White paper

AI-enabled care pathway for prostate MRI: supporting early detection and diagnosis

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Prostate cancer (PCa) is the second most common cancer and the fifth leading cause of cancer-related deaths in men worldwide. [1]

Over the past decade, multiparametric prostate MRI (mpMRI) has fundamentally changed the diagnostic pathway by shifting decision-making from systematic, PSA-triggered biopsy toward imaging-guided risk stratification and targeted biopsy. [2]

Professional societies and clinical guidelines [3] now recommend prostate MRI prior to biopsy in appropriate clinical settings, establishing imaging as a central component of contemporary prostate cancer diagnosis. [4] State-of-the-art mpMRI protocols require high-quality acquisition, standardized lesion assessment according to PI-RADS, and precise communication with referring urologists for biopsy planning [5].

AI Augmenting Physician Practice – diagnostic clinical decision support

Three stages of the prostate MRI workflow are particularly well suited for AI enablement: image acquisition, image interpretation, and segmentation of the prostate gland and targets for biopsy. Together, these applications aim to address key limitations of conventional workflows – long scan times, motion sensitivity, inter-reader variability, and time-consuming post-processing – while maintaining full compliance with established diagnostic standards such as PI-RADS v2.1.

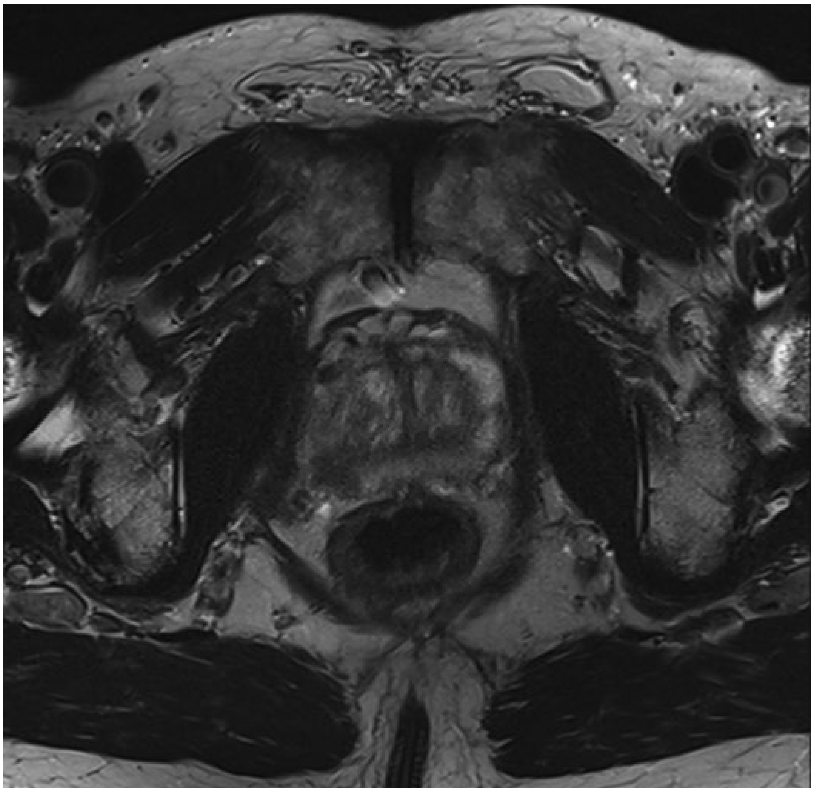
Siemens Healthineers integrates two complementary AI technologies into the MRI workflow – Deep Resolve during acquisition, and AIRC Prostate MR AI in prostate MRI evaluation.

