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Review Article

The PIRADS v2.1 Classification: A Guide for Reading and Interpretation

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Abstract: The Prostate Imaging Reporting and Data System (PIRADS) is a cornerstone of modern prostate cancer diagnostics, standardizing the acquisition, interpretation, and reporting of multiparametric Magnetic Resonance Imaging (mpMRI). This article provides a comprehensive guide to PIRADS version 2.1, detailing its structured algorithm for assigning a risk score from 1 to 5 that correlates with the likelihood of clinically significant prostate cancer (csPCa). We explain the zone-dependent rules, sequence-specific criteria, and key improvements of v2.1, including its refined transition zone assessment. Furthermore, we contextualize its clinical impact with current evidence and discuss emerging trends, such as biparametric MRI and artificial intelligence, that are shaping the future of prostate imaging.

Keywords: Prostate Cancer, Multiparametric MRI, PIRADS, Standardized Reporting, Targeted Biopsy, Transition Zone.

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1. INTRODUCTION

The Prostate Imaging Reporting and Data System (PIRADS) is a standardization framework designed to:

- Ensure optimal and consistent acquisition techniques for multiparametric MRI (mpMRI) of the prostate.
- Provide a universal language for image interpretation and report generation.
- Assign a risk score (from 1 to 5) that correlates with the probability of a lesion being a clinically significant prostate cancer (csPCa), most commonly defined as a Gleason score ≥ 7 [1].

Version 2.1, published in 2019, introduces minor clarifications and adjustments to v2.0, primarily aimed at improving reproducibility and refining the evaluation criteria for the transition zone (TZ) [2].

2. PIRADS Scores and Their Clinical Significance

The score is assigned per lesion (not per patient). A single patient can have multiple lesions, each with its own PIRADS score.

Score	Probability of Clinically Significant Cancer	Significance	Recommended Management
1	Very Low	No abnormality	No action required (standard follow-up if needed)
2	Low	Probably benign finding (e.g., cyst, typical BPH)	Biopsy not recommended based on MRI
3	Equivocal	Presence of an indeterminate abnormality	Decision to biopsy must be individualized, based on clinical context (PSA, DRE, history)
4	High	Suspicious abnormality	Targeted biopsy recommended
5	Very High	Highly suspicious abnormality	Targeted biopsy strongly recommended

3. Score Assignment Rules (PIRADS v2.1 Algorithm)

The assignment of the final score depends on the location of the lesion (Peripheral Zone - PZ - or Transition Zone - TZ) and the designated "dominant" sequence.

