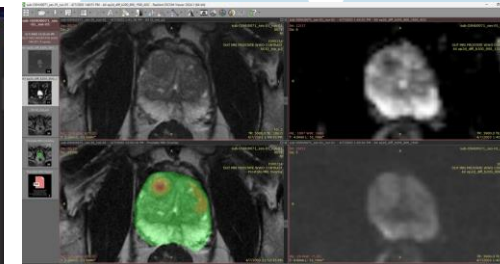
DeepHealth Prostate



AI Rad Companion Prostate
MR – Siemens Healthineers

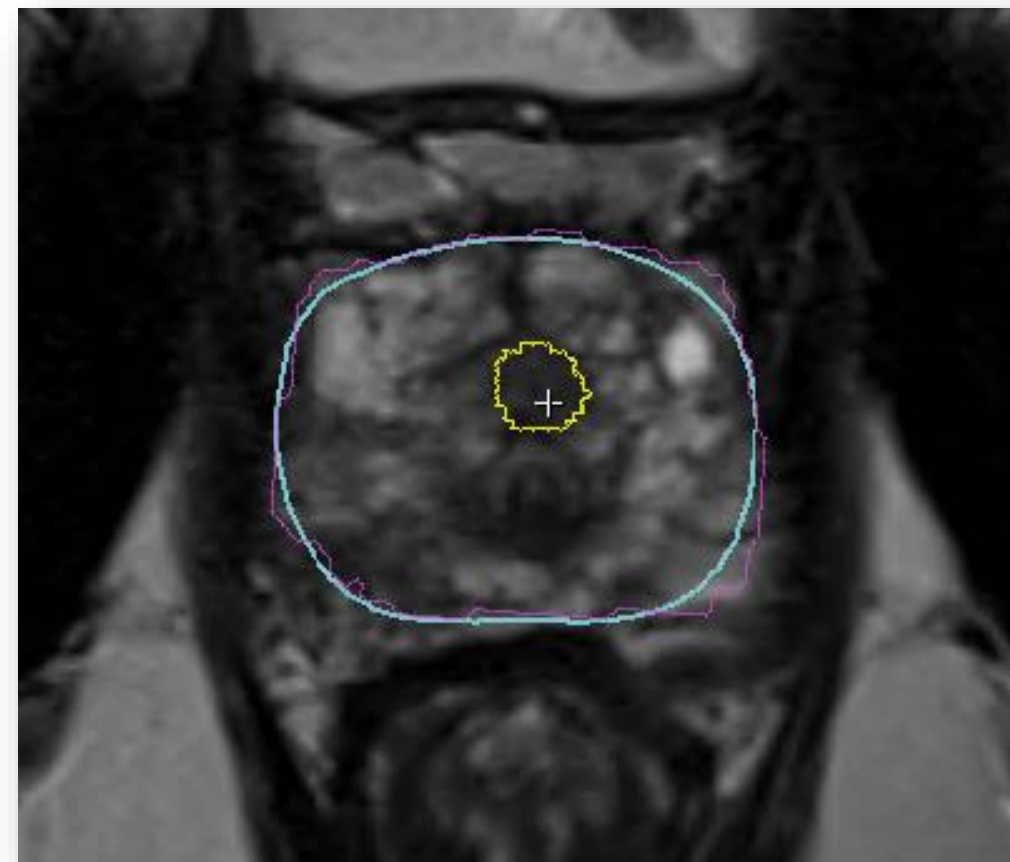
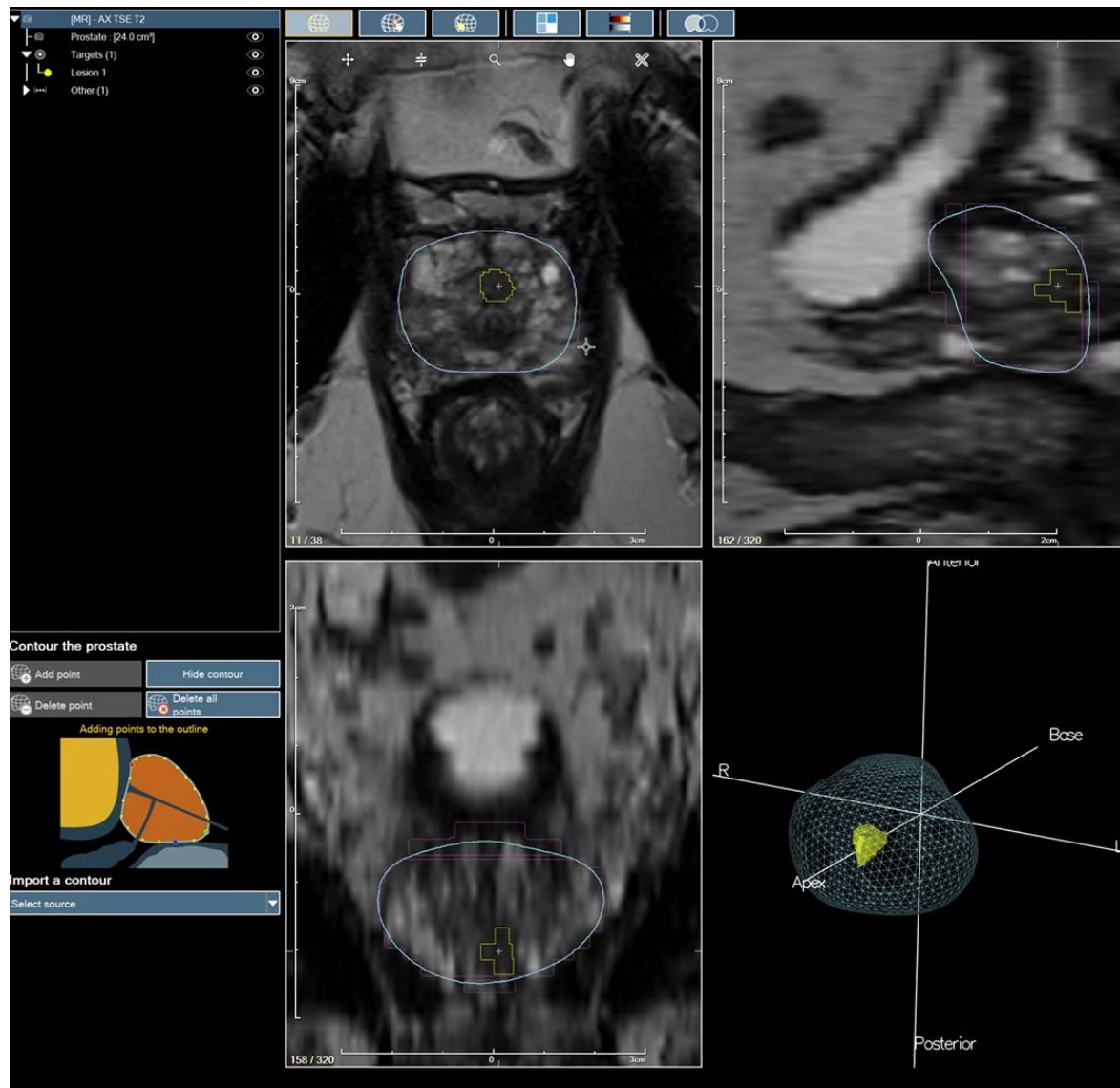


Pi – Lucida Health



ProstatID – Bot Image

Gland Segmentation and Targeting



Gland Segmentation and Targeting

MRI PROSTATE WO/W IV CONTRAST ✓ Accept

DO NOT de-select the contrast order

- MRI contrast administration specifications

- ✓  MRI PROSTATE WO/W IVCON 
Routine
- ✓  MRI 3D POST PROCESSING 
Routine
- ✓ iv contrast (will be provided with radiology test)
MRI Prostate Inject, intravenously, once for 1 dose. No IV access, insert saline lock post exam. If patient has a central line or IVAD, may access for administration according to line specific nursing protocol in the MR contrast administration protocol. In Office, Disp-1 each, 100ml each.