Deep Resolve – AI-powered image acquisition: delivering consistency and image quality

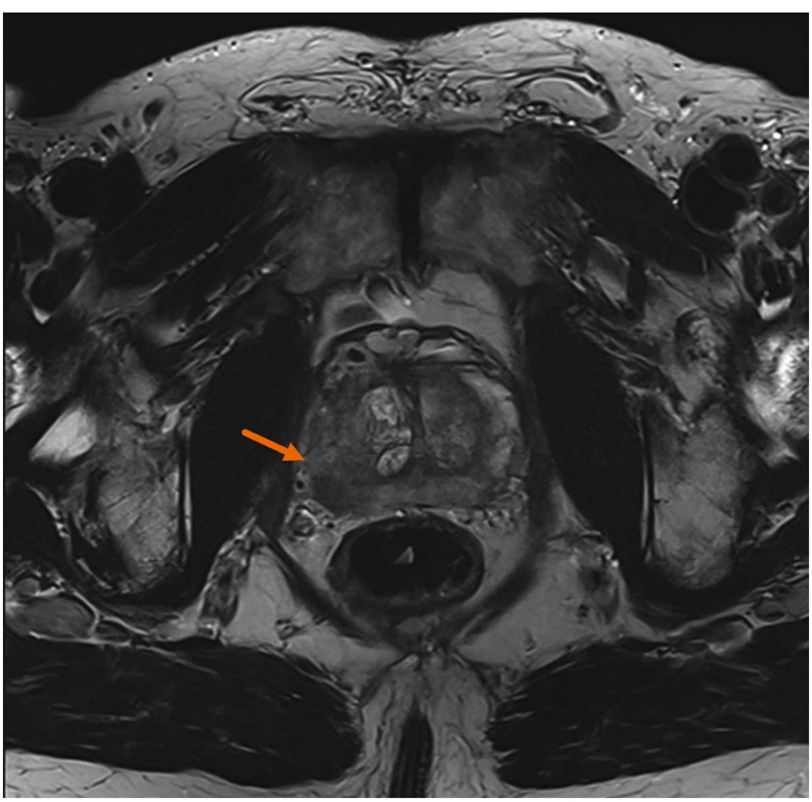
High-resolution T2-weighted and diffusion-weighted imaging sequences are essential for accurate prostate MRI interpretation but are traditionally time-consuming and sensitive to patient motion. Prolonged acquisition times can lead to motion artifacts, repeat scans, and reduced diagnostic confidence, particularly in elderly or anxious patients. [6]

AI-based deep-learning reconstruction techniques address this challenge by enabling accelerated image acquisition while preserving or improving image quality. These algorithms are trained on large datasets of high-quality reference images and reconstruct diagnostic images from undersampled data with reduced noise and improved sharpness. [7]

A peer-reviewed study has demonstrated that deep learning-based reconstruction can enable faster scans while maintaining diagnostic image quality and lesion conspicuity. [8] In a retrospective comparison, deep learning-accelerated diffusion weighted imaging of the prostate enabled an acquisition time reduction of about 39% compared with standard DWI, without relevant loss of diagnostic image quality. [9] Nevertheless, the exact magnitude of time savings and throughput gains depends on local protocols, hardware, and reconstruction settings, underlining the importance of site-specific protocol optimization. In clinical practice, deep learning-based reconstructions enable shorter, more consistent prostate MRI protocols that remain fully PI-RADS compliant and are expected to improve patient comfort, reduce motion artifacts, and increase scanner throughput. [10]



T2 TSE
TA 4:37 min
0.3 x 0.3 x 3.0 mm³



T2 TSE
Deep Resolve
TA 1:38 min
0.3 x 0.3 x 3.0 mm³

Improved quality of prostate TSE acquisition and the lesion visualization with Deep Resolve.
Courtesy of University Hospital Tübingen and Siemens Healthineers. Reprinted from Gassenmaier et al., European Journal of Radiology 2021.