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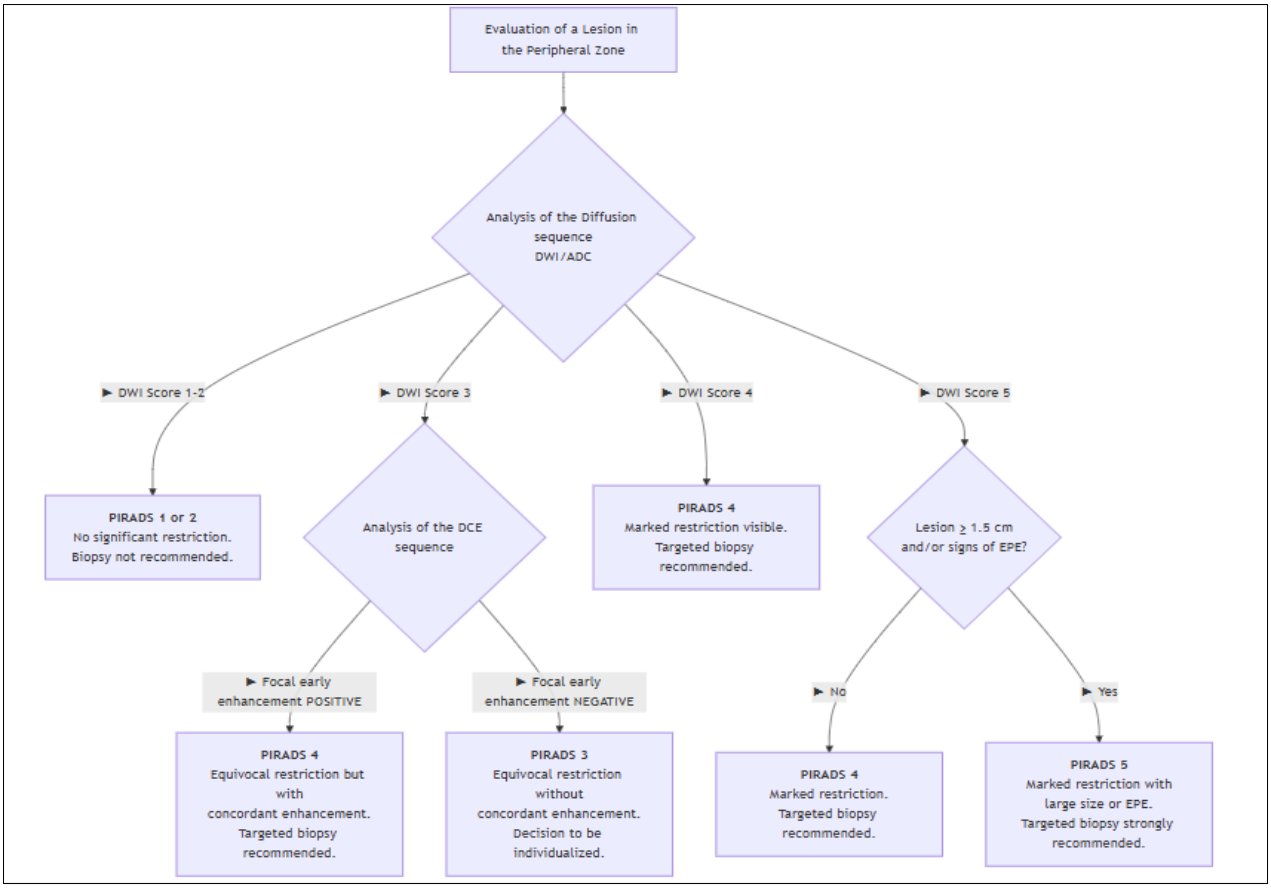
A. For Lesions in the PERIPHERAL ZONE (PZ)
The dominant sequence is Diffusion-Weighted Imaging (DWI/ADC).

DWI Score	DCE Score	Final PIRADS Score	Explanation
1-2	+/-	1-2	No significant diffusion restriction.
3	Negative	3	Equivocal restriction without concordant focal enhancement.
3	Positive	4	Equivocal restriction but with concordant early focal enhancement.
4	+/-	4	Marked restriction (visible on high b-value and ADC map).
5	+/-	5	Marked restriction + lesion ≥ 1.5 cm or signs of extraprostatic extension (EPE).