Prostate MRI Order includes a request for 3D post-processing and requires providers to specify which MR/US fusion system will be used.

MRI PROSTATE WO/W IV CONTRAST ✓ Accept

DO NOT de-select the contrast order

- MRI contrast administration specifications

- ✓ MRI PROSTATE WO/W IVCON 
Routine ✓ Accept ✗ Cancel

Priority: Routine STAT

Reason for Exam:

☐ Anal fissure or fistula ☐ Hemorrhoids or perianal venous thrombosis ✓ Prostate cancer suspected

Reason for Exam (Free Text):

Suspected Diagnosis: Elevated PSA, biopsy naïve Elevated PSA, prior negative biopsy Active surveillance Pre-treatment planning/staging BCR, post radical prostatectomy BCR, post radiation BCR, post ablation Post treatment monitoring Other

What is the planned biopsy access: Transrectal Transperineal Not Applicable

 Specify biopsy system:

Does patient need anesthesia or anxiolysis: No anesthesia or anxiolysis needed Anxiolysis needed Anesthesia needed

Release to patient: Delay

Comments: Insert SmartText 100%

Gland Segmentation and Targeting

EXAMINATION: MRI PELVIS WITHOUT AND WITH IV CONTRAST (MULTIPARAMETRIC PROSTATE MRI)

CLINICAL HISTORY: 77 years old being evaluated for prostate cancer. No prior biopsy.

Previous biopsy: None reported

PSA: 7.08 ng/mL 12% free;

Prior therapy: None.

TECHNIQUE: Multiparametric MRI of the prostate and pelvis performed on a 3T scanner utilizing phase pelvic coil. Sequences obtained: multiplanar T2-WI with small FOV; Axial DWI with multiple B-values and creation of ADC-maps; DCE T1-weighted images through the prostate obtained before, during and after the administration of intravenous gadolinium.

THREE-DIMENSIONAL IMAGING: 3D imaging including complex volumetric analysis of the prostate was performed on a dedicated stand-alone workstation by the interpreting physician, with images reviewed and archived.

CONTRAST:

IV: 8.2 cc of Elucirem.

Prostate MRI Report includes the 3D technique (required for CPT code 76377), and the platform used for volumetric analysis.

IMPRESSION:

1.2 cm LEFT apex anterior transition zone periurethral PI-RADS 4 lesion.

No pelvic lymphadenopathy.

No suspicious osseous lesions.

=====

PI-QUAL v1: 3-3-3-5

Number of targets created for MR/US fusion biopsy:

Peripheral zone: 0

Transition zone: 1

Platform used: Siemens

If present, targets were numbered in order of level of suspicion for clinically significant prostate cancer (Grade Group 2 or higher).

PI-RADS v2.1 Assessment Categories and clinically significant cancer detection rates (CDR):

PI-RADS 1: Very low (CDR: 6%)

PI-RADS 2: Low (CDR: 6%)

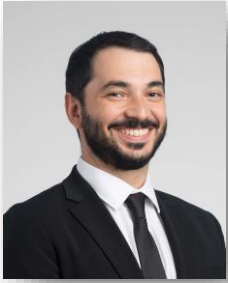
PI-RADS 3: Intermediate (CDR: 20%)

PI-RADS 4: High (CDR: 55%)

PI-RADS 5: Very high (CDR: 83%)

Source: Oerther B, et al. Update on PI-RADS Version 2.1 Diagnostic Performance Benchmarks for Prostate MRI: Systematic Review and Meta-Analysis. Radiology. 2024 Aug;312(2):e233337 PMID: 39136561.

Transrectal vs Transperineal Biopsy



Dr. Alp Beksac



Transperineal local anesthesia

Transrectal vs Transperineal Biopsy

Transperineal Versus Transrectal Magnetic Resonance Imaging-targeted and Systematic Prostate Biopsy to Prevent Infectious Complications: The PREVENT Randomized Trial



Hu et al, 2024 PMID: 38212178

- Multicenter RCT; n = 658
- GG ≥ 2 PCa: TP: 53% vs TR: 50%
- Adjusted difference 2.0%; 95% CI –6.0, 10

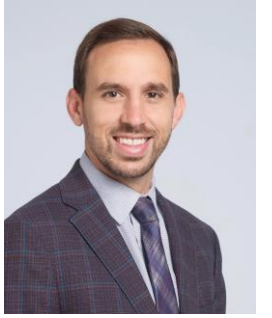
Transperineal biopsy:

- No infections
- Only one case of urinary retention
- Higher rates of transient pain

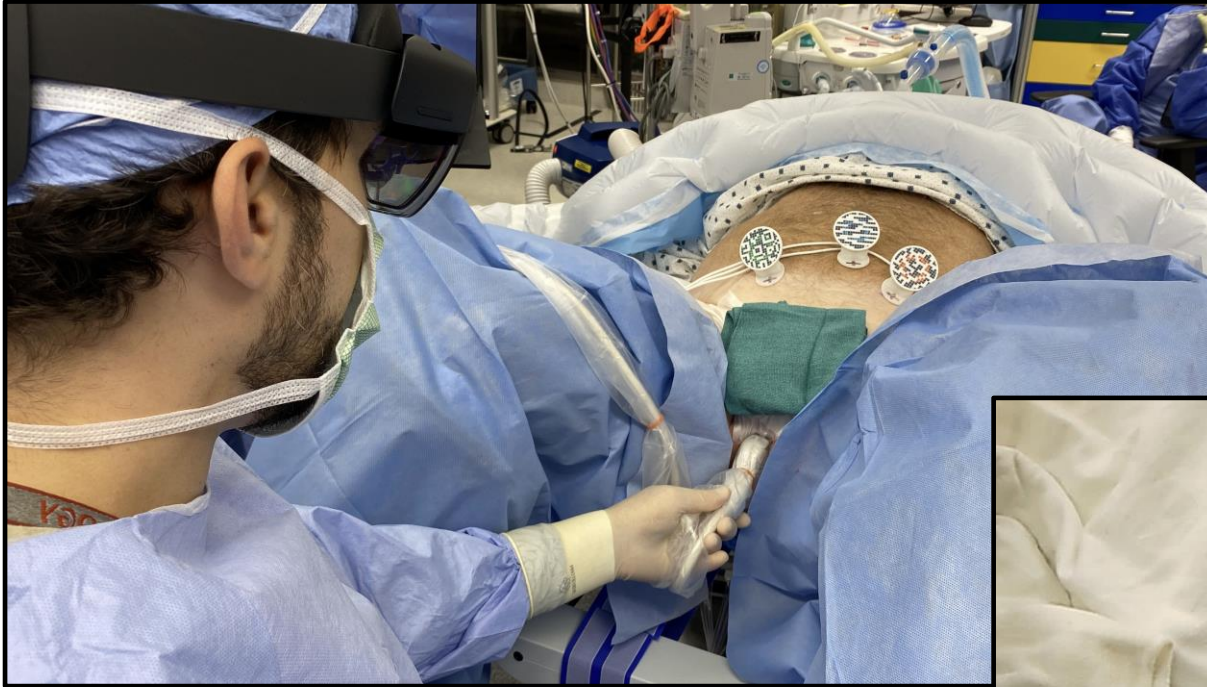
Table 2 – Adverse events by randomization arm where differences are calculated as the difference in the transrectal arm subtracted from the transperineal arm

