10:15 – 10:45 Integrating Radiology and Oncology: A Multidisciplinary Approach

MRI in prostate cancer

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Thank you

Prof. Henrik S. Thomsen

A Multidisciplinary Approach

- What is MRI of the prostate ?
- Why ?
- How ?
- What is multidisiplinary in this context ?
- How do we do it ?
- What have we learned?
- Is it worth it ?
- Health economists ? Lifequality ? Survival ?
- Ask the patients ?

But you cannot say MRI for the prostata with out saying PI-RADS

- PI-RADS and Jelle Barentsz

Eur Radiol (2012) 22:746–757
DOI 10.1007/s00330-011-2377-y

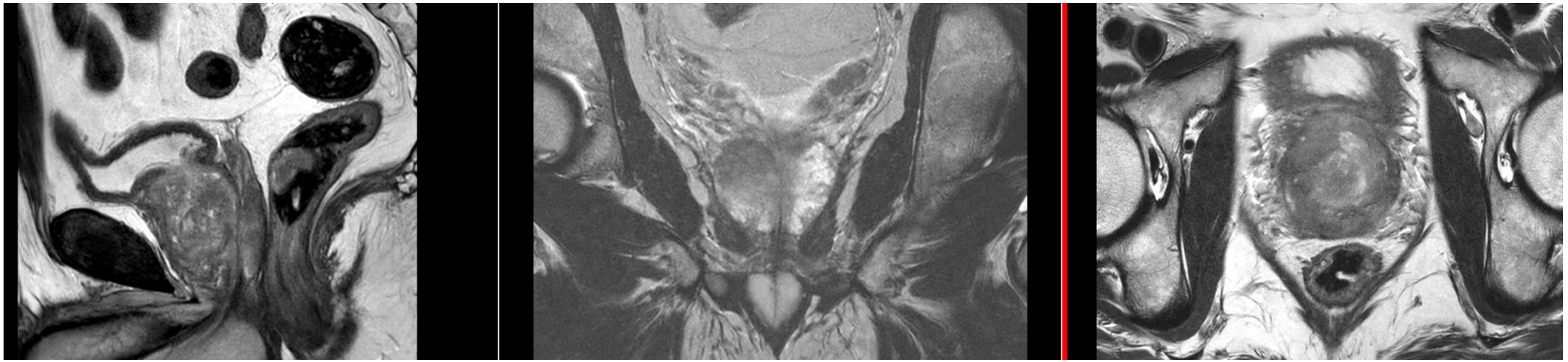
UROGENITAL

ESUR prostate MR guidelines 2012

Jelle O. Barentsz · Jonathan Richenberg · Richard Clements · Peter Choyke · Sadhna Verma · Geert Villeirs · Olivier Rouviere · Vibeke Logager · Jurgen J. Fütterer

5-point scoring system used by radiologists and urologists to evaluate prostate MRIs. It acts as a "common language" that scores the likelihood of clinically significant prostate cancer to be present.

This is MRI of the prostate

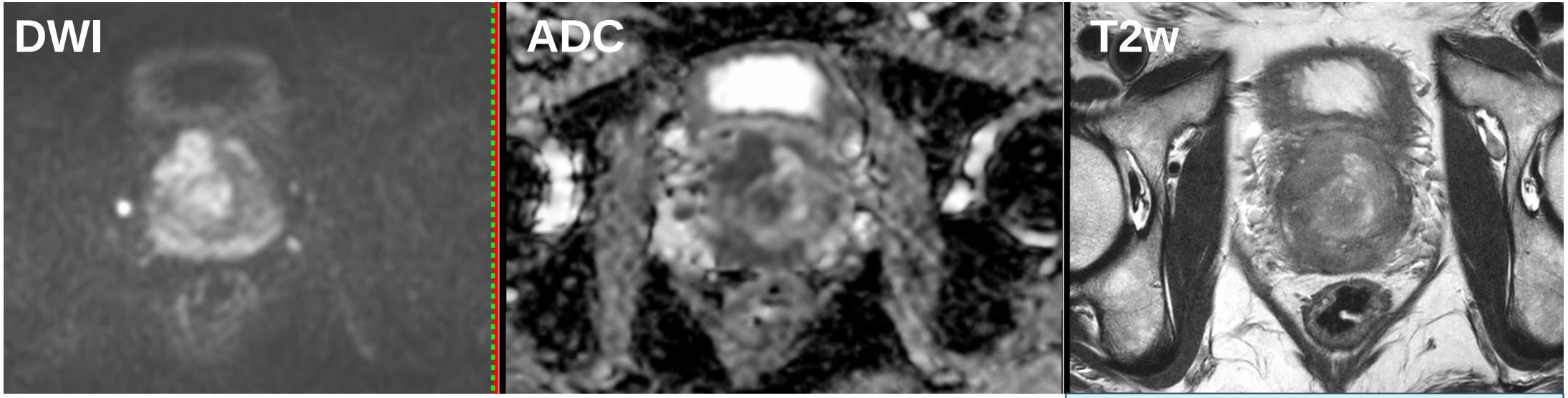


Basic 3-plane T2w, sagittal, coronal and axial. Anatomy is shown.

Patient preparation very important. Avoid rectal gas and ejaculation.

Image quality very important. High signal to noise, high resolution and no movements.

Functional imaging 1. Restricted water movement between cells and inside cells



DWI (Diffusion Weighted Imaging)

ADC (Apparent Diffusion Coefficient)

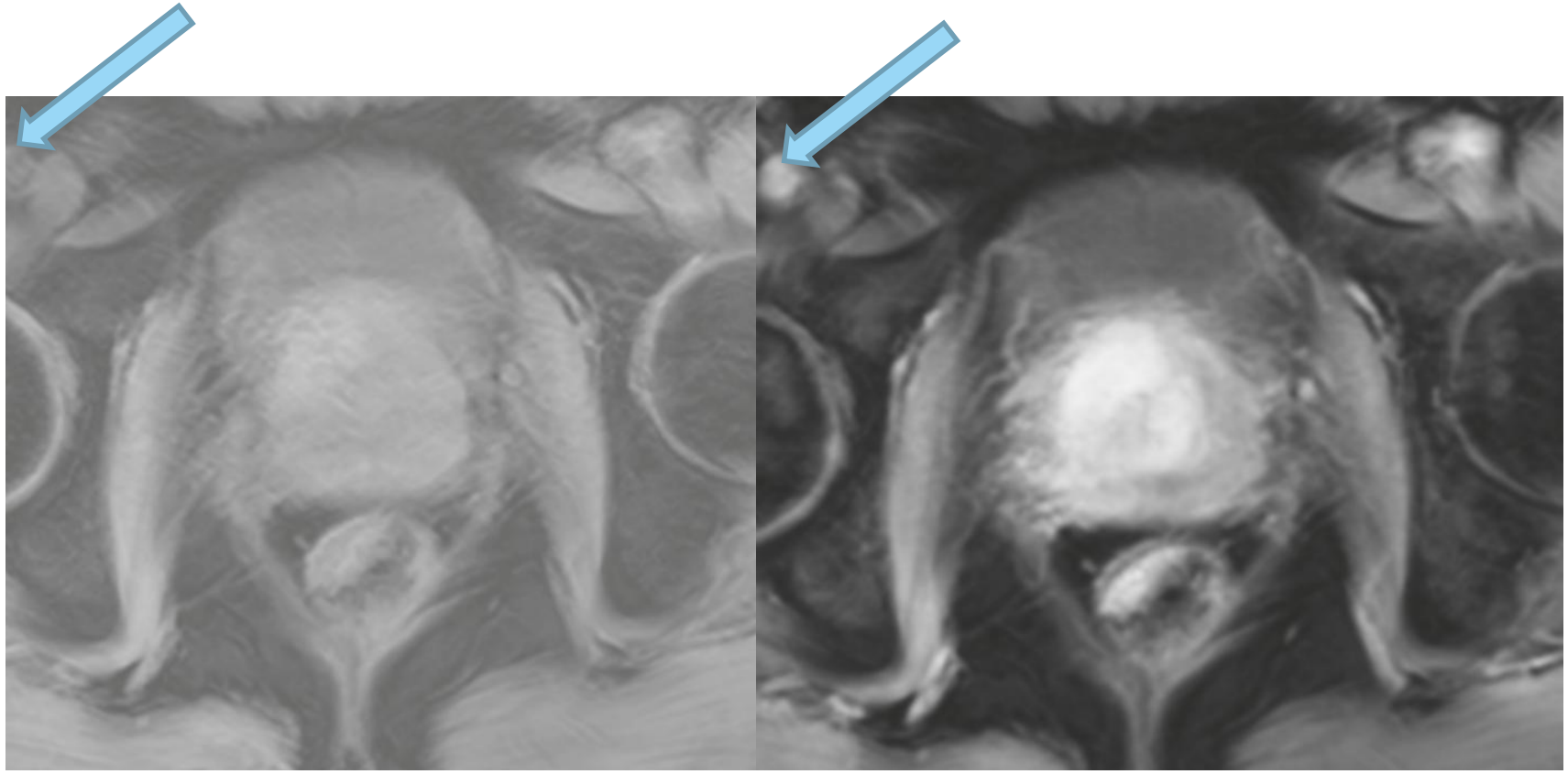
T2w (anatomy but also homogen tumor)

"Disease is White on Image"

"Aware Dark Cancer"

Memo

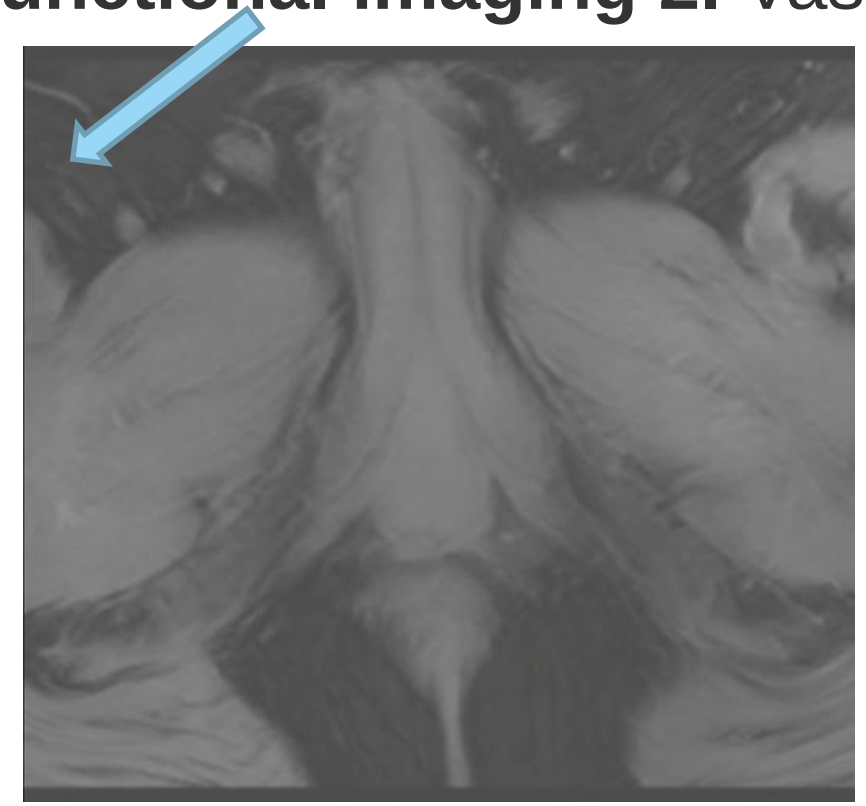
Functional imaging 2. Vascularity



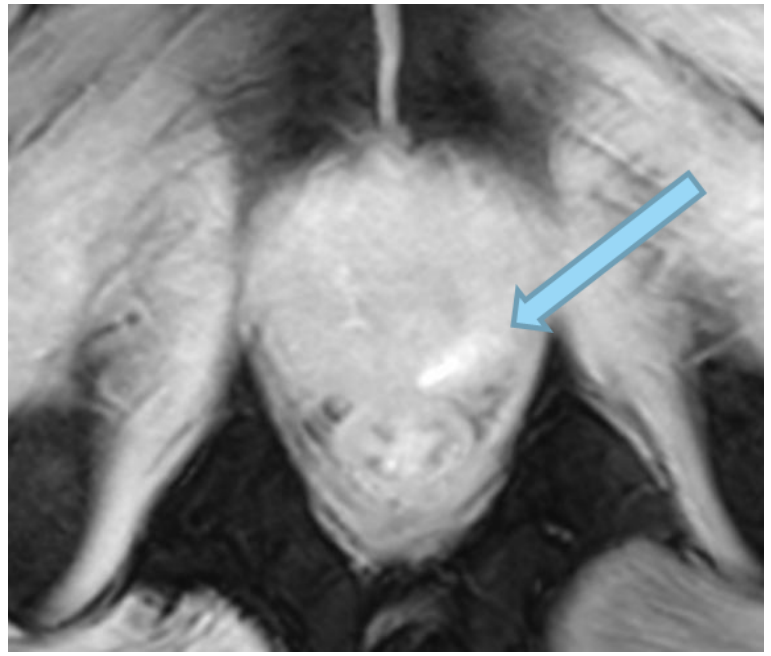
DCE (Dynamic Contrast Enhancement) time resolution ≤ 15sec

T1w Fatsaturated or by subtraction

Functional imaging 2. Vascularity



A different patient shortly after biopsy with blood product in the prostata.