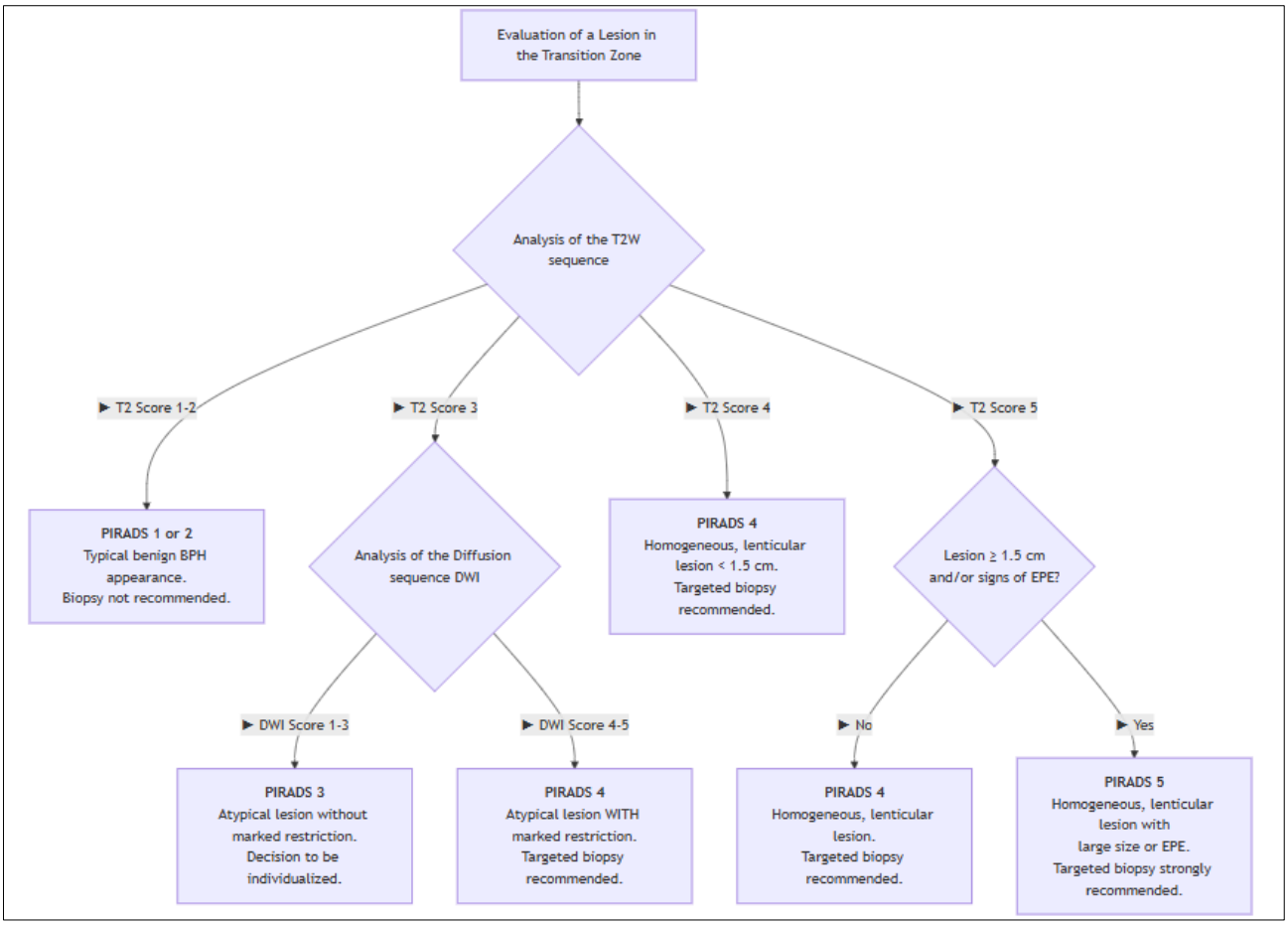
Role of T2W in PZ: Secondary. It helps confirm location and detect "stellar lesions" (benign stromal BPH, appearing as thin, linear T2 hypointensity without diffusion restriction).



B. For Lesions in the TRANSITION ZONE (TZ)
The dominant sequence is T2-Weighted Imaging (T2W).

T2W Score	DWI Score	Final PIRADS Score	Explanation
1-2	+/-	1-2	Normal tissue or typical BPH (encapsulated "circumscribed" nodule).
3	1-3	3	Non-encapsulated, hypointense T2 lesion without marked restriction.
3	4-5	4	Non-encapsulated, hypointense T2 lesion with marked restriction.
4	+/-	4	Homogeneous, hypointense, non-encapsulated, lenticular/polygonal shape, < 1.5 cm.
5	+/-	5	Homogeneous, hypointense, non-encapsulated, lenticular/polygonal shape, ≥ 1.5 cm or signs of EPE.

Role of DCE in TZ: Secondary. Early focal enhancement is often present but not necessary for diagnosis. It is most useful for confirming the suspicious site and guiding precise targeting.