Characteristic	Transperineal (N = 287), n (%)	Transrectal (N = 280), n (%)	Difference (%)	95% Confidence interval (%)	p value
Infection	0 (0)	4 (1.4)	–1.4	–3.6, 0.2	0.059
Urinary retention	1 (0.3)	3 (1.1)	–0.7	–2.8, 1.0	
Bleeding requiring intervention	0 (0)	1 (0.4)	–0.4	–2.0, 1.0	
Gleason grade group 2–5	151 (53)	141 (50)	2.0	–6.0, 10	
Gleason grade group 1	49 (17)	62 (22)	–5.1	–12, 1.7	

Transperineal US-guided biopsy

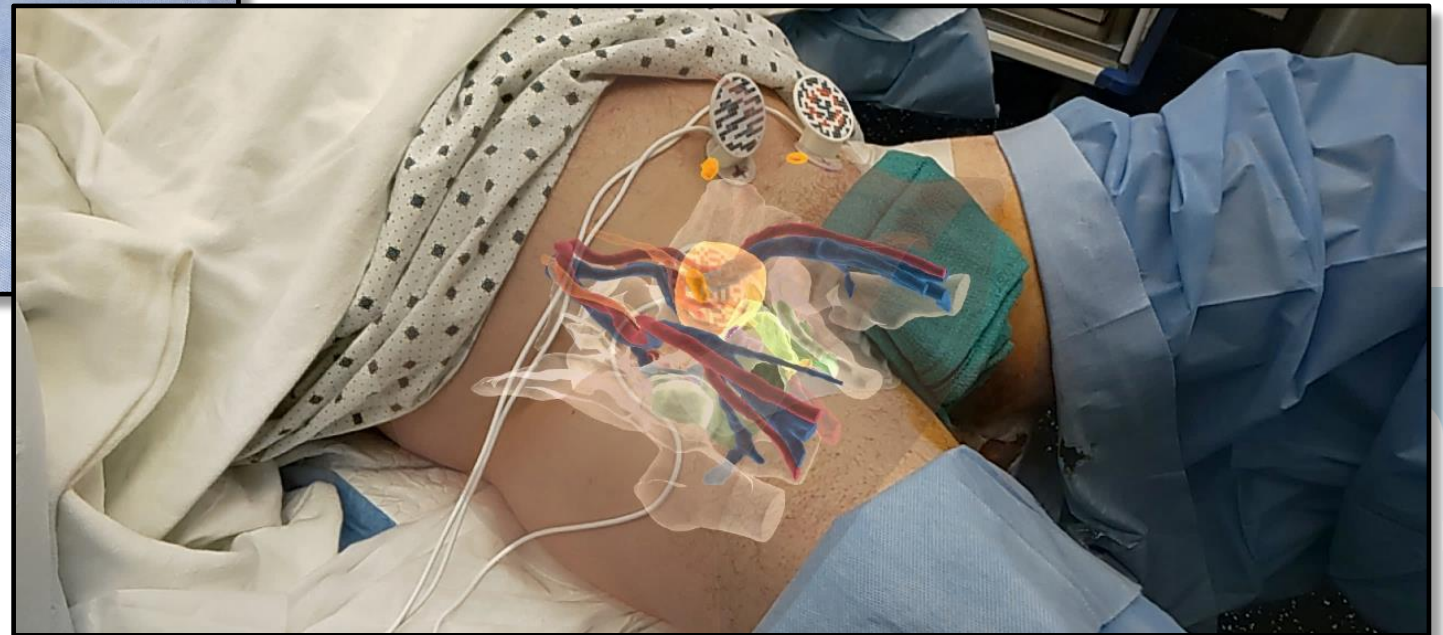


Zeyad Schwen, MD



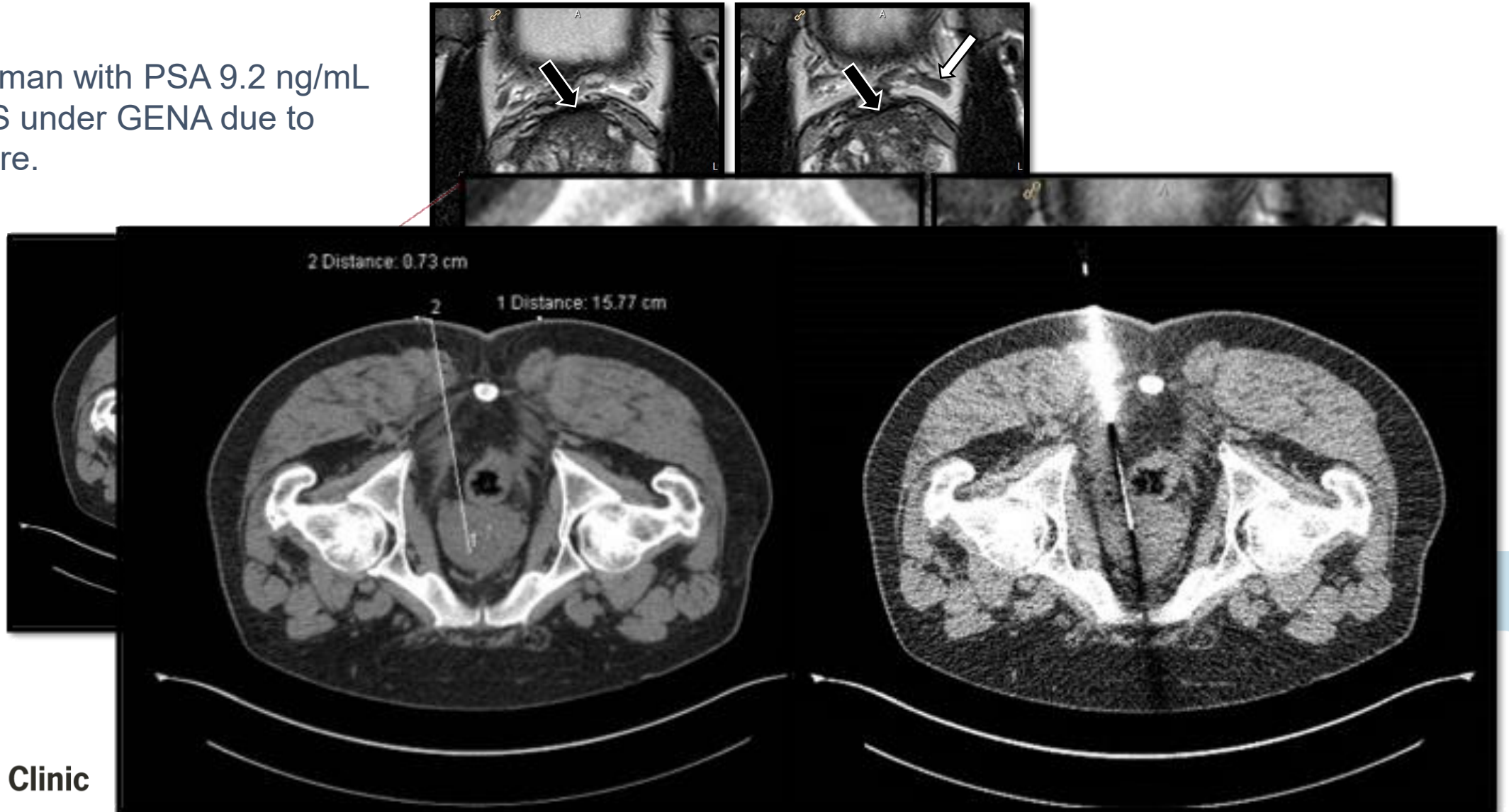
MedView AR System with
Microsoft HoloLens