DCE (Dynamic Contrast Enhancement) time resolution ≤ 15sec

T1w Fatsaturated or by subtraction

But you cannot say MRI for the prostata with out saying PI-QUAL

- **PI-QUAL version 2: an update of a standardised scoring system for the assessment of image quality of prostate MRI**
- Clinical relevance statement High image quality is crucial for prostate MRI, and the updated version of the PI-QUAL score (PI-QUAL v2) aims to address the limitations of version 1. It is now applicable to both multiparametric MRI and MRI without intravenous contrast medium.

Table 2 Essential technical prerequisites per sequence

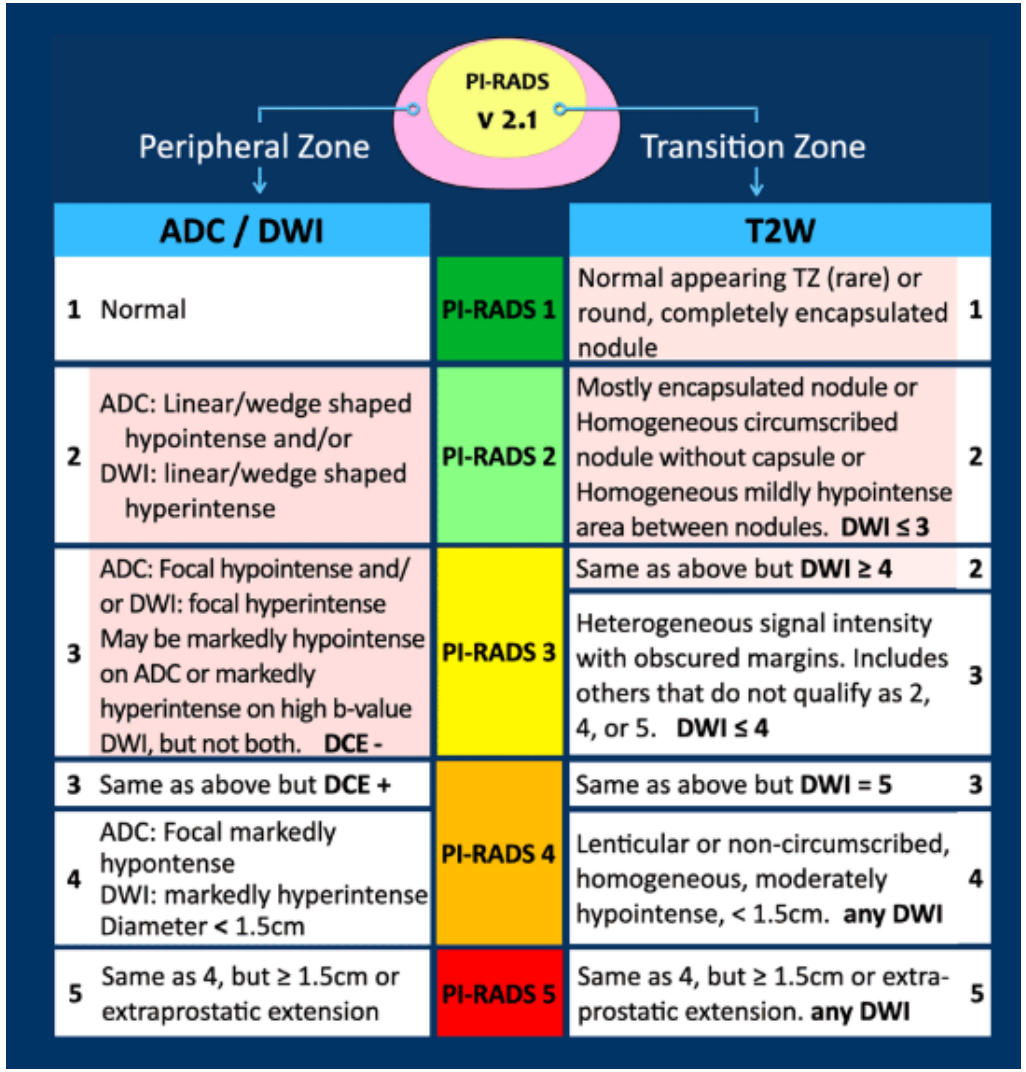
T2-WI	DWI	DCE
3 mm Slice thickness	≤ 4 mm Slice thickness High *b* value sequence (≥ 1400 s/mm^2), calculated or acquired ADC map using at least two *b* values up to 1000 s/mm^2	3 mm Slice thickness Temporal resolution ≤ 15 s Fat suppression (or include post-processing, e.g. subtraction/heat maps) 3D sequences (preferred)

T2-WI T2-weighted imaging, *DWI* diffusion-weighted imaging, *DCE* dynamic contrast-enhancement, *ADC* apparent diffusion coefficient

Eur Radiol. 2024 Nov;34(11):7068-7079.doi: 10.1007/s00330-024-10795-4. Epub 2024 May 24

This is multiparametric MRI of the prostate

- Images are evaluatede according to PI-RADS guidelines v.2.1
- PI-RADS 1 – Very low (clinically significant cancer is highly unlikely to be present)
- PI-RADS 2 – Low (clinically significant cancer is unlikely to be present)
- PI-RADS 3 – Intermediate (the presence of clinically significant cancer is equivocal)
- PI-RADS 4 – High (clinically significant cancer is likely to be present)
- PI-RADS 5 – Very high (clinically significant cancer is highly likely to be present)



ADC / DWI		T2W	
1 Normal	PI-RADS 1	Normal appearing TZ (rare) or round, completely encapsulated nodule	1
2 ADC: Linear/wedge shaped hypointense and/or DWI: linear/wedge shaped hyperintense	PI-RADS 2	Mostly encapsulated nodule or Homogeneous circumscribed nodule without capsule or Homogeneous mildly hypointense area between nodules. **DWI ≤ 3**	2
3 ADC: Focal hypointense and/ or DWI: focal hyperintense May be markedly hypointense on ADC or markedly hyperintense on high b-value DWI, but not both. **DCE -**	PI-RADS 3	Same as above but **DWI ≥ 4**	2
		Heterogeneous signal intensity with obscured margins. Includes others that do not qualify as 2, 4, or 5. **DWI ≤ 4**	3
3 Same as above but **DCE +**	PI-RADS 4	Same as above but **DWI = 5**	3
4 ADC: Focal markedly hypontense DWI: markedly hyperintense Diameter < 1.5cm		Lenticular or non-circumscribed, homogeneous, moderately hypointense, < 1.5cm. **any DWI**	4
5 Same as 4, but ≥ 1.5cm or extraprostatic extension	PI-RADS 5	Same as 4, but ≥ 1.5cm or extra-prostatic extension. **any DWI**	5

Ref: www.acr.org/Clinical-Resources/Clinical-Tools-and-Reference/Reporting-and-Data-Systems/PI-RADS

Why ?

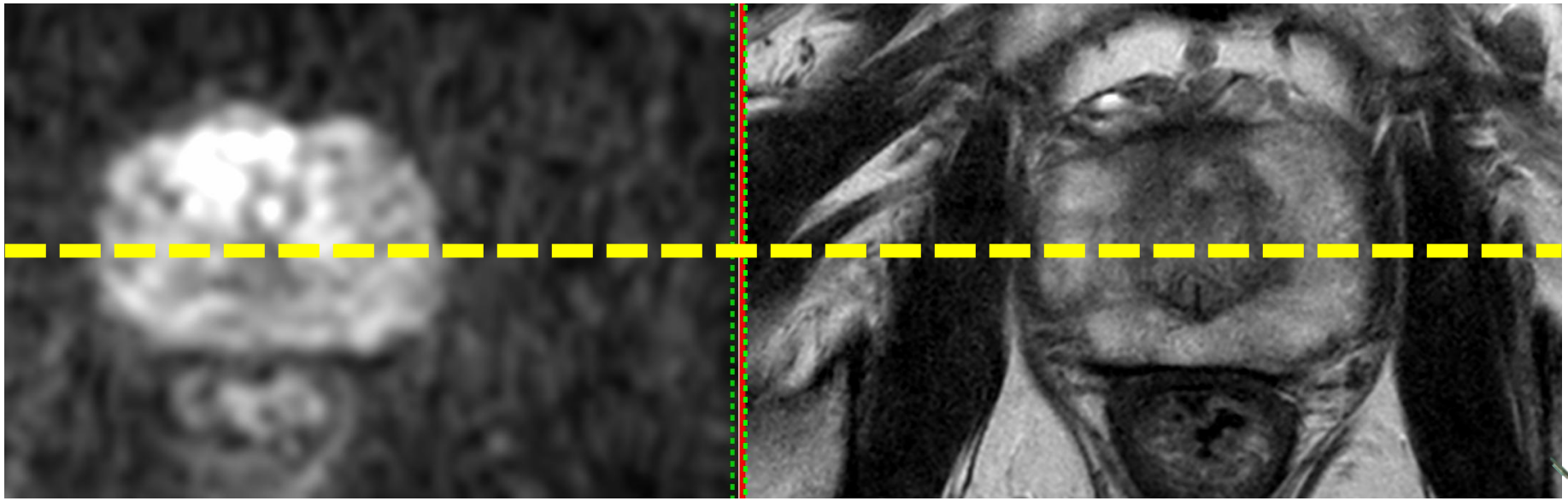
Numbers from 2022 World Cancer Recearch Fund

		Incidens	ASR/100,000	deaths/ASR100,000
Japan	125M	104,318	50,1	14,095/4.4
Denmark	5.9M	4,443	?	aprox.1370/?