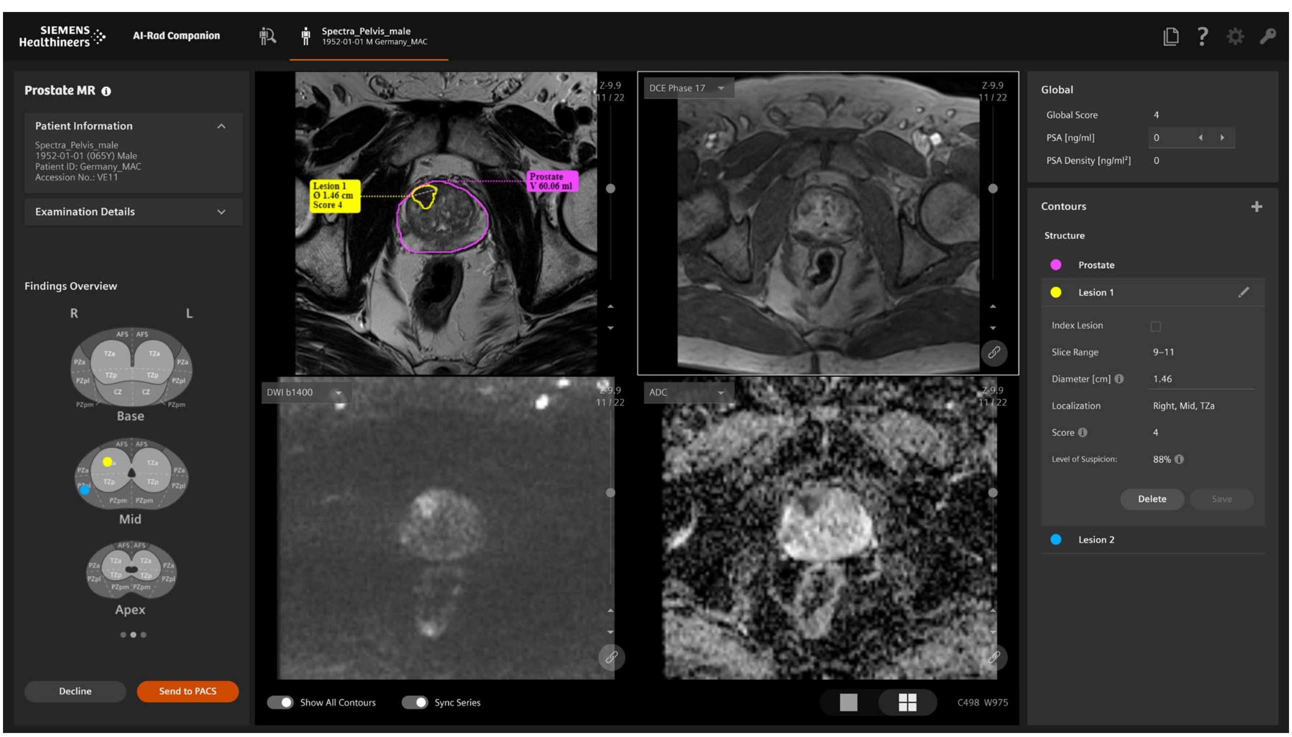
AI-Rad Companion: AI-augmented interpretation and MR/US fusion biopsy planning

Beyond image acquisition, prostate MRI interpretation involves multiple steps, including gland volume and PSA density calculations, lesion detection, localization and classification, and preparation of the images for MR/US fusion biopsy. [11] These tasks require substantial reading time [12] and may introduce variability between readers, particularly in high-volume or multi-site environments.

AI-Rad Companion Prostate MR is designed to support radiologists during postprocessing and interpretation by automating key steps within the prostate MRI workflow. The software provides automated prostate gland segmentation, volume estimation, and AI assisted lesion detection and classification, while supporting structured reporting and PIRADS-based assessment. [13] When patient PSA values are available, PSA density can be calculated directly within the workflow.
In addition, the software generates a structured report proposal that can be reviewed and used by the radiologist as a basis for the final report. When used in combination with Syngo Carbon as the PACS environment, AI Rad Companion Prostate MR results can be taken over into the reading workflow and integrated into the final report.

Importantly, all AI-generated results are presented to the physician for review and can be adjusted or refined by the radiologist. Clinical responsibility for interpretation and final decision-making remains with the physician at all times.