Option for patients without a rectum or who
are unable to tolerate TRUS



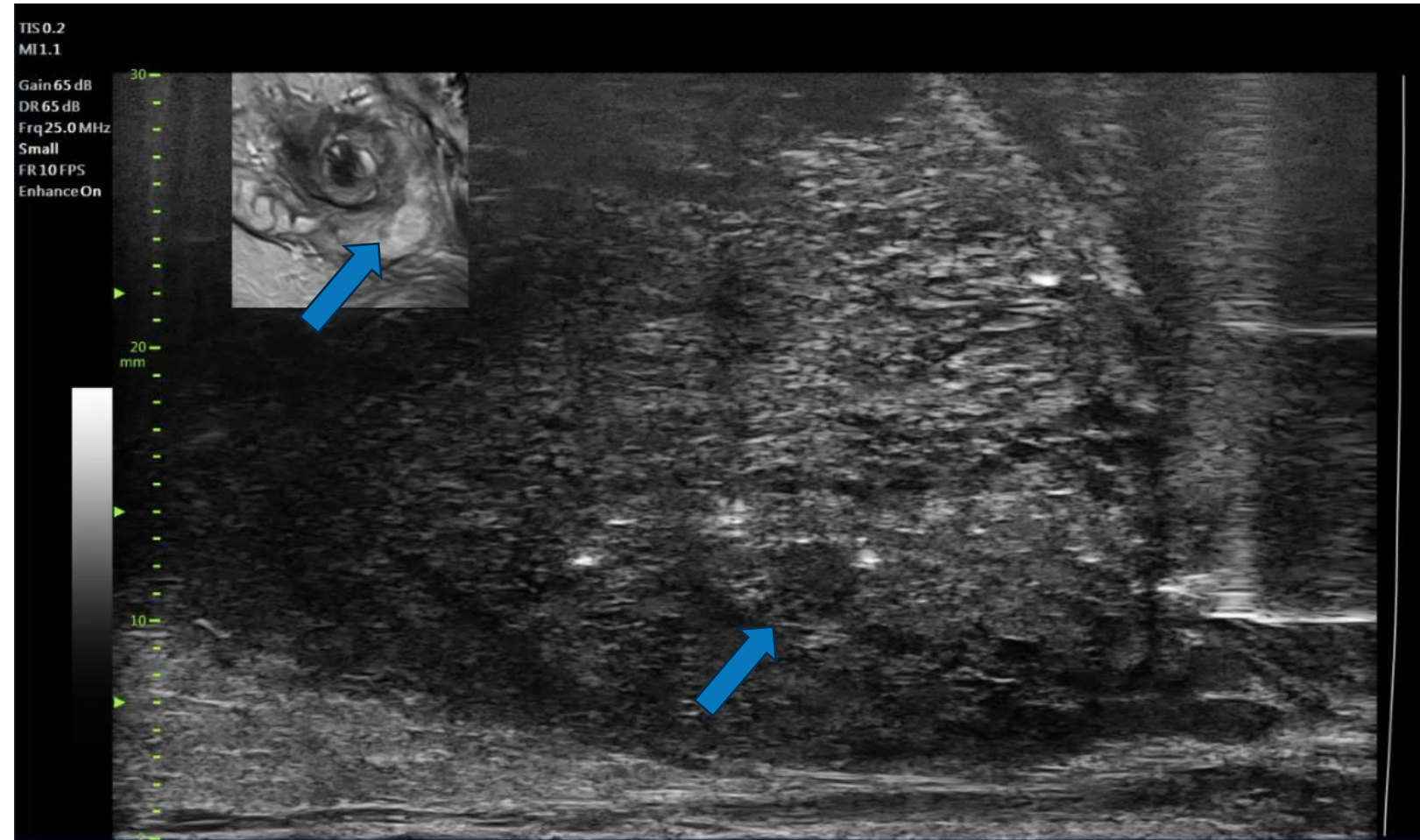
Transgluteal CT-guided biopsy

65-year-old man with PSA 9.2 ng/mL
Failed TRUS under GENA due to
rectal stricture.



MicroUS

- 29 MHz
- Image resolution 0.07 mm.
- It can be performed alone or using MRI fusion.



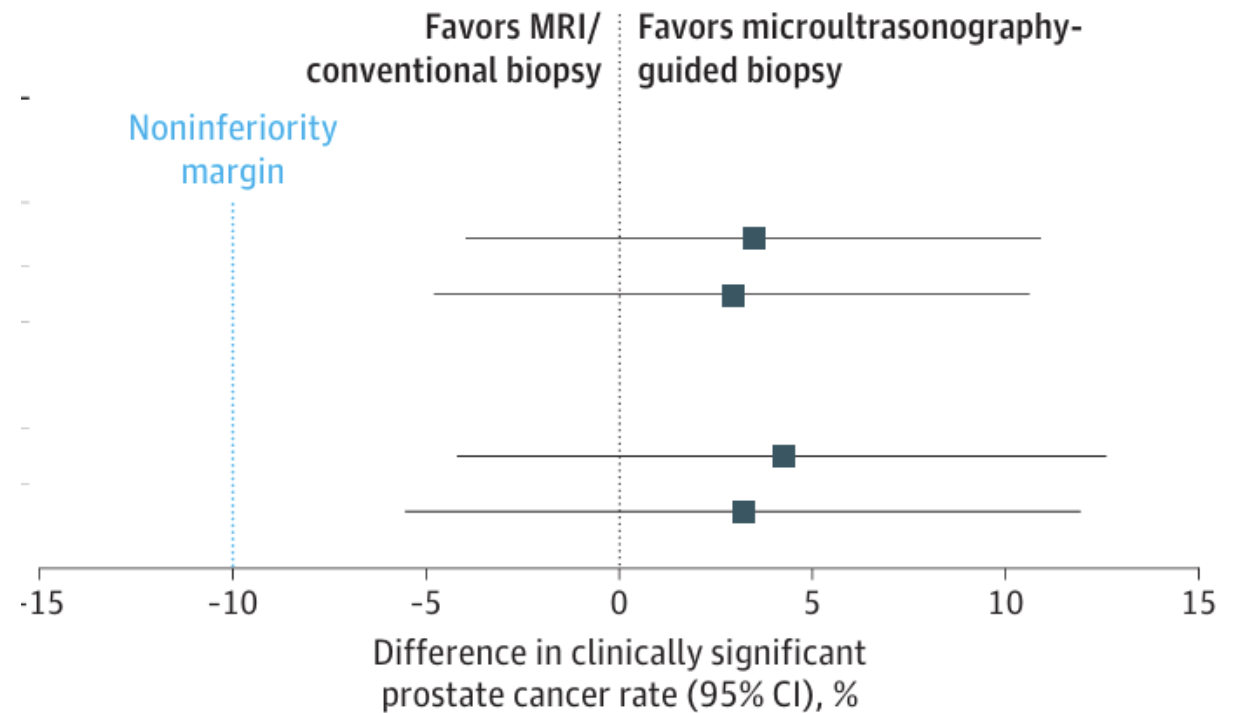
MicroUS

JAMA | Original Investigation

Microultrasound-Guided vs MRI-Guided Biopsy for Prostate Cancer Diagnosis The OPTIMUM Randomized Clinical Trial

Kinnaird A., et al, 2025 PMID: 40121537

- Multicenter RCT (20 centers, 8 countries)
- N= 678 men
- MicroUS vs MRI for GG ≥ 2 detection:
- MicroUS: 57 (47.1%)
- MRI: 141(42.6%)
- MicroUS/MRI 106 (46.9%)