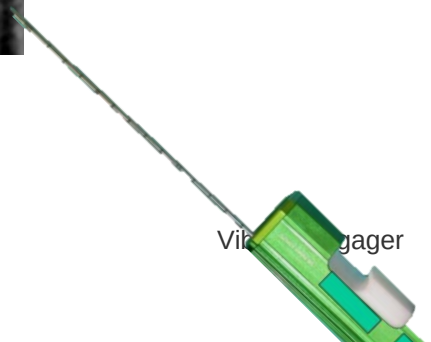
- PROSTATE CANCER STATISTICS
- **Prostate cancer is the 4th most common cancer worldwide.**
- **It is the 2nd most common cancer in men.**
- **Global Numbers at a Glance**
- **New Cases:** ~1.47 million per year
- **Deaths:** ~397,000 per year
- **Global Incidence Rate:** 29.4 cases per 100,000 men
- **Lifetime Risk:** Roughly 1 in 8 men will be diagnosed
- Incidence Japan 167/100.000 men
- Incidence Denmark 151/100.000 men

Before the MRI era:

Biopsy was done transrectal, ultrasound guidet or without image guidance



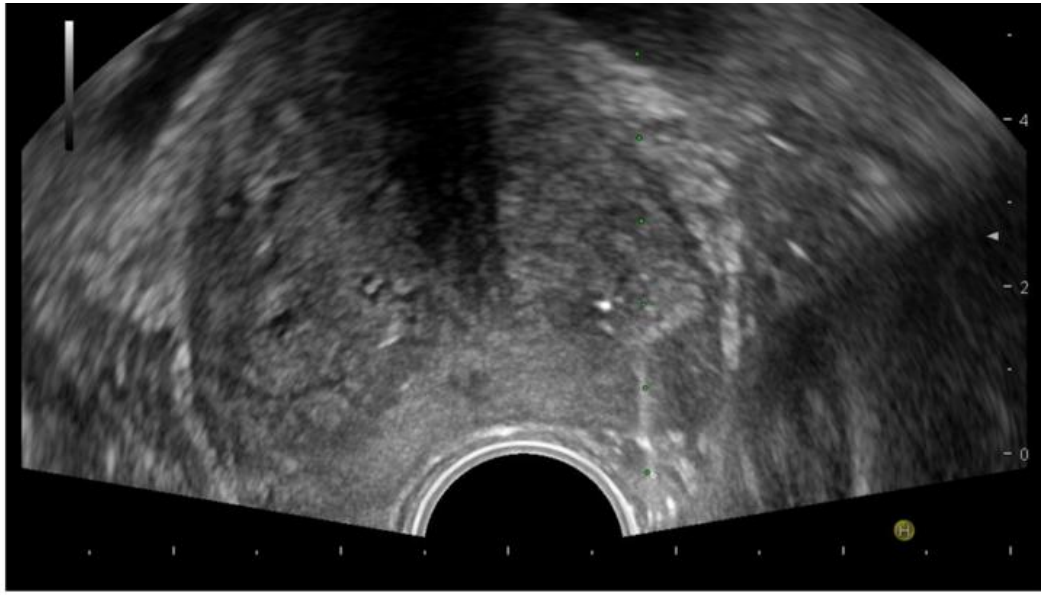
only 1,8 cm

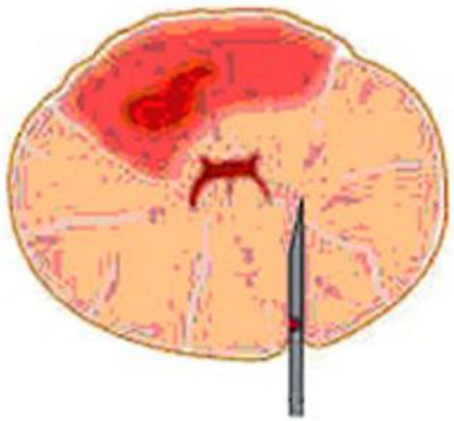


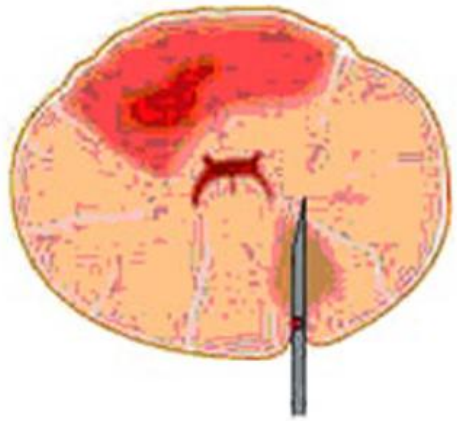
TRUS biopsy transrectal

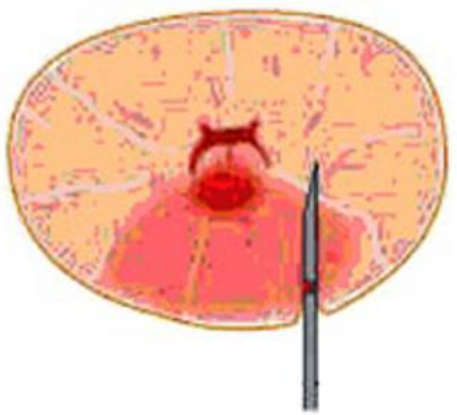
All men suspected on having PCa with expected survival of >10years,

Sepsis 5%









How?

- Patient with non specific symptoms: PSA? Hæmospermia? Hamaturia? Problems voiding? Erectil dysfunction? Other?
- Visit GP
- Referal to specialist/hospital
- Referal to MRI (the whole team and information letter to the patient)..
- Imaging (the whole team), reading, reporting, lesion marking..
- Refere back to urologist, biopsy, (the whole team) send to..
- Pathologist (the whole team) slide analysis and reporting back to the
- Urologist.. Now informing the patient of treatment posiblities….
- ……. Whats next?????

1. What is the role of the radiologist…

… in the MDT PCa approach?

MDT at Herlev hospital (DK) :

When: 2x per week, 1 hour.

Who: radiologist, nuclear-medicine p
oncologist, urologist staff,
"flow"-nurses y.

How: prior, a list of 25pt w/ relevant clinical information and questions.

I review images and the reports to speed discussion

Everybody prepares to speed discussion !

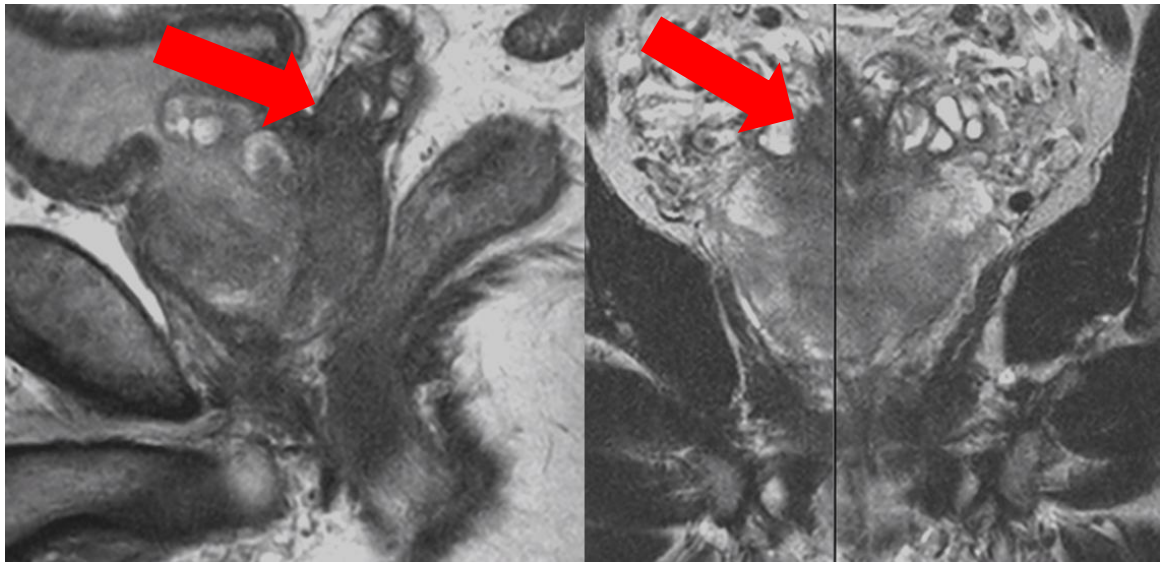
MDT at Herlev hospital:
We discuss, one at the time…..

- Co-morbidity etc.

- Where and how many metastasis?
- Is it necessary and/or possible to biopsy them?
- Is other imaging needed ? Which modalities?
- Treatment decision

And most important

- MRI evaluation of Prostate:
  - staging, seminal vesicles, urethra, EPE (“capsule”) and lymph nodes (local?) other findings? ..operability …



- Cilnical info:
  - urologist->DRE, mobility of prostate-> operability.

- MRI targeted biopsies:
  - Were they correct or a mismatch?
  - Good → feedback on own performance.

Evaluation…

- Mismatch - was it

  - 1. bad MRI acquisition,
  - 2. bad MRI reporting,
  - 3. bad biopsies/bad contouring or alignment/targeting error
    - - many aspects

    - Collect data to improve.

Evaluation…

- Compare prostatectomies with MRI
  - Index lesions, second a
  - Tumor size, location,
  - spread..seminal vesic
- INVISIBLE lesions!!!
- And learn from mistakes…..

When treatment decisions are based on MRI findings

You must know your own performance statistics

But you cannot say Education and Experince with out saying..

Eur Radiol. 2020 Oct;30(10):5404-5416. doi: 10.1007/s00330-020-06929-z. Epub 2020 May 19.

ESUR/ESUI consensus statements on multi-parametric MRI for the detection of clinically significant prostate cancer: quality requirements for image acquisition, interpretation and radiologists' training

Consensus-based criteria 'basic' versus 'expert' radiologists. *N/A* not applicable

Basic	Criterion	Expert
100	Minimum number of supervised cases before independent reporting	N/A
400	Minimum number of cases read	1000
150	Minimum number of cases/year	200*
1	Examination interval (year(s))	4
80	Agreement in double reads with expert centre (%)	≥ 90

Three headings summarize the outcomes: (1) image quality assessment, (2) interpretation and reporting and (3) experience and training centres.

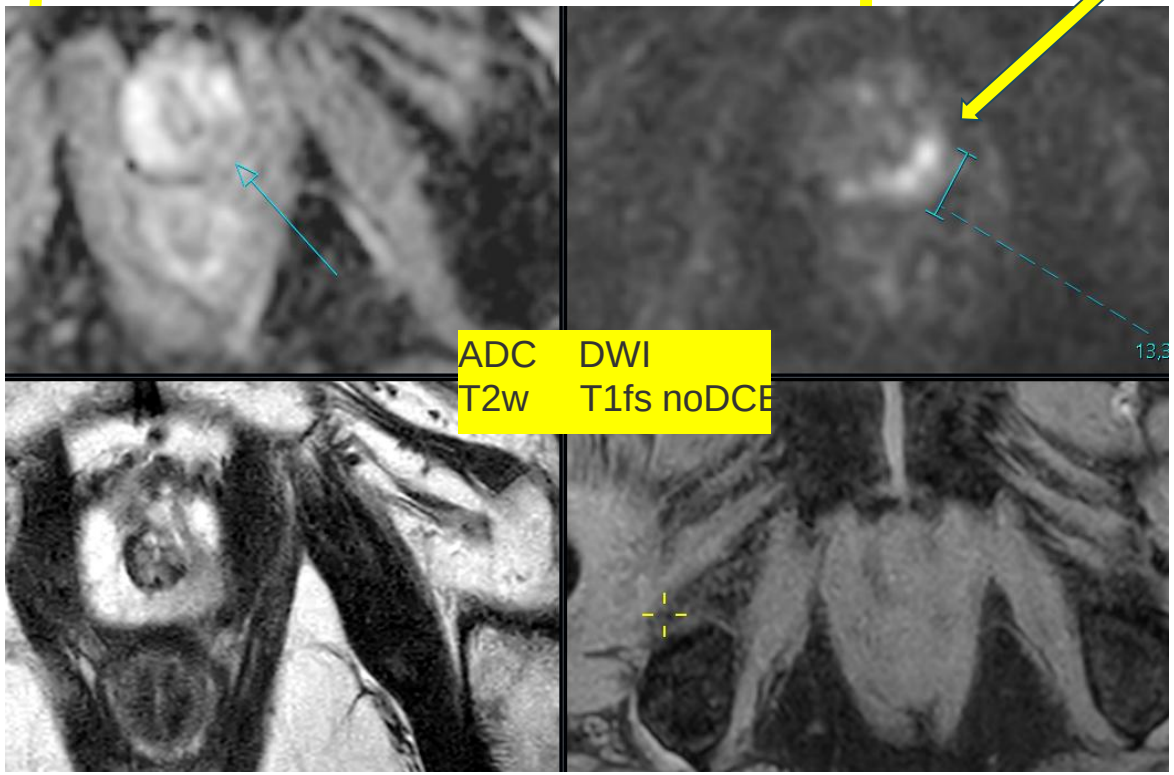
Let us have a case 62Y PSA 4.3 vol 39ml PSAD 0,11.

