

# MRIdian<sup>®</sup> MR-Guided Radiation Therapy for Prostate Cancer

## Overview

Prostate cancer is the most common type of cancer diagnosed in men in the U.S. and the second most common type in men worldwide.<sup>1</sup> It is the second leading cause of cancer death in the U.S. and the sixth leading cause of cancer death globally.<sup>1,2,3</sup> Prostate cancer treatment costs are close to \$12 billion annually in the U.S. alone.<sup>1</sup>

## Treatment Landscape & Challenges

While surveillance or observation is a valid approach for patients with low-risk prostate cancer, current curative treatment options for prostate cancer include surgery, brachytherapy, and external beam radiation therapy (EBRT). EBRT is delivered in conventional fractionated or moderately hypofractionated treatment courses (1.8 to 3 Gy/day). Radiation delivery techniques and modalities include intensity-modulated radiation therapy (IMRT), proton beam therapy, and, increasingly, stereotactic body radiation therapy (SBRT).

The treatment of prostate cancer presents unique challenges given the proximity of nearby critical structures such as the bladder, rectum, and urethra, as well as anatomical motion caused by bodily processes such as the bladder filling or the movement of bowel gas.

## Worldwide Prostate Cancer Statistics<sup>3</sup>

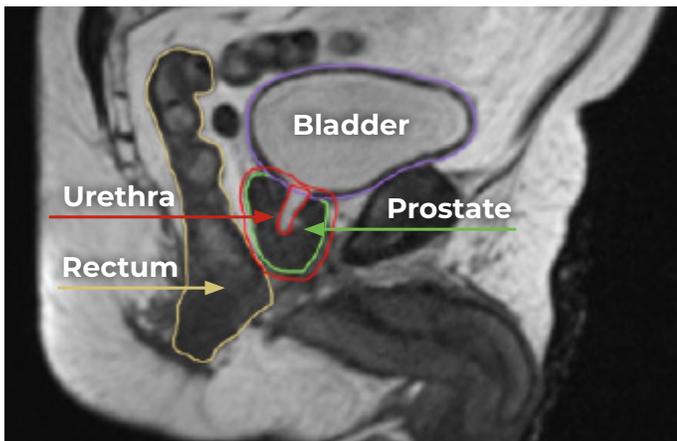
- 1,276,106 new cases each year
- 358,989 deaths annually
- Sixth leading cause of cancer death

## U.S. Prostate Cancer Statistics<sup>1,2</sup>