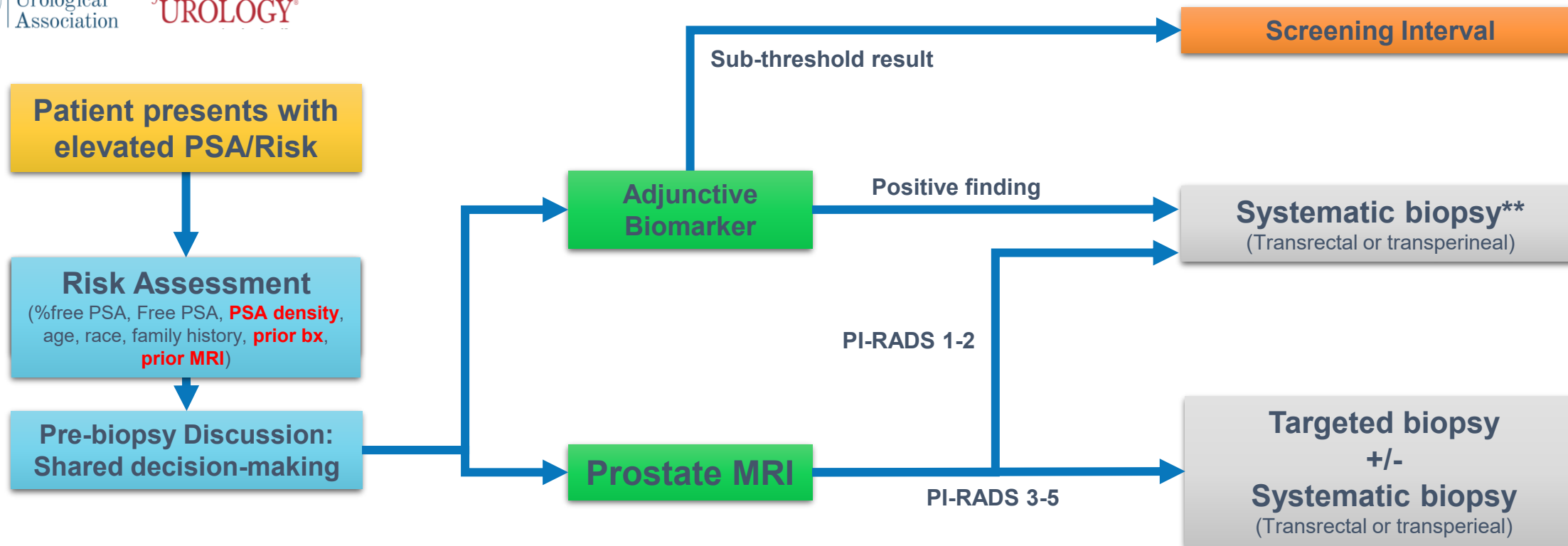
MicroUS-guided biopsy was noninferior to MRI fusion-guided biopsy, difference, 3.52% [95%CI,-3.95% to 10.92%]; noninferiority P < .001)

Biopsy Sampling Strategy



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Association

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**Early Detection of Prostate Cancer: AUA/SUO Guideline Part II:
Considerations for a Prostate Biopsy**

The Value of Systematic Biopsy

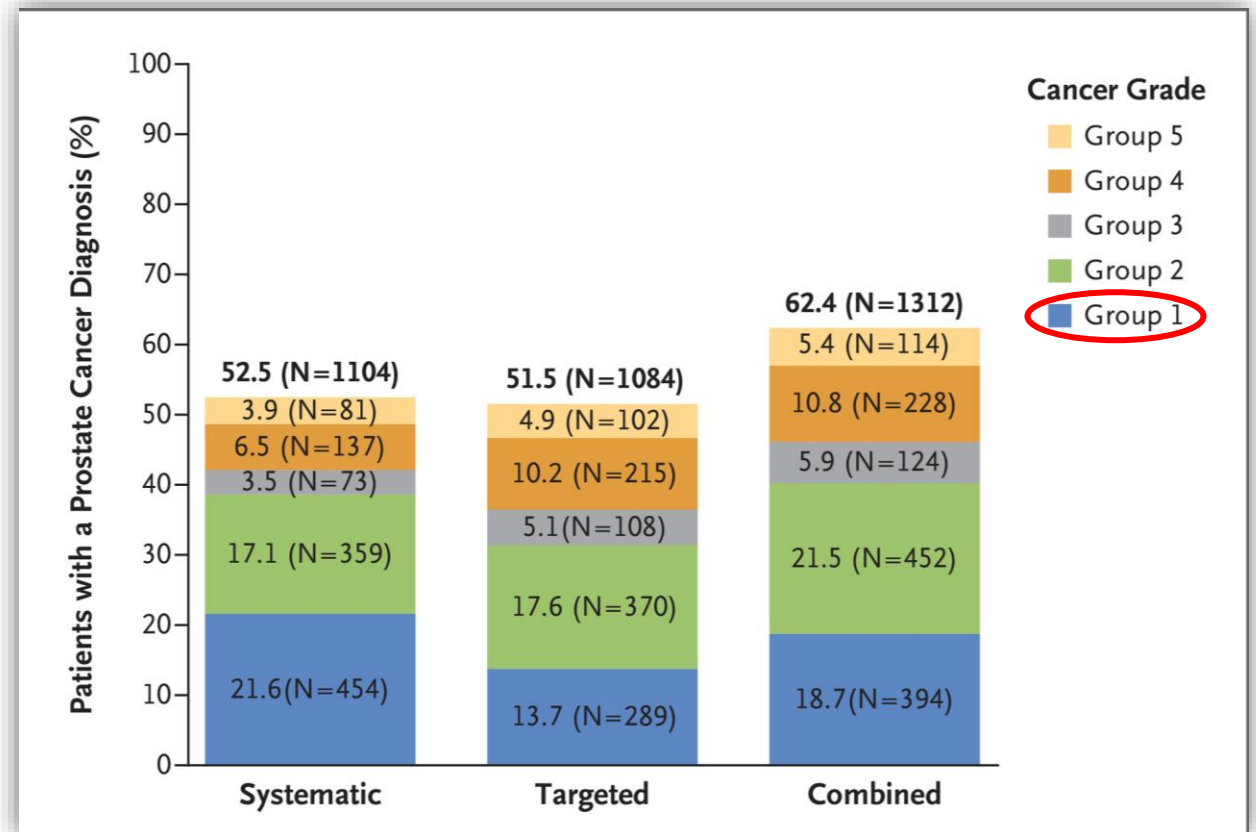
MRI-Targeted, Systematic, and Combined Biopsy for Prostate Cancer Diagnosis



The NEW ENGLAND
JOURNAL of MEDICINE

Ardoot et al, 2020 PMID: 32130814

- N = 2103 men
- **Targeted + Systematic biopsy:**
 - $\uparrow$ GG ≥ 2 PCa detection rates
 - $\downarrow$ rates on upgrades on RP
 - Small $\uparrow$ in GG 1 PCa



The Value of **Systematic Biopsy**

Regional Versus Systematic Biopsy in Addition to Targeted Biopsy: Results from a Systematic Review and Meta-analysis