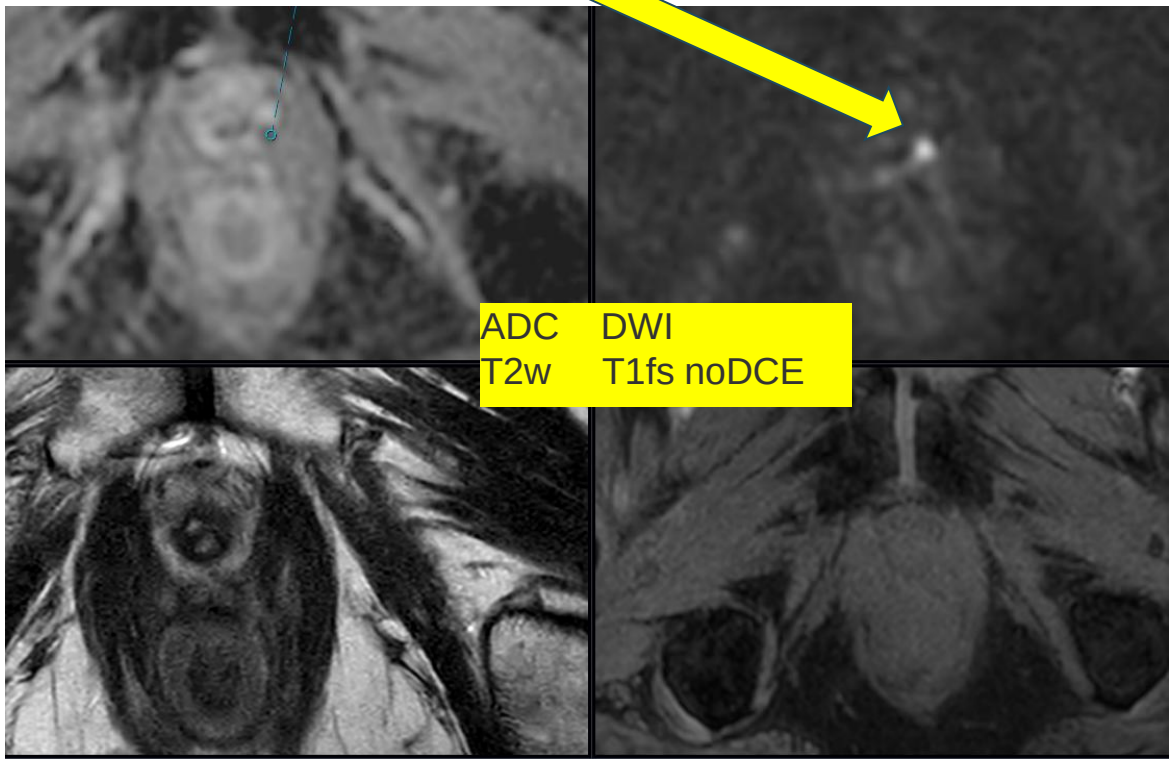
- **1. MRI showed 2 lesions**

01:PIRADS 4 LMPZpm 13 mm - ADC 0,85

02:PIRADS 3-LAPZa 6 mm - ADC 0,63

.

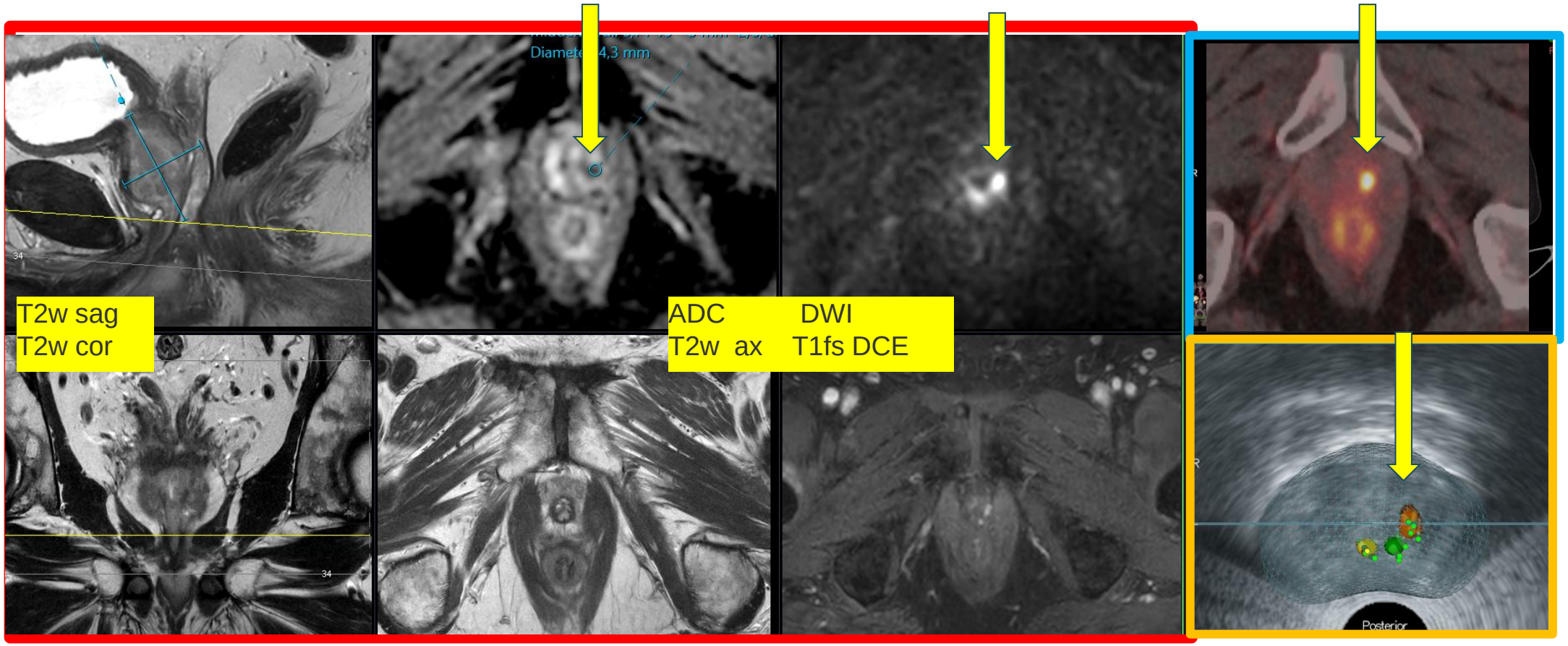




01: GS 7 (3+4) i 5 / 15 mm, 2 / 11 mm, 1 / 13 mm og mikrofokus / 10 mm.
02: GS7 (3+4) i 3 / 11 mm, 0 / 13 mm, 0 / 13 mm og 0 / 4 mm.

2. MRI, 6 mth later 64Y, PSA 5.4, Prostate vol. 43ml PSAD 0,12

mpMRI with PI-RADS 4 in left apex 6mm……
PSMA-PET-CT and ultrasound fusion marked lesions



Second MRI showed

nr 01 Il defined VM PZpm but location is marked

nr 02 PI-RADS 4 LA PZ a, 8 mm ADC 0,65

01:. Adenokarcinoma, Gleason score 7 (4+3) i 6 / 11 mm, 3 / 14 mm og 2 / 9 mm

02: Adenokarcinoma, Gleason score 9 (4+5) i 7 / 14 mm, 1 / 12 mm, 0 / 11 mm og 0 / 13 mm.

03: Benign biopsy

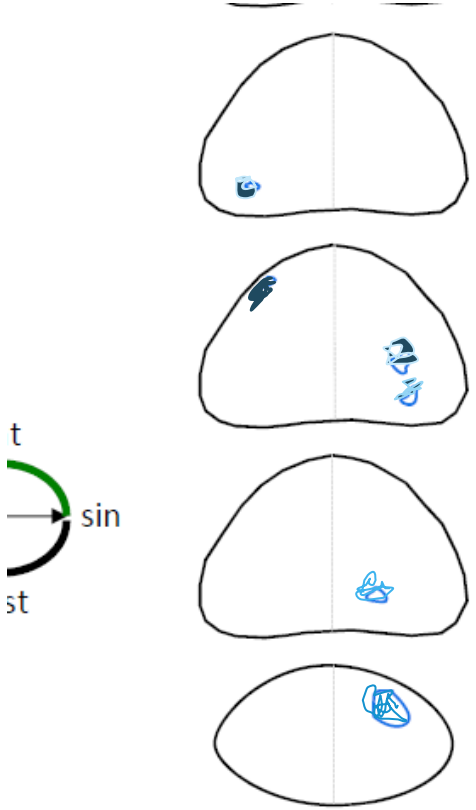
.

MDT meeting descision

- Biopsies showed adenokarcinoma Gleason Score 9 (4+5) in 5 of 10 biopsier from of (2/3 MR-targes).
- TNM: cT1c N0, M0, PSA 5,3.
- **Final conclusion**
- TNM: cT1c N0, M0, PSA 5,3. No metastasis shown on PSMA-PET-CT. No findings suspicious of seminal vescles involvement or EPE.
- High risk patient
- Prostatectomy is offered.

We se the prostatecomy results at MDT this ensures educational feedback and a possibilty for improvement and research.

Prostatectomy drawing
pT2 pNx pR0



But you cannot say Reporting and Local staging with out saying..