To support downstream workflows, AI-Rad Companion Prostate MR provides structured output (DICOM SR) and exports annotated images and DICOM RT-STRUCT files. This standardized, machine-readable information enables precise MR/US fusion biopsy targeting and helps reduce information loss between radiology and referring urologists. [14]



AI-Rad Companion Prostate MR automatically detects and segments suspicious lesions, visualizes their location, and provides a PI-RADS score recommendation.
Courtesy of Radiomedicum Bad Nauheim, Germany.

“The biggest gain for us is efficiency.”

Dr. Andrei Purysko, MD
Radiologist at Cleveland Clinic

From workflow efficiency to confidence in PI-RADS reporting

By combining accelerated acquisition with AI-assisted interpretation, AI-enabled prostate MRI workflows aim to deliver value across multiple dimensions. Automation of repetitive tasks reduces reading time and cognitive load for radiologists, allowing greater focus on complex cases and clinical decision-making. [15]

Standardized segmentation, structured reporting, and consistent data export improve communication with urologists and support multidisciplinary collaboration. In equivocal cases, such as PI-RADS 3 lesions, AI may serve as an additional reference point, supporting radiologists in balancing diagnostic sensitivity and specificity while avoiding unnecessary biopsies. [16]

Benefits of an AI-enabled workflow for Prostate MR

For radiologists:

- AI based volume estimation supports reproducible prostate measurements and streamlines routine post processing tasks.
- AI assisted lesion detection and PI RADS aligned assessment support efficient and consistent interpretation within the prostate MRI reading workflow.
- Structured reporting with standardized output helps ensure completeness and consistency of findings and reduces information loss when communicating results to the referring urologist, including via DICOM RT STRUCT export.
- AI Rad Companion Prostate MR helps to reduce inter reader variability and enhance diagnostic confidence by providing an additional, independently generated assessment for physician review.

For patients:

- Shorter and more comfortable MRI examinations supported by Deep Resolve technologies that can help reduce scan time and motion sensitivity.
- AI supported analysis may help support diagnostic confidence by providing an additional, independently generated evaluation that is reviewed by the radiologist as part of the interpretation process. [17]
- More standardized assessment and reporting may contribute to clearer communication of findings between radiologists and referring clinicians, supporting informed clinical decision making.

For urologists:

- Export of AI generated prostate and lesion contours in RT STRUCT format provides standardized, machine readable targets for fusion biopsy systems, potentially reducing repetitive manual image handling and the risk of information loss.
- More efficient multidisciplinary communication through standardized imaging derived information may support clearer lesion localization and case discussion within the diagnostic and therapy planning workflow.

Healthcare systems – operations

Streamlining referrals:
AI-enabled efficiency and consistent image quality position radiology as a preferred partner and service line connector between departments, particularly urology and primary care

Alignment with professional society and best practice guideline alignment:

- The 2026 American Urological Association AUA/SUO Early Detection of Prostate Cancer Guideline amendment upgraded the recommendation for MRI prior to initial biopsy to Grade A evidence, stating: "Clinicians may use magnetic resonance imaging (MRI) prior to initial biopsy to increase the detection of Grade Group (GG) 2+ prostate cancer."
  ↗ *auanet.org/guidelines*

- NCCN guidelines recommend MRI prior to biopsy more explicitly, positioning it as a standard step in the diagnostic pathway, thereby reinforcing the role of MRI-guided decision-making in prostate cancer diagnosis.
  ↗ *nccn.org/guidelines*

- EAU 2026 guidelines reinforce performing MRI before biopsy in suspected organ-confined disease (Strong recommendation) and omitting biopsy when MRI is negative (PI-RADS ≤2) with low clinical suspicion.
  ↗ *uroweb.org/guidelines/prostate-cancer*

On-premise AI deployment for prostate MRI

In addition to cloud-based approach of AI-Rad Companion Prostate MR, many institutions prefer on-premise AI solutions due to data governance, regulatory, or infrastructure requirements. Siemens Healthineers addresses this need with an AI-assisted prostate MRI reading workflow through its locally deployed ***syngo*.via solutions.**

Targeted biopsy:
Prostate mpMRI is increasingly positioned as a standard gateway in screening and early prostate cancer pathways, reducing unnecessary procedures while improving precision, and upcoming reimbursement changes are expected to better align payment structures with MRI-guided, image-targeted biopsy care.