Sanguedolce et al, 2024 PMID: 39455339

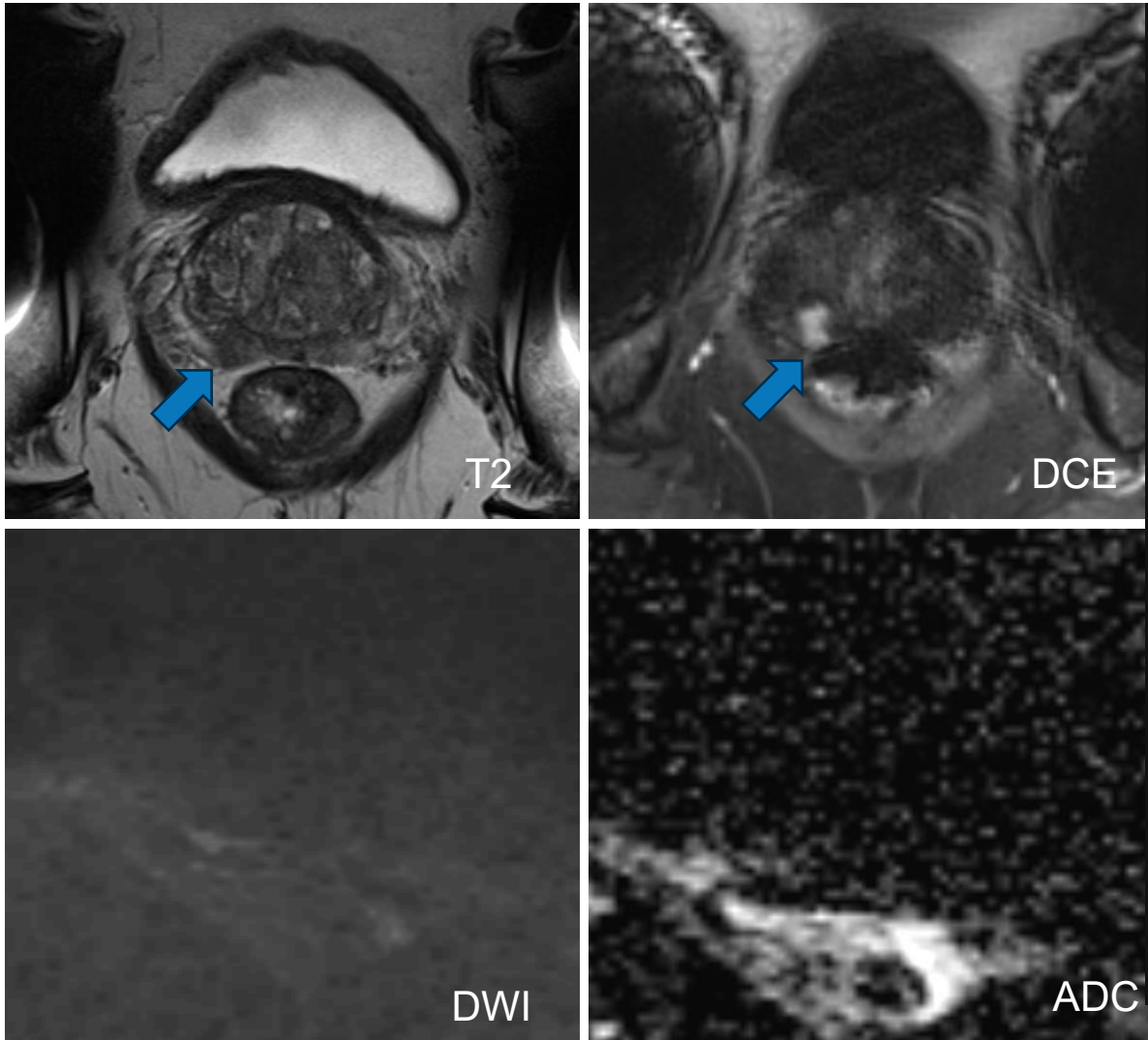
- 21 studies
- GG ≥ 2 detection:
 - MRI-Targeted + Systematic biopsy: 46.1 %
 - MRI-Targeted + **Regional** biopsy: 44.2%
 - OR 1.07, 95% CI 0.99–1.16, $p = 0.07$;
- **MRI-Targeted + Systematic biopsy: higher GG 1 PCa detection**
 - OR 1.16, 95% CI 1.04–1.30, $p = 0.008$

Regional biopsy =
Ipsilateral or perilesional



Case 1:

71-year-old man with PSA 6.5 ng/ml



FINAL DIAGNOSIS

A. Prostate, left base, biopsy:

- Benign prostatic tissue.

B. Prostate, left mid, biopsy:

- High-grade prostatic intraepithelial neoplasia.

C. Prostate, left apex, biopsy:

- Small focus of atypical glands (atypical small acinar proliferation).

D. Prostate, right base, biopsy:

- Prostatic adenocarcinoma, Gleason score 3+4=7 (Grade Group 2), involving 1 of 2 cores (55%, 8 mm).

- Percentage of Gleason pattern 4 = 30%.

E. Prostate, right mid, biopsy:

- Benign prostatic tissue.

F. Prostate, right apex, biopsy:

- Benign prostatic tissue.

G. Prostate, T1 right mid/base posteromedial peripheral zone, biopsy:

- Small focus of atypical glands (atypical small acinar proliferation).