Agrotis *et al. European Radiology*
https://doi.org/10.1007/s00330-026-12397-8

European Radiology

INVITED REVIEW Open Access

ESR Essentials: MRI-based T-staging in prostate cancer—practice recommendations by the European Society of Urogenital Radiology

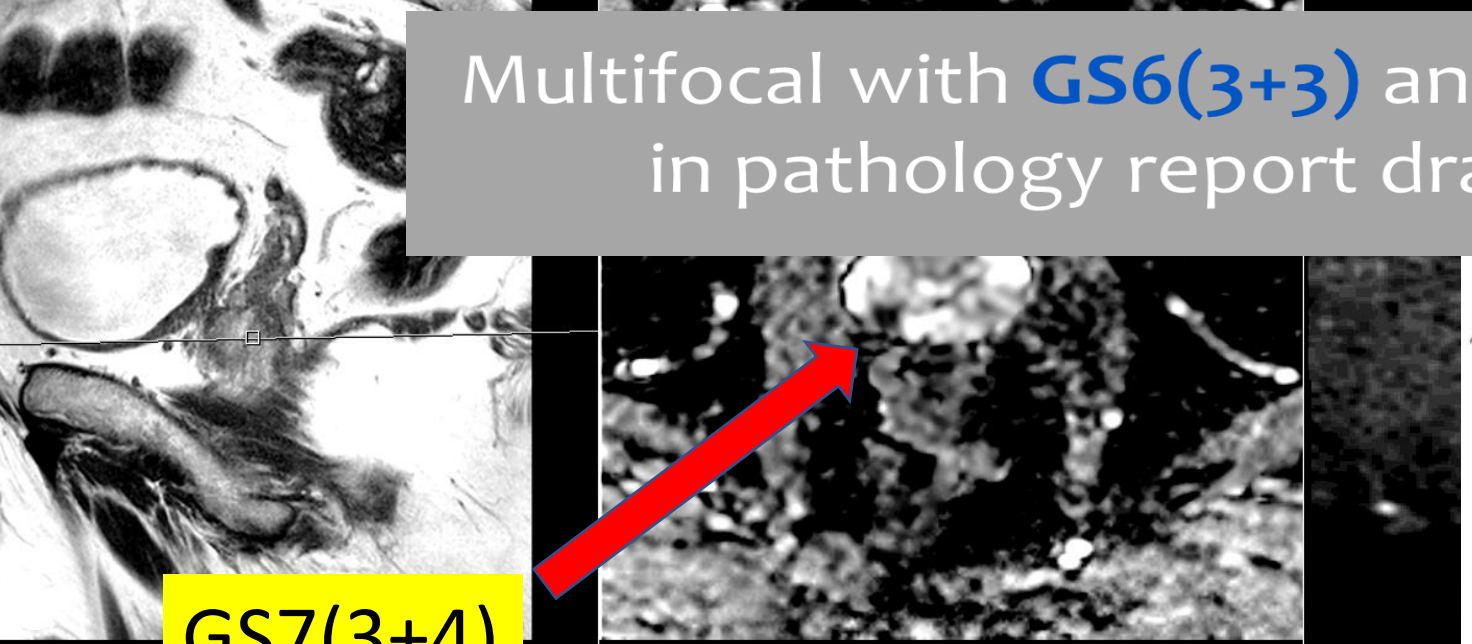
Key Points

Question Wide variation in prostate MRI acquisition, image quality, and reporting undermines diagnostic accuracy. A structured roadmap is needed to ensure consistent quality and reproducible practice.

Findings The ESUR Prostate MRI Working Group outlines a three-step framework —'Build it right', 'See it right', 'Improve and innovate'—to standardise acquisition, interpretation, and quality assurance.

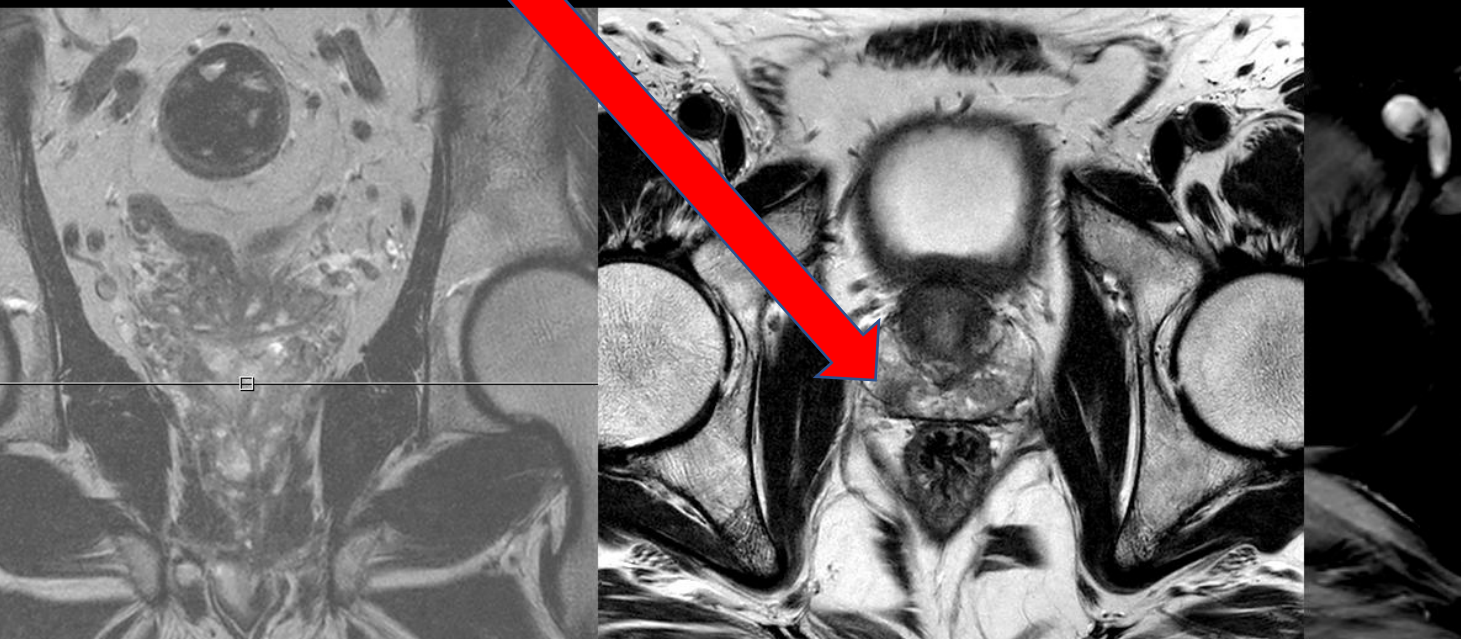
Clinical relevance Applying this roadmap in clinical practice aims to enhance diagnostic confidence and promote consistent, high-quality prostate cancer care across diverse healthcare settings.

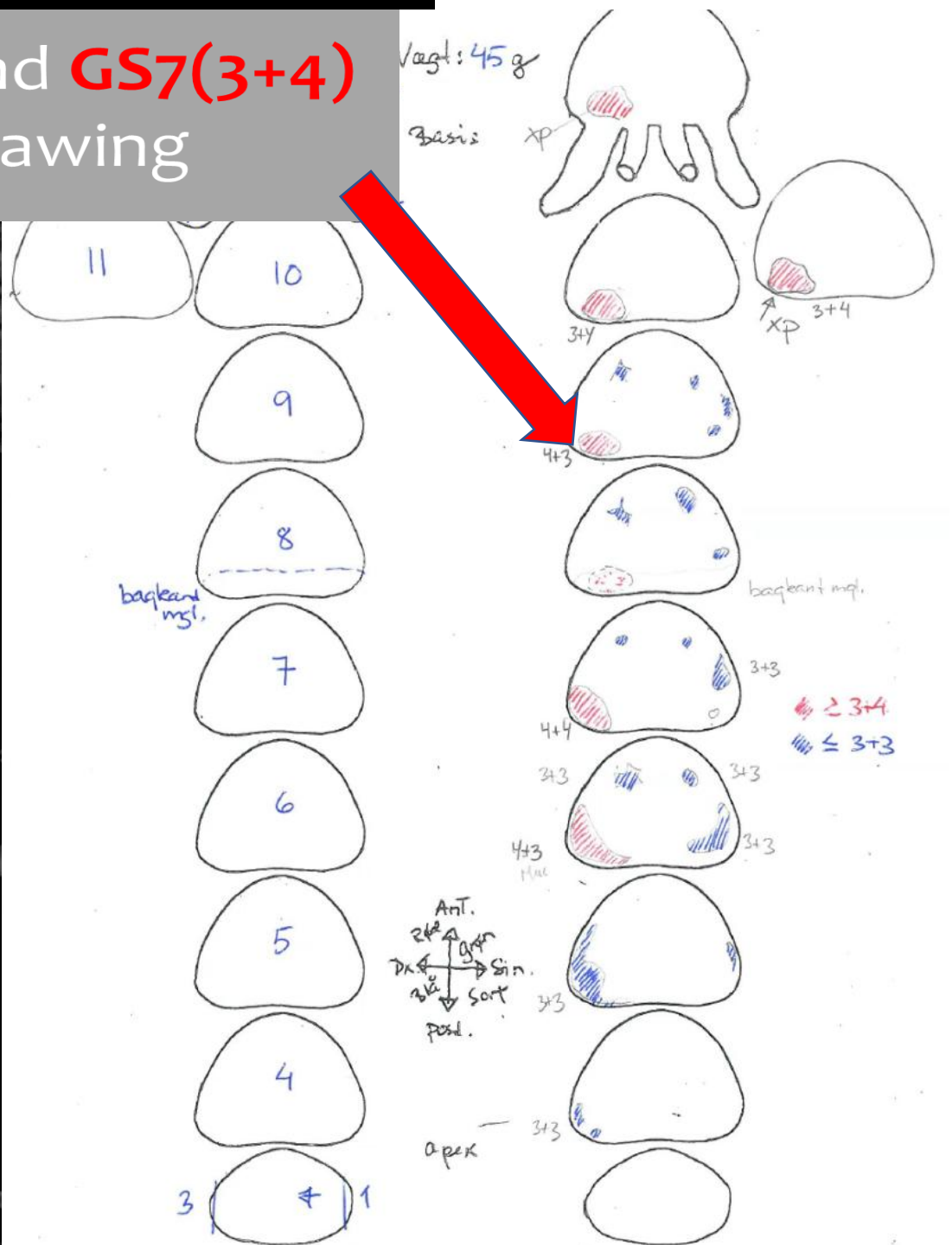
Multifocal with GS6(3+3) and GS7(3+4) in pathology report drawing



GS7(3+4)

A new case The value of ADC

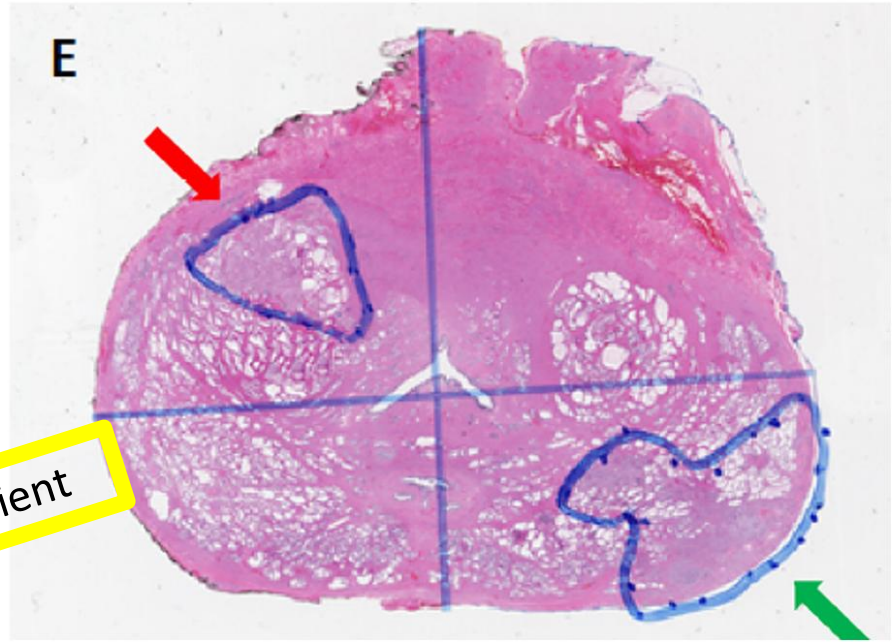




- What does your pathology report look like?
- Do you get histopathological feedback?

- Whole mount sectioning?
- Angulation of cuts of the tissue .
- Able to compare with MRI?
- And which surgical procedure ?

(Red arrow) with Gleason score 3 + 3.