Clinical evidence and validation studies

Many institutions emphasize prospective validation and real-world evaluation when introducing AI into prostate MRI workflows. **Validation studies often employ study designs that compare physician interpretation with and without AI assistance, for example, by contrasting AI aided reads with unaided reads.** Such approaches support transparency and trust building prior to routine clinical adoption.

The clinical performance of AI-Rad Companion Prostate MR has been evaluated across a range of study designs, patient populations, and institutional settings. The available evidence encompasses retrospective and prospective analyses, single- and multi-center cohorts, and both case-level and lesion-level endpoints, with biopsy or expert (consensus) annotations serving as the reference standard.

Winkel et al. (2021)
A multi-reader/multi-case comparison of AI-supported vs. unaided reading in terms of diagnostic performance, interreader variability and reading time, using datasets from a public database and expert consensus as the reference standard.
↗ *doi.org/10.1097/rli.0000000000000780*

Youn et al. (2021)
A retrospective comparison of AI standalone diagnostic performance with the original clinical reads and the results of multiple radiologists with different levels of experience, using biopsy as the reference standard.
↗ *doi.org/10.1016/j.ejrad.2021.109894*

Labus et al. (2022)
A multi-reader/multi-case comparison of AI-supported vs. unaided reading on a retrospective institution-specific dataset with biopsy as the reference standard, including a breakdown of the improvement conferred by AI depending on reader experience.
↗ *doi.org/10.1007/s00330-022-08978-y*

Oerther et al. (2023)
A retrospective evaluation of the case-level and lesion-level performance of the AI algorithm on an Active Surveillance cohort.
↗ *doi.org/10.1002/pros.24528*

Oerther et al. (2025)
A multi-center benchmarking of PI-RADS score assignment and lesion detection using biopsy as the reference standard.
↗ *doi.org/10.3390/cancers17050815*

Lee et al. (2025)
A prospective bicenter evaluation of diagnostic performance vs radiologists, using biopsy as the reference standard.
↗ *doi.org/10.1148/radiol.232788*

Boellard et al. (2025)
A comparison of AI and manual segmentations of prostate MRI for the purpose of 3D model based prostatectomy surgery planning.
↗ *doi.org/10.3390/diagnostics15091141*

FDA 510(k) summary (2025)
A multi-reader/multi-case comparison of AI-supported vs. unaided reading of consecutive datasets from two U.S. sites.
↗ *accessdata.fda.gov/cdrh_docs/pdf24/K241770.pdf*

Engel et al. (2025)
A retrospective evaluation of case- and lesion-level PI-RADS classification performance vs. that of radiologists on consecutive patients with a suspicion of prostate cancer.
↗ *doi.org/10.1007/s11547-025-02003-0*

Nakrour et al. (2025)
Retrospective comparison of case-level diagnostic performance in aided vs. unaided reading, using biopsy as the reference standard.
↗ *doi.org/10.1016/j.clinimag.2025.110484*

Jain et al. (2026)
Retrospective evaluation of per-patient and per-lesion performance of lesion detection at the correct localization, using the radiology report as the reference standard.
↗ *doi.org/10.1186/s13244-026-02261-0*

A clinical use case

AI-enabled prostate MRI in practice, Cleveland Clinic

Cleveland Clinic, a high-volume academic medical center with a strong focus on prostate cancer imaging, has explored integrating AI across the prostate MRI pathway.

Before introducing AI support, prostate MRI interpretation relied on manual volume calculation, lesion assessment, and gland segmentation as preparation for fusion biopsy. These steps were recognized as time-intensive and subject to inter-reader variability, particularly in a busy clinical environment. [18]

“Preparing prostate MRI studies for fusion biopsy is one of the most time-consuming parts of the workflow,” explains Dr. Andrei Purysko, MD, radiologist at Cleveland Clinic.