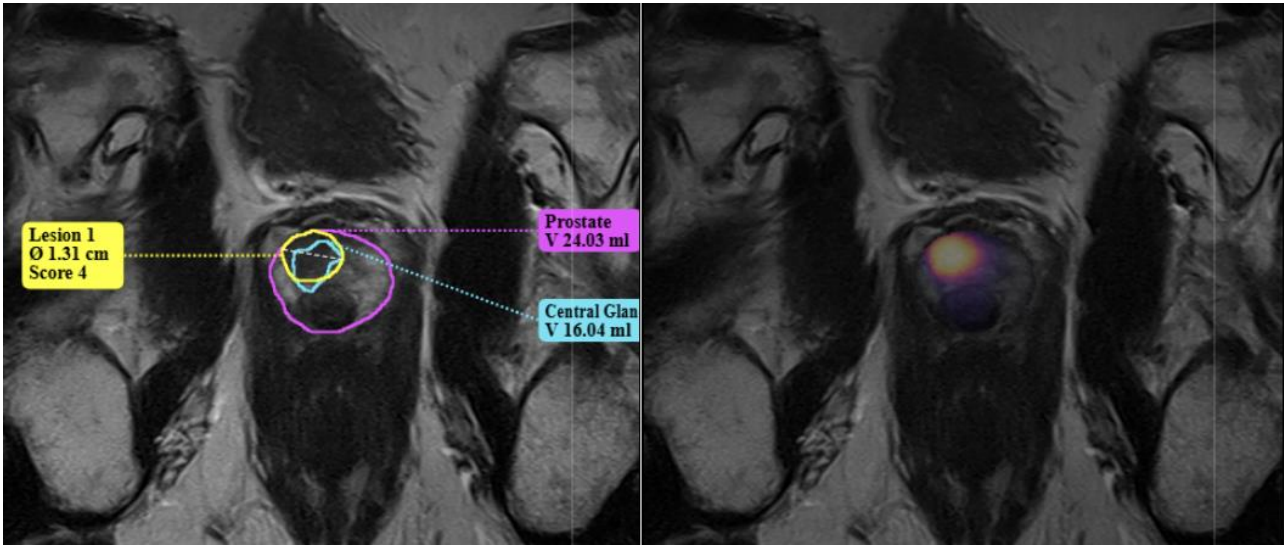
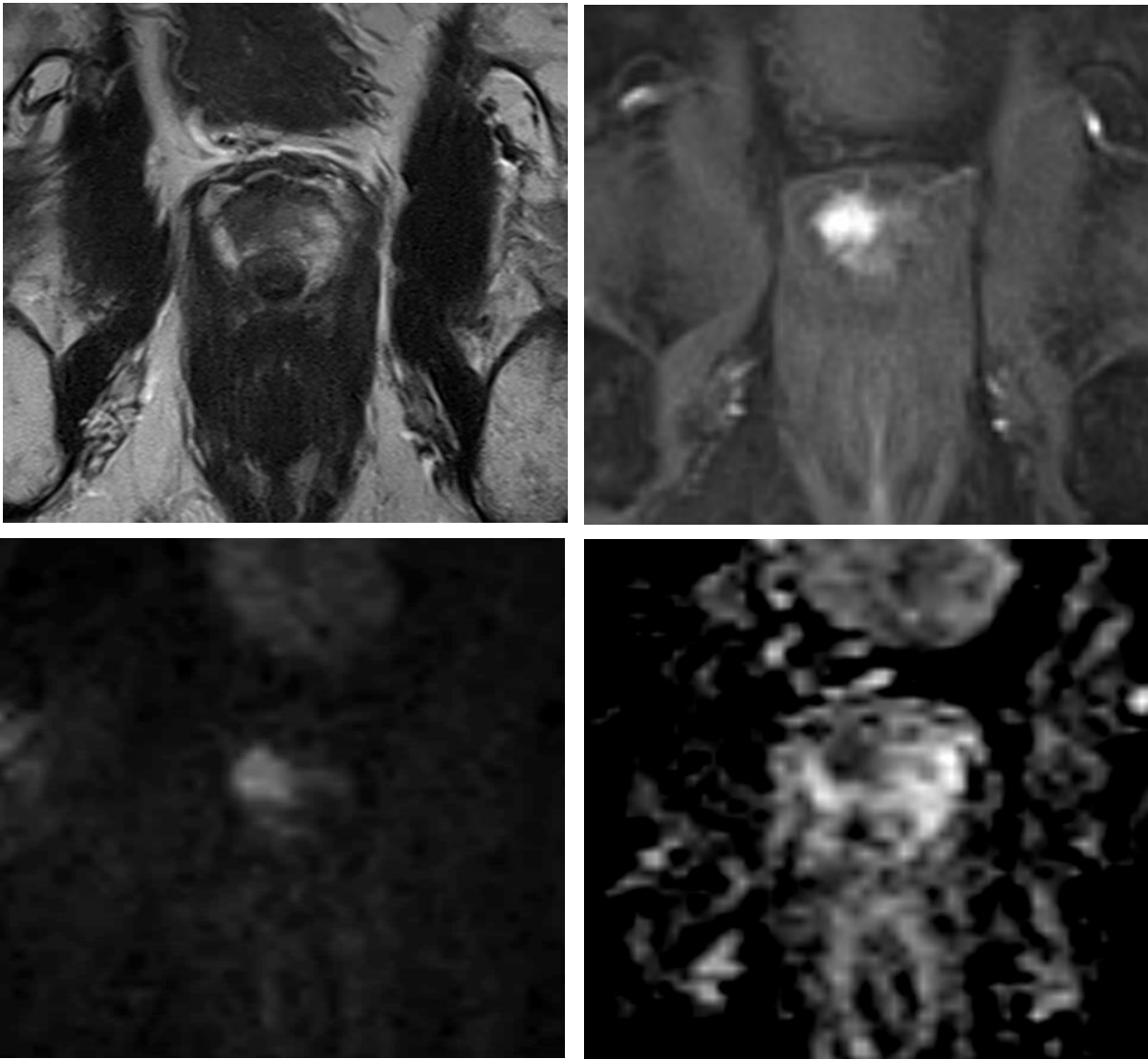
H. Prostate, T2 left apex anterior transition zone, biopsy:

- Benign prostatic tissue.

PI-RADS 4 Right base posteromedial PZ

Case 2:
73-year-old man with PSA 4.0 ng/ml

Reader: PI-RADS 4
AIRC: PI-RADS 4 (LoS: 99%)



● Lesion 1	
Index Lesion	☐
Slice Range	11–12
Diameter [cm] ⓘ	1.31
Localization	Right, Apex, TZa
Score ⓘ	4
Level of Suspicion:	99% ⓘ

Case 2:

73-year-old man with PSA 4.0 ng/ml

FINAL DIAGNOSIS

A. Prostate, left lateral anterior, core biopsy:
- Benign prostatic tissue.

B. Prostate, left medial anterior, core biopsy:
- Benign prostatic tissue.

C. Prostate, left lateral posterior, core biopsy:
- Benign prostatic tissue.

D. Prostate, left medial posterior, core biopsy:
- Benign prostatic tissue.

E. Prostate, right lateral anterior, core biopsy:
- Prostatic adenocarcinoma, Gleason score 3+4=7 (Grade Group 2), involving 1 of 2 cores (4 mm, 35%).
- Percentage of Gleason pattern 4 = 5%.

F. Prostate, right medial anterior, core biopsy:
- Prostatic adenocarcinoma, Gleason score 3+4=7 (Grade Group 2), involving 2 of 2 cores (6 mm, 40%; 5 mm, 40%).
- Percentage of Gleason pattern 4 = 20%.

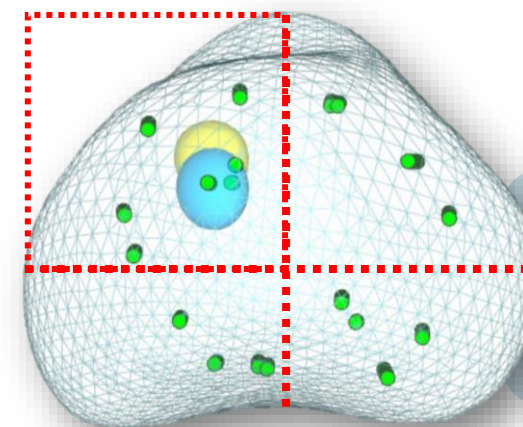
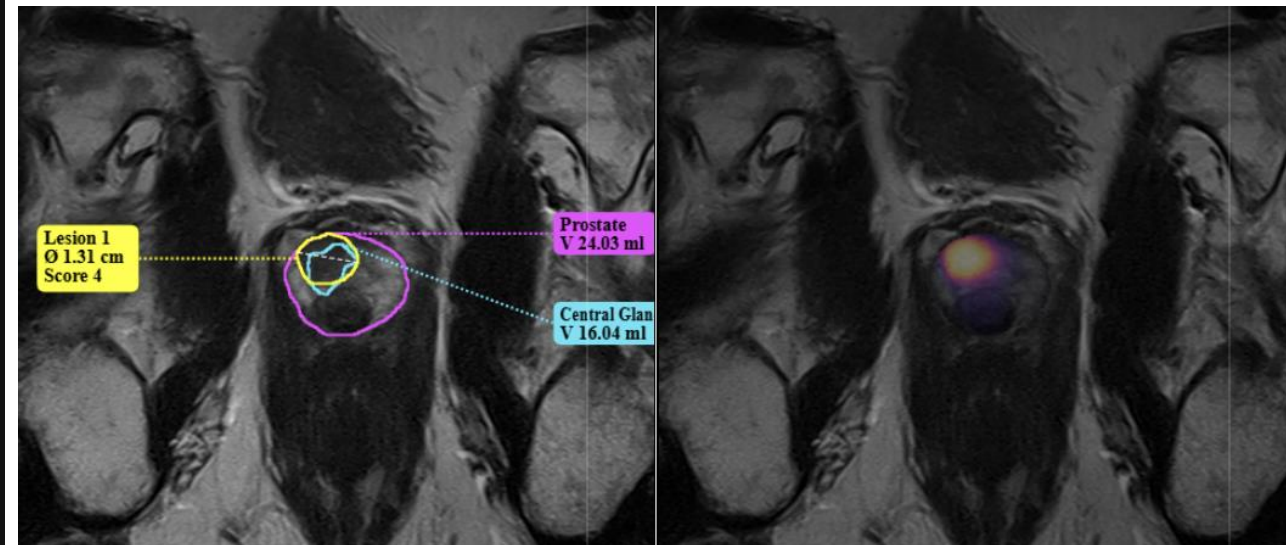
G. Prostate, right lateral posterior, core biopsy:
- Benign prostatic tissue.