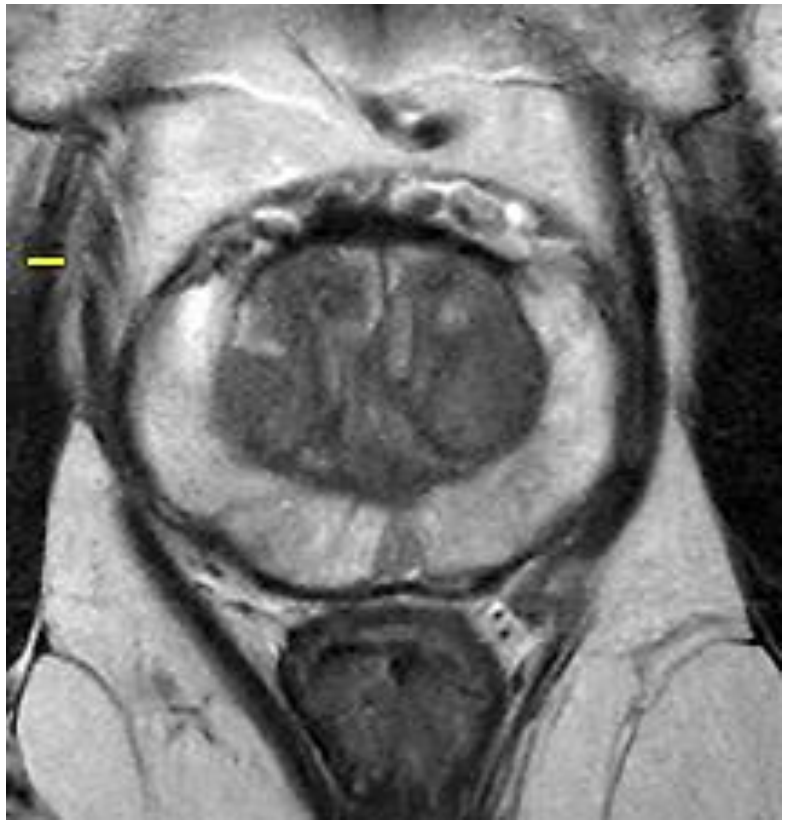


Not the previous patient

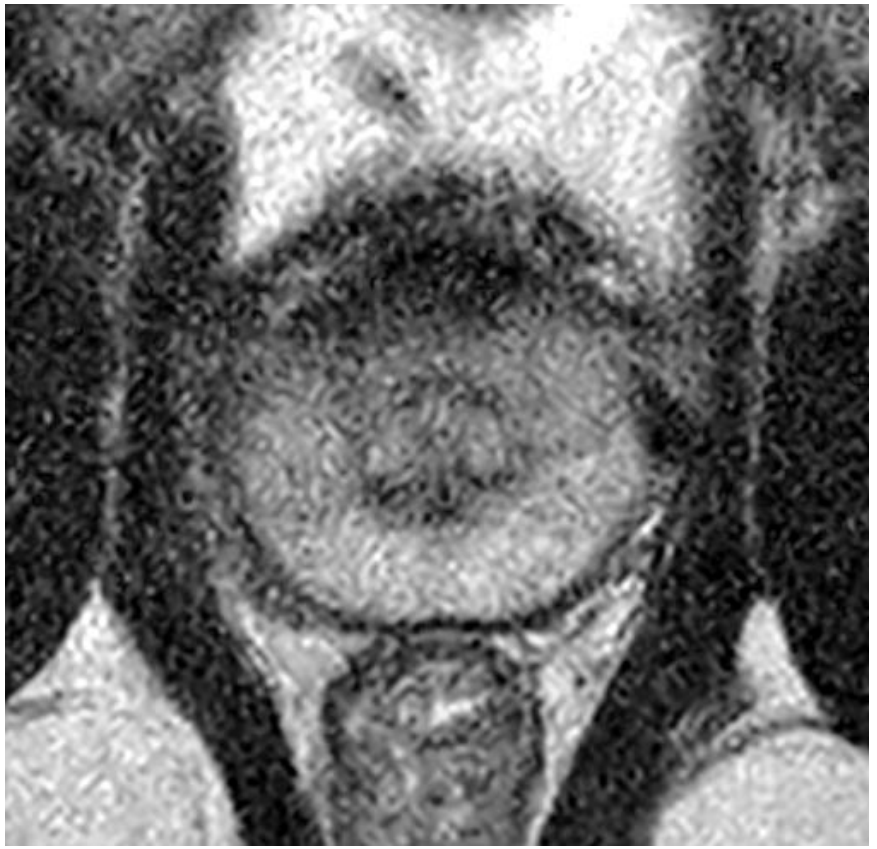
(Green arrow) with Gleason score 3 + 4

What have we learned?

Good quality



Bad quality



Does the radiologist perform good independent of image quality?

- No of course not
- **Results: (only some)**
- High-quality images higher csPCa detection rate (56.5% to 64.3%)
- High-quality images had a higher PPV (72.5% to 78.8)
- PI-RADS 3 (24.0% to 52.9%) contained more low-quality images compared to
- PI-RADS 4-5 (20.6% to 39.3%),

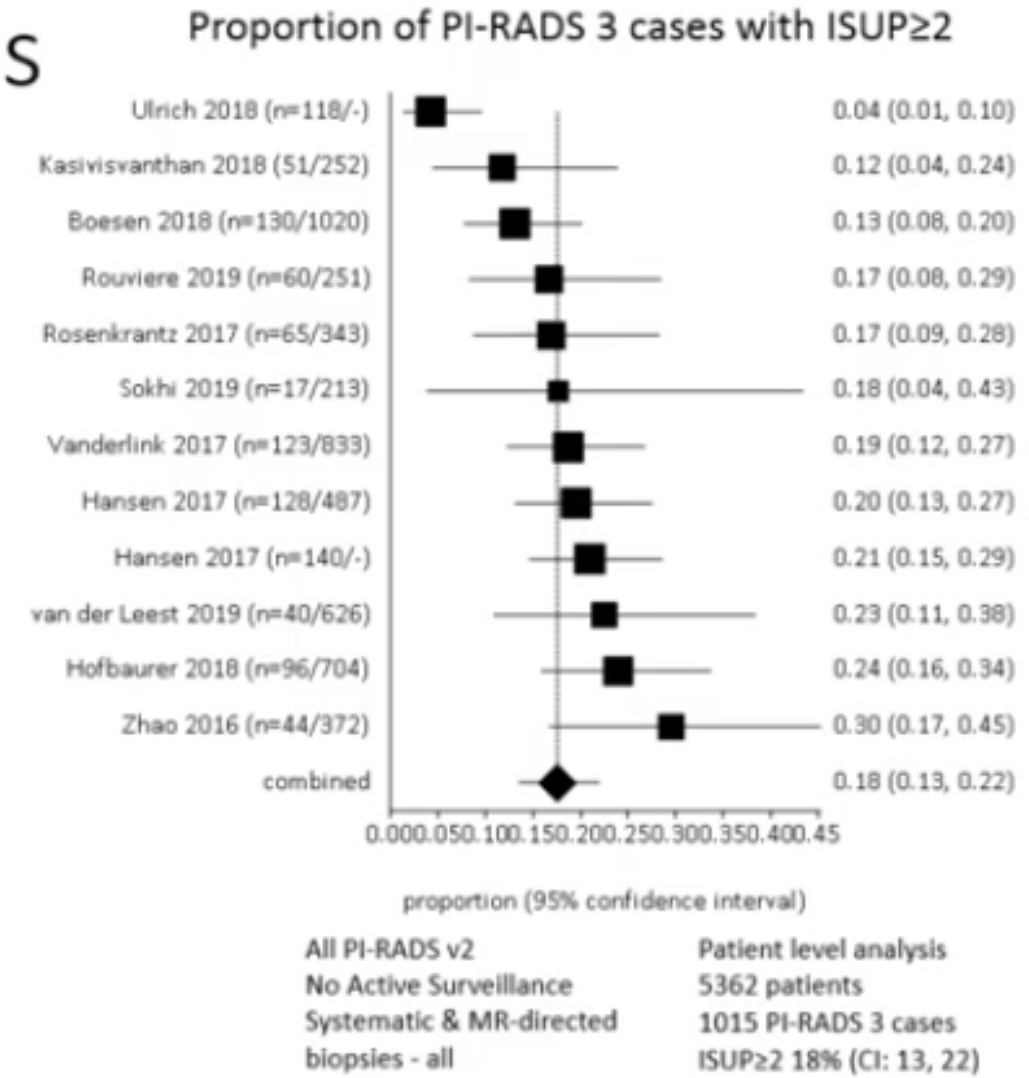
Impact of prostate MRI image quality on diagnostic performance for clinically significant prostate cancer (csPCa)

Abdom Radilo (NY) 2024 Nov;49(11):4113-4124. doi: 10.1007/s00261-024-04458-7. Epub 2024 Jun 27.