4. Sequence-Specific Score Definitions (v2.1)

Diffusion-Weighted Imaging (DWI/ADC) – Dominant in PZ

Score 1: No abnormality (no hyperintensity on high b-value, no hypointensity on ADC).
Score 2: Linear/rounded hyperintensity on high b-value but without corresponding ADC hypointensity (T2 shinethrough artifact).
Score 3: Focal hyperintensity on high b-value and corresponding ADC hypointensity, of indeterminate size or < 1.5 cm.
Score 4: Focal, marked hyperintensity on high b-value and corresponding ADC hypointensity, ≥ 1.5 cm.
Score 5: Focal, marked hyperintensity on high b-value and corresponding ADC hypointensity, ≥ 1.5 cm and/or with signs of EPE.

T2-Weighted Imaging (T2W) – Dominant in TZ

Score 1: Normal homogeneous tissue (homogeneously hypointense TZ in young men) or typical encapsulated BPH nodule ("circumscribed").
Score 2: Heterogeneous BPH nodules but with well-defined borders and/or cysts.
Score 3: Non-encapsulated, poorly defined, heterogeneous hypointense lesion(s). This is the TZ's "grey zone".
Score 4: Homogeneous, hypointense, non-encapsulated lesion with a lenticular or polygonal shape, < 1.5 cm in the greatest dimension.
Score 5: Homogeneous, hypointense, non-encapsulated lesion with a lenticular or polygonal shape, ≥ 1.5 cm in the greatest dimension and/or with signs of EPE.

Dynamic Contrast-Enhanced (DCE) Imaging – "Tie-Breaker" in PZ

Negative: No enhancement OR diffuse enhancement without early focal component OR focal enhancement that is not early.
Positive: Focal enhancement that is:
Early: Appears at the same time or before enhancement of the iliac arteries.
Correlative: Located in the same area as the abnormality visible on other sequences.

5. Key Points and v2.1 Enhancements

- Clarification on TZ: Improved distinction between benign BPH (scores 1-2) and suspicious lesions (scores 4-5), with a more precise definition of the "lenticular/polygonal" lesion [2].
- Lesion Size: The 1.5 cm threshold is introduced as a key discriminator between scores 4 and 5, especially in the TZ.
- "Stellar Lesion" (Stromal Benign Prostatic Hyperplasia): Highlighted as a benign entity in the TZ: stellar-shaped, T2 hyperintense, without diffusion restriction. Should be classified as PIRADS 1 or 2 [3].
- Reproducibility: The primary goal of the clarifications is to reduce inter-reader variability, particularly for equivocal (score 3) lesions [4].

6. Current Evidence and Future Directions

PIRADS v2.1 is supported by strong evidence demonstrating its efficacy in risk stratification and guiding targeted biopsies, significantly improving the detection of csPCa while reducing unnecessary procedures [5, 6]. The landscape of prostate MRI is evolving rapidly. Key developments include:

Biparametric MRI (bpMRI): There is growing validation of protocols using only T2W and DWI (omitting DCE), reducing scan time, cost, and avoiding contrast administration [7]. While PIRADS v2.1 is built on mpMRI, future versions may formally integrate bpMRI.

Artificial Intelligence (AI): Deep learning models are showing promise in assisting radiologists with lesion detection (CADe), segmentation, and characterization (CADx), potentially further standardizing interpretation and reducing variability [8].

PIRADS v3.0: An update is under active development by the American College of Radiology (ACR). It is expected to incorporate these new trends, refine scoring criteria based on accumulated evidence, and provide guidance on integrating emerging techniques like PSMA-PET.

7. CONCLUSION

The PIRADS v2.1 classification is the indispensable standard for interpreting prostate mpMRI. Its structured algorithm, based on anatomic location and a dominant sequence, guides radiologists toward a standardized and reproducible evaluation. Understanding its rules and nuances is essential for effective communication with urologists and optimal integration into the patient's diagnostic and therapeutic strategy. As the field advances with bpMRI and AI, PIRADS continues to evolve, ensuring that prostate MRI remains a precise and powerful tool in the era of personalized medicine.

Conflict of Interest: The authors declare that they have no conflict of interest.

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