“Preliminary clinical experience suggests that AI-Rad Companion reduces prostate MRI post-processing user interaction by approximately 40% compared with conventional semi-automated biopsy-planning workflows.”

Dr. Andrei Purysko, MD
Radiologist at Cleveland Clinic

By integrating AI based image reconstruction and AI assisted post processing into the prostate MRI workflow, Cleveland Clinic aims to improve efficiency. Accelerated acquisition supports shorter and more consistent examinations, while AI assisted interpretation helps streamline segmentation and biopsy target preparation within the reading workflow.

“The biggest gain for us is efficiency,” says Dr. Purysko. ”AI helps us focus more on interpretation and clinical decision-making. Preliminary clinical experience suggests that AI-Rad Companion reduces prostate MRI post-processing user interaction by approximately 40% compared with conventional semi-automated biopsy-planning workflows. The efficiency gain is even greater for negative examinations without biopsy targets, where user interaction time is reduced by more than 80%.”

At Cleveland Clinic, a prospective clinical trial (NCT07084779, PI: Andrei Purysko, MD) is underway: 150 eligible patients undergoing prostate MRI for an elevated PSA will receive parallel interpretations of the images (radiologist alone followed by radiologist + AI). This prospective trial highlights the shift from traditional PSA-triggered systematic biopsy to a more precise, imaging-first approach using Siemens Healthineers tools. The workflow combines accelerated acquisition with Deep Resolve (AI-powered image reconstruction) and post-processing/decision support with AI-Rad Companion Prostate MR. The AI-enabled

The statements by customers of Siemens Healthineers described herein are based on results that were achieved in the customer’s unique setting. Because there is no “typical” hospital or laboratory and many variables exist (e.g., hospital size, samples mix, case mix, level of IT and/or automation adoption) there can be no guarantee that other customers will achieve the same results.

pathway reduces MRI scan time, produces clearer images, improves patient comfort (reduced risk of motion artifacts), and enhances diagnostic precision. A full mpMRI protocol with multiplanar T2-weighted images (turbo spin echo with Deep Resolve Boost (Denoising Strength: Medium) and Deep Resolve Sharp, diffusion-weighted images (b values 50, 400, 900 and calculated 1500, using Deep Resolve) and dynamic contrast enhanced T1-weighted images (Compressed Sensing GRASP-VIBE with temporal resolution of 7 seconds) can be completed in under 30 minutes (scan time under 12 minutes).

In addition to efficiency, AI is evaluated as a confidence-supporting tool, particularly in borderline cases. Standardized outputs and structured data export further support collaboration between radiology and urology, facilitating precise fusion biopsy planning.

“In our retrospective analysis, AI-Rad Companion showed excellent concordance with subspecialty-trained abdominal radiologists in more than 85% of cases. It also achieved excellent sensitivity for detecting clinically significant (Grade Group 2) prostate cancer and a high negative predictive value, both exceeding 90%,” says Dr. Purysko.

Siemens Healthineers – commitment to innovation

Siemens Healthineers pursues the development of ethical, trustworthy, and transparent AI solutions supported by ongoing research and clinical collaboration. Within prostate MRI, this approach encompasses AI technologies across the imaging pathway, including deep learning-based image reconstruction during acquisition (Deep Resolve) and AI-assisted post-processing and interpretation (AI-Rad Companion Prostate MR). These complementary technologies are trained on large and anatomically diverse medical imaging datasets to address different stages of the clinical workflow: disease detection, diagnosis, and treatment planning across a range of clinical applications. Deep learning-based reconstruction supports accelerated acquisition and image quality consistency, while AI-assisted interpretation contributes to standardized lesion assessment, segmentation, and structured reporting.

By integrating AI into both acquisition and evaluation steps, Siemens Healthineers aims to support physicians in the delivery of precision care.

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AI-Rad Companion Prostate MR is not commercially available in all countries, and its future availability cannot be ensured.

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