H. Prostate, right medial posterior, core biopsy:
- Benign prostatic tissue.

I. Prostate, target one right apex anterior peripheral zone slightly crossing over the midline, core biopsy:
- Prostatic adenocarcinoma, Gleason score 3+4=7 (Grade Group 2), involving 2 of 3 cores (3 mm, 20%; 1 mm, 5%).
- Percentage of Gleason pattern 4 = 10%.

Reader: PI-RADS 4

AIRC: PI-RADS 4 (LoS: 99%)



Case 2:

73-year-old man with PSA 4.0 ng/ml

FINAL DIAGNOSIS

- A. Prostate, left lateral anterior, core biopsy:
 - Benign prostatic tissue.
- B. Prostate, left medial anterior, core biopsy:
 - Benign prostatic tissue.
- C. Prostate, left lateral posterior, core biopsy:
 - Benign prostatic tissue.
- D. Prostate, left medial posterior, core biopsy:
 - Benign prostatic tissue.
- E. Prostate, right lateral anterior, core biopsy:
 - Prostatic adenocarcinoma, Gleason score 3+4=7 (Grade Group 2), involving 1 of 2 cores (4 mm, 35%).
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- F. Prostate, right medial anterior, core biopsy:
 - Prostatic adenocarcinoma, Gleason score 3+4=7 (Grade Group 2), involving 2 of 2 cores (6 mm, 40%; 5 mm, 40%).
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- G. Prostate, right lateral posterior, core biopsy:
 - Benign prostatic tissue.
- H. Prostate, right medial posterior, core biopsy:
 - Benign prostatic tissue.
- I. Prostate, target one right apex anterior peripheral zone slightly crossing over the midline, core biopsy:
 - Prostatic adenocarcinoma, Gleason score 3+4=7 (Grade Group 2), involving 2 of 3 cores (3 mm, 20%; 1 mm, 5%).
 - Percentage of Gleason pattern 4 = 10%.

Prostate Cancer Biopsy Summary

Number of cores examined: 19

Number of cores positive: 5

Highest Grade Group: 2

Highest % of core involvement: 40% (6 mm)

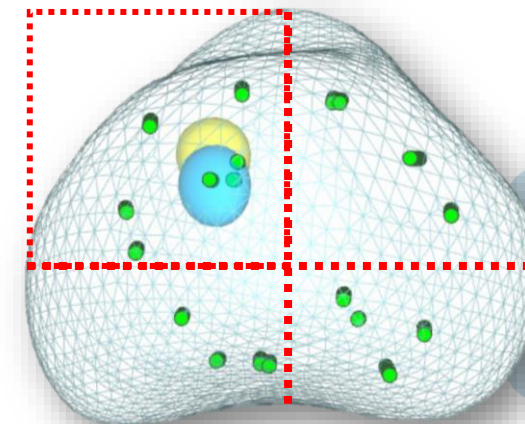
Unfavorable histology: Absent

Borderline histology: Present

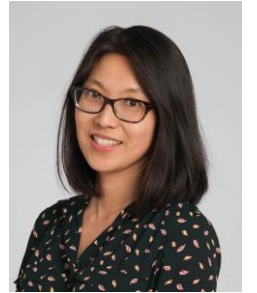
Large cribriform pattern 4: Absent

Intraductal carcinoma: Absent

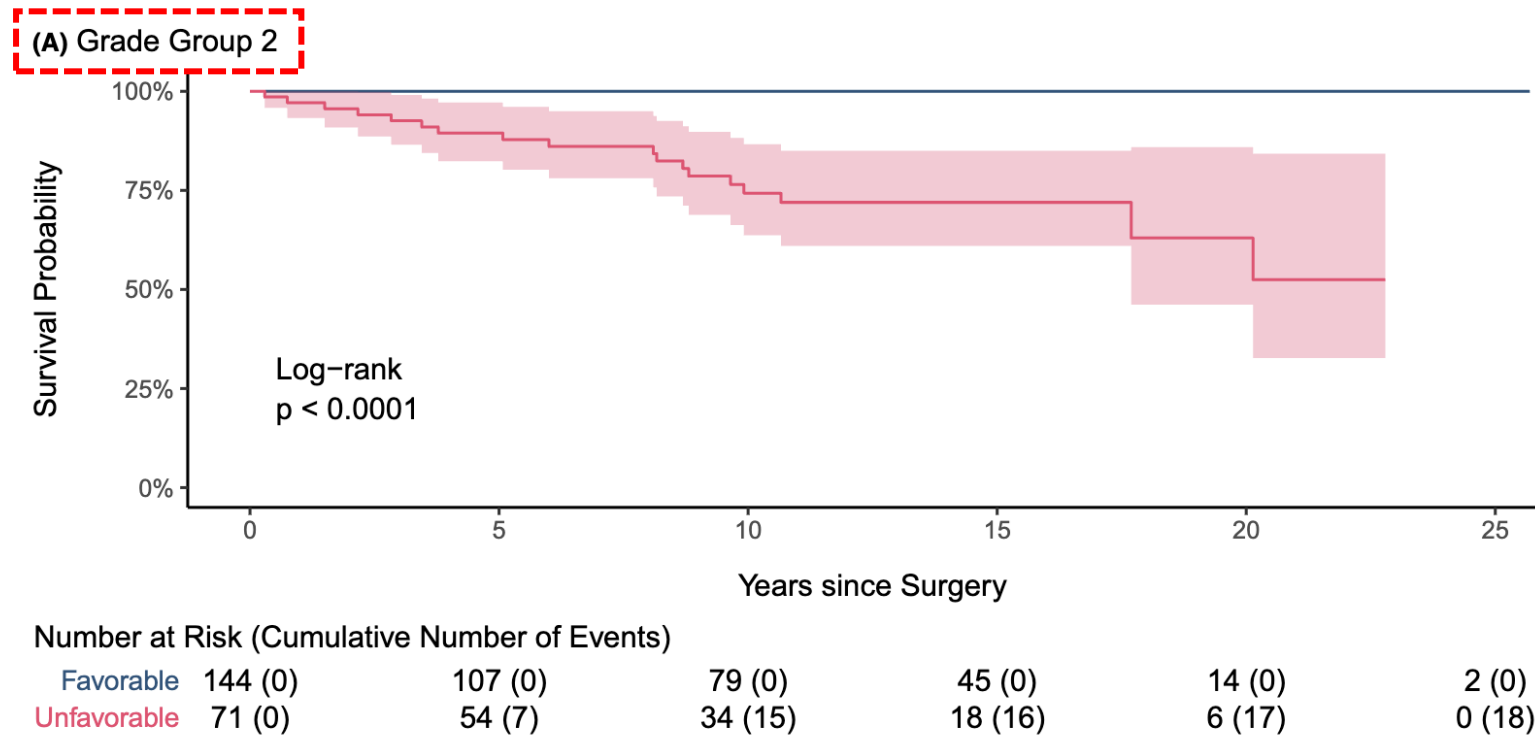
Block for additional biomarkers/molecular studies: F1



Proposal for an optimised definition of adverse pathology (unfavourable histology) that predicts metastatic risk in prostatic adenocarcinoma independent of grade group and pathological stage



Jane Nguyen, MD, PhD



Take Home Message

- MRI-targeted biopsy improves detection of clinically significant prostate cancer.
- Selecting the appropriate biopsy method should be individualized based on patient factors, anatomy, institutional expertise, and available resources.
- Limited systematic sampling remains essential to reduce the risk of missing or undersampling tumors.
- Review of the biopsy report (and understanding histopathology assessment) is an important element of the QC process.

Thank you!





Every life deserves world class care.