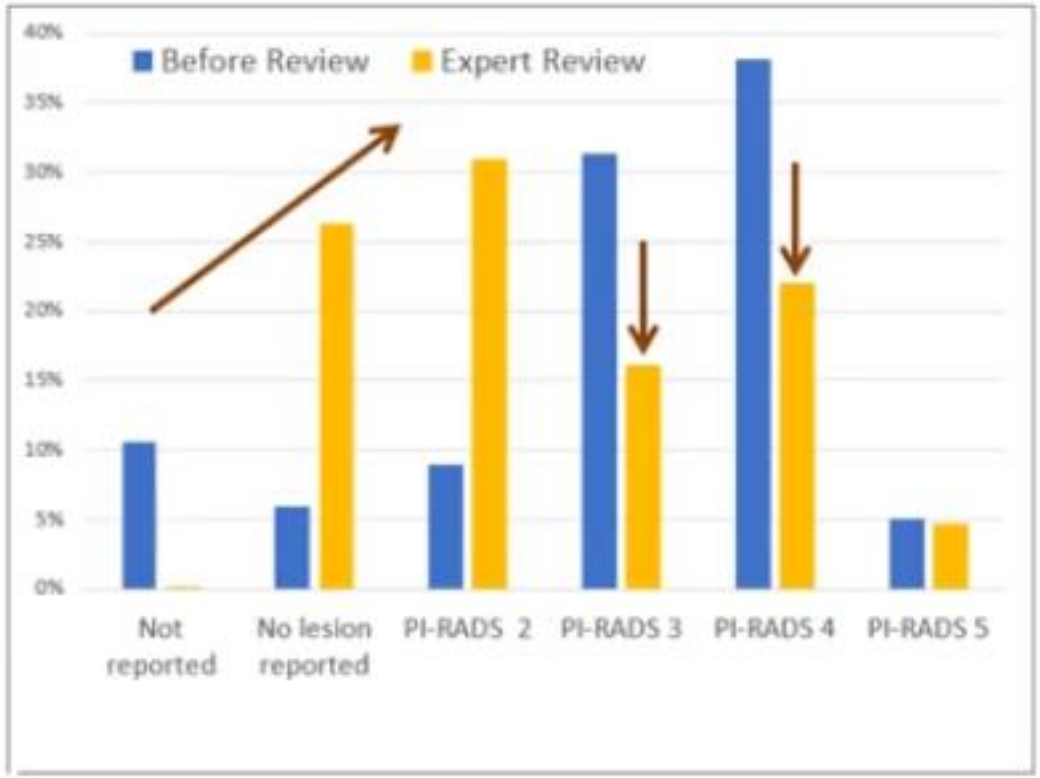
Cancers in PI-RADS 3 cases

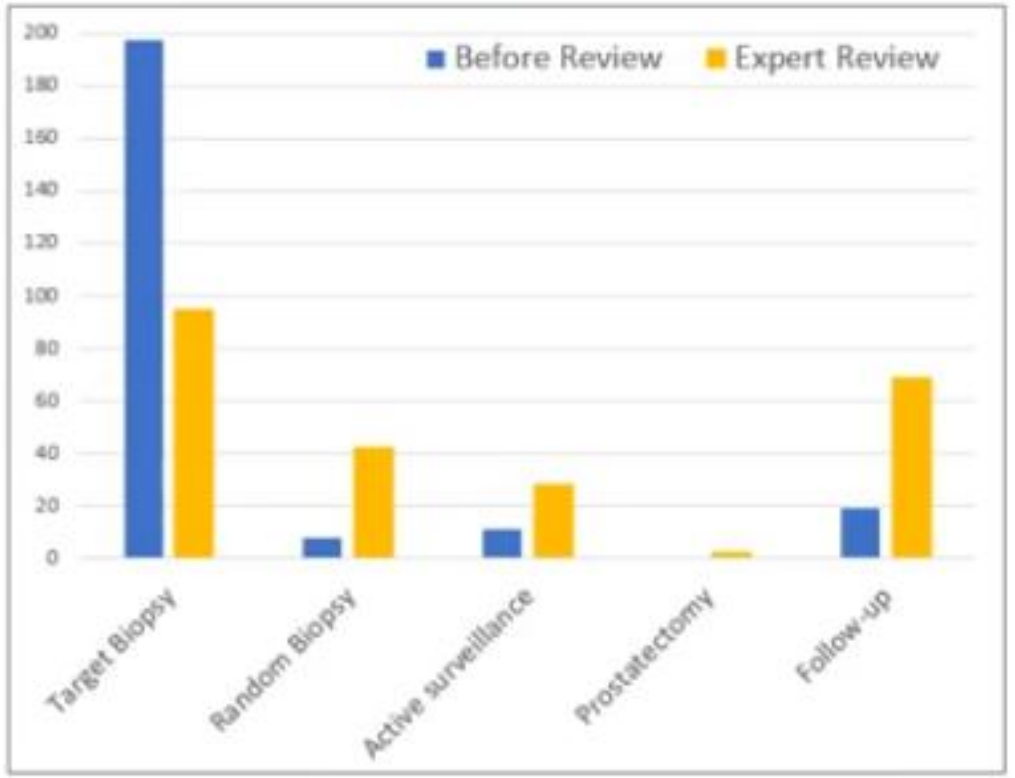
Studies, Cases, Prevalence & Cancer Detection Rates

- 12 studies with 5362 patients (mixed)
- PI-RADS 3 prevalence: 16% (CI: 11, 20; range: 6-26), n=1015
- All cancers detection: 38% (CI: 34, 40; range 11-53)
- ISUP≥2: 18% (13, 22; range, 4-30)



Expert radiologic-urological review reduces PI-RADS 3-4 cases and need for/type of biopsy





Significant discordance between PI-RADS reports in peripheral and tertiary subspecialized centers (k=0.23)

51% patient referred for targeted biopsies could be avoided

35% of men could skip prostate sampling all together

Luzzago S, Petralia G, et al. Clin Genitourin Cancer. 2018 [Epub]

Vibeke Løgager

THE LANCET

PROMIS

Diagnostic accuracy of multi-parametric MRI and TRUS biopsy in prostate cancer (PROMIS): a paired validating confirmatory study

Hashim U Ahmed*, Ahmed El-Shater Bosaily*, Louise C Brown*, Rhian Gabe, Richard Kaplan, Mahesh K Parmar, Yolanda Collaco-Mor
Katie Ward, Richard G Hindley, Alex Freeman, Alex P Kirkham, Robert Oldroyd, Chris Parker, Mark Emberton, and the PROMIS study gr

BIDOC

JAMA Network | Open

Original Investigation | Urology

Assessment of the Diagnostic Accuracy of Biparametric Magnetic Resonance Imaging for Prostate Cancer in Biopsy-Naive Men
The Biparametric MRI for Detection of Prostate Cancer (BIDOC) Study

Lars Boesen, MD, PhD; Nis Nørgaard, MD; Vibeke Løgager, MD; Ingegerd Balslev, MD; Rasmus Bisbjerg, MD; Karen-Cecilie Thestrup, MD; Mads D. Winther; Henrik Jakobsen, MD; Henrik S. Thomsen, DMC

The NEW ENGLAND JOURNAL of MEDICINE

PRECISION

ORIGINAL ARTICLE

MRI-Targeted or Standard Biopsy for Prostate-Cancer Diagnosis

V. Kasivisvanathan, A.S. Rannikko, M. Borghi, V. Panebianco, L.A. Mynderse, M.H. Vaarala, A. Briganti, L. Budäus, G. Hellawell, R.G. Hindley, M.J. Roobol, S. Eggener, M. Ghei, A. Villers, F. Bladou, G.M. Villeirs, J. Virdi, S. Boxler, G. Robert, P.B. Singh, W. Venderink, B.A. Hadaschik, A. Ruffion, J.C. Hu, D. Margolis, S. Crouzet, L. Klotz, S.S. Taneja, P. Pinto, I. Gill, C. Allen, F. Giganti, A. Freeman, S. Morris, S. Punwani, N.R. Williams, C. Brew-Graves, J. Deeks, Y. Takwoingi, M. Emberton, and C.M. Moore, for the PRECISION Study Group Collaborators*

MRI-FIRST

Use of prostate systematic and targeted biopsy on the basis of multiparametric MRI in biopsy-naive patients (MRI-FIRST): a prospective, multicentre, paired diagnostic study

Olivier Rouvière, Philippe Puech, Raphaële Renard-Penna, Michel Claudon, Catherine Roy, Florence Mège-Lechevallier, Myriam Decaussin-Petrucci, Marine Dubreuil-Chambardel, Laurent Magaud, Laurent Remontet, Alain Ruffion, Marc Colombel, Sébastien Crouzet, Anne-Marie Schott, Laurent Lemaitre, Muriel Rabilloud, Nicolas Grenier, for the MRI-FIRST Investigators*

available at www.sciencedirect.com
journal homepage: www.europeanurology.com

European Association of Urology

4M

Platinum Priority – Prostate Cancer
Editorial by XXX on pp. x–y of this issue

Head-to-head Comparison of Transrectal Ultrasound-guided Prostate Biopsy Versus Multiparametric Prostate Resonance Imaging with Subsequent Magnetic Resonance-guided Biopsy in Biopsy-naïve Men with Elevated Prostate-specific Antigen: A Large Prospective Multicenter Clinical Study

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COCHRANE

Cochrane Database of Systematic Reviews

Prostate MRI, with or without MRI-targeted biopsy, and systematic biopsy for detecting prostate cancer

Cochrane Systematic Review - Diagnostic | Version published: 25 April 2019
https://doi.org/10.1002/14651858.CD012663.pub2

Am score 33 View article information

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View authors' declarations of interest

Level 1 evidence – Clear advantage of an MRI-based diagnostic strategy

Multiple factors influencing biopsy-outcome

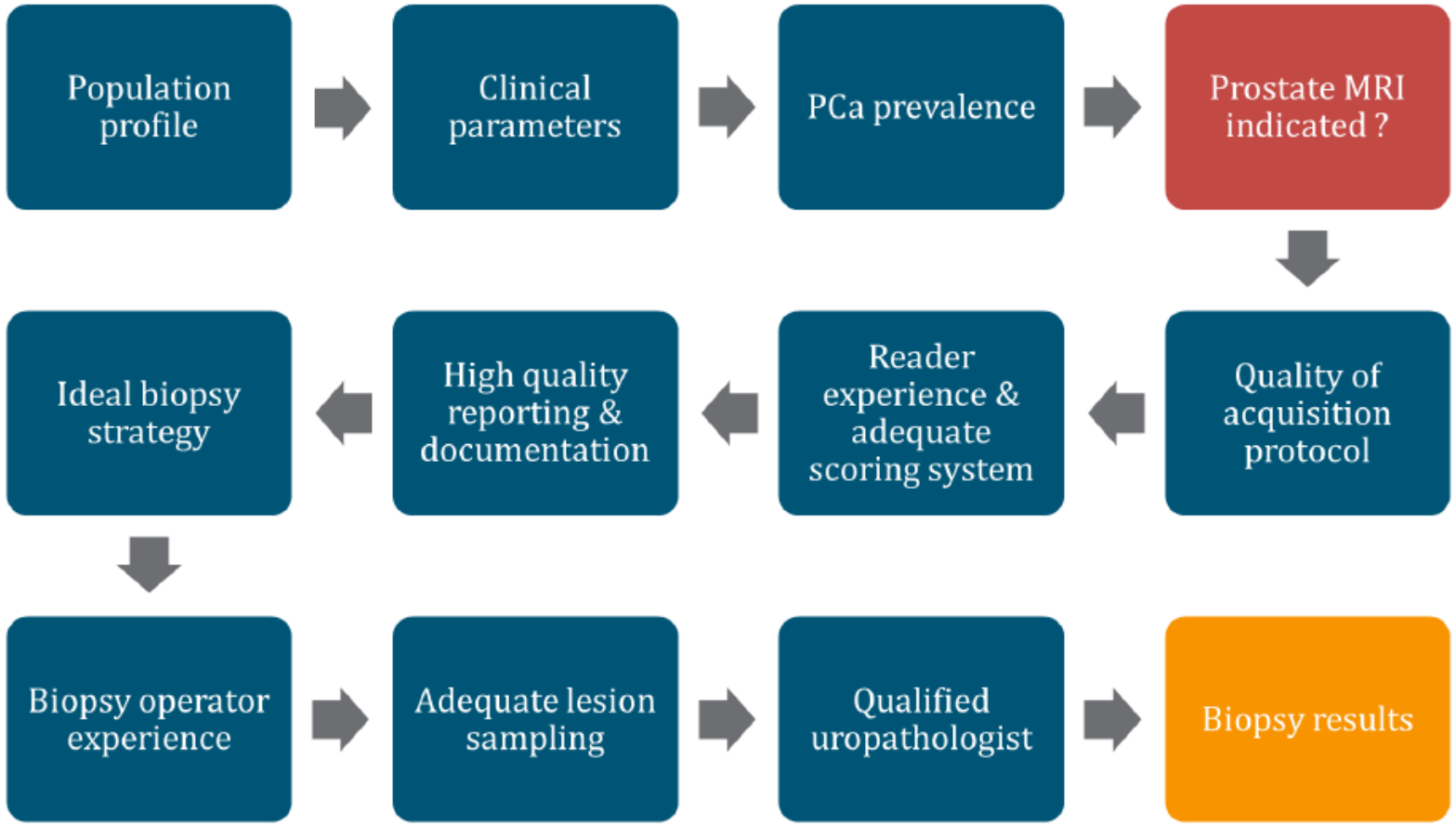
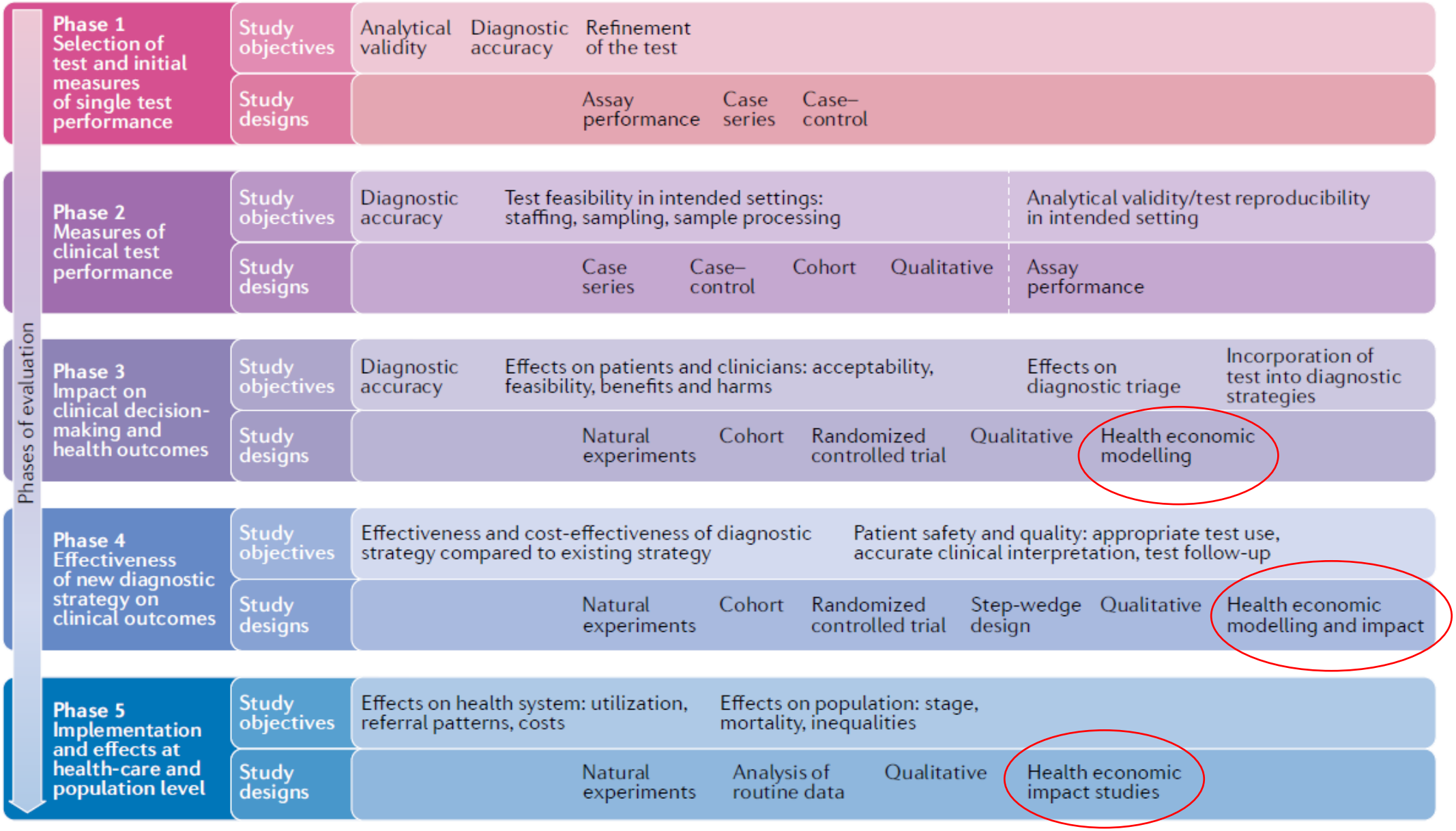


Figure 7: Factors that can influence the biopsy outcome of an MRI-guided diagnostic pathway.

Is it worth it?

CanTest frameworks for evaluation of diagnostic strategies for early and timely detection of cancers



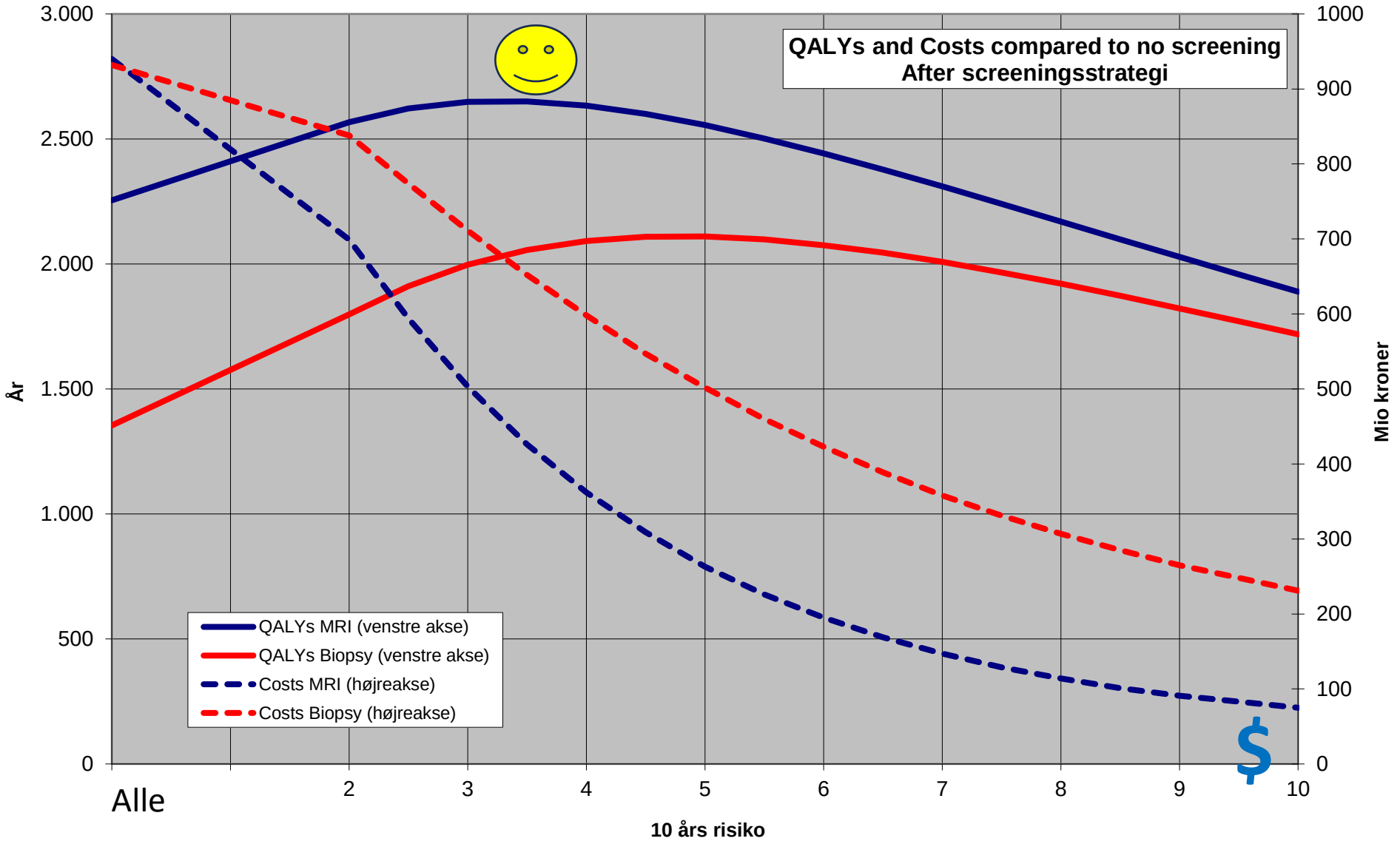
Eldred-Evans et al, September 2020, vol 17, nature/nrurol

Results III: Screening minus no screening

Screeningsstrategier

JAMA Network Open

Callender et al, 2021



Ekstra QALYs
Ekstra Costs

Blue for MRI first strategy
Red for Biopsi first strategy

QALYs are consequently higher in MRI first strategies
Costs is constantly lower in MRI first strategies

QALY max at 10 yrs risk 3-4% for MRI first strategy
At price 350-500 mio kr over several yrs

Results IV: Screening minus no screening

Screeningsstrategier

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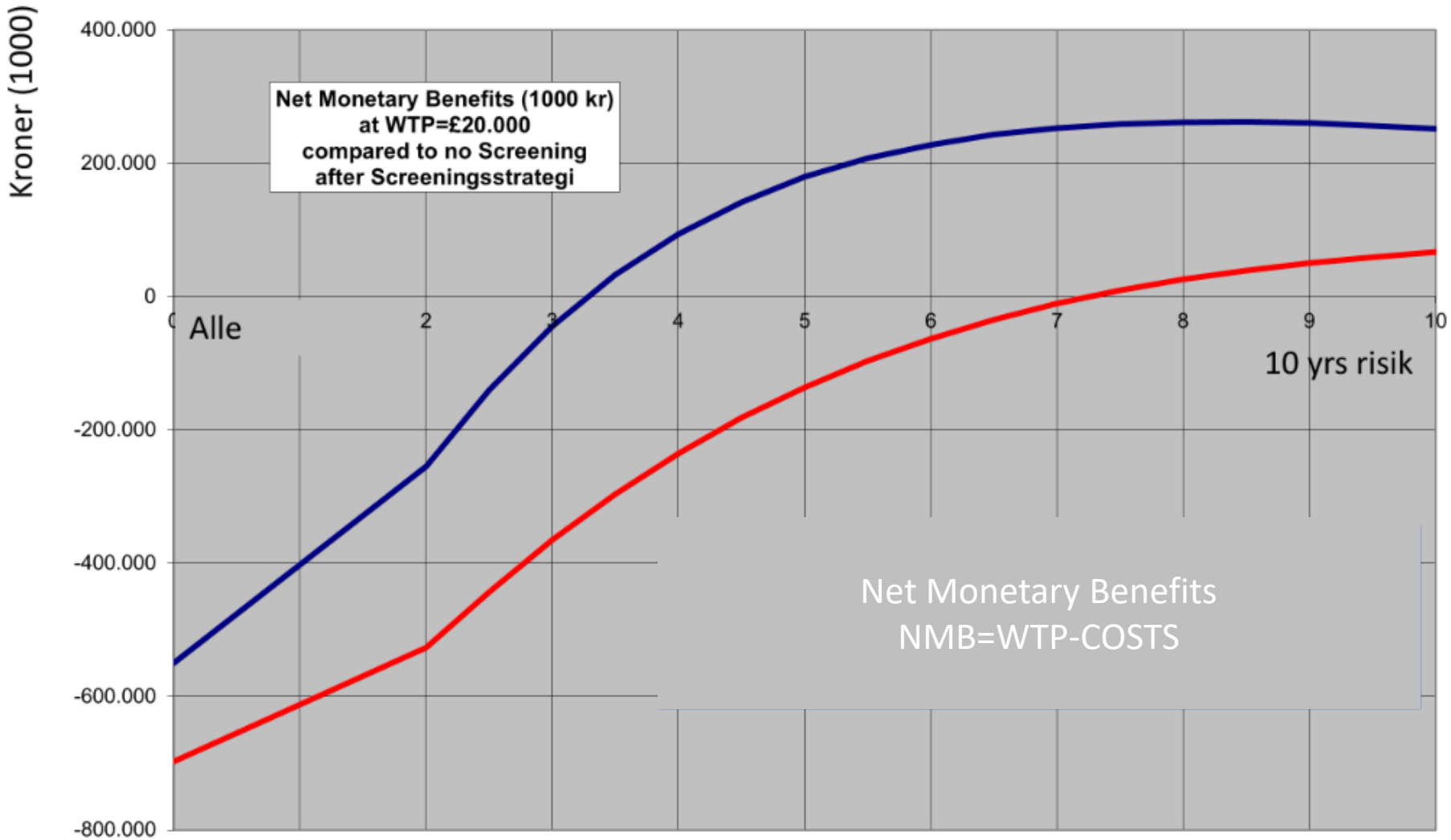

Net Monetary Benefits

Blue for MRI first strategy
Red for Biopsi first strategy

NMB er consequently higher for MRI first strategy than for Biopsi first strategy

NMB reaches plateau at 10 yrs risik of 7% for MRI first strategy, at the price of150 mio kr over several yrs

Kære Jes

Summa Summarum

Screeningsstrategier

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Callender et al, 2021

- MRI first strategies exceeds Biopsy first strategy on:
- Benefit-harm profiles
  - On QALYs and
  - On Costs

→ And therefore on NMB

- **Quite convincing**

- Pointing towards a risk based strategy
  - Preferrable 7% risik over 10 yrs – depending on willigness to pay
  - Minimum 3-4% over 10 år – otherwise the gain of QALYs is lost

- This could be input for a new RCT in Europa – or at least a prospektiv evaluation
- This is what the Health Econom-y (-mist) says

- ***But they say alot of things…***

SDU CPop

Putting bits and pieces together

Thank you

- With a lot of help from all our friends…

Thank you

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Any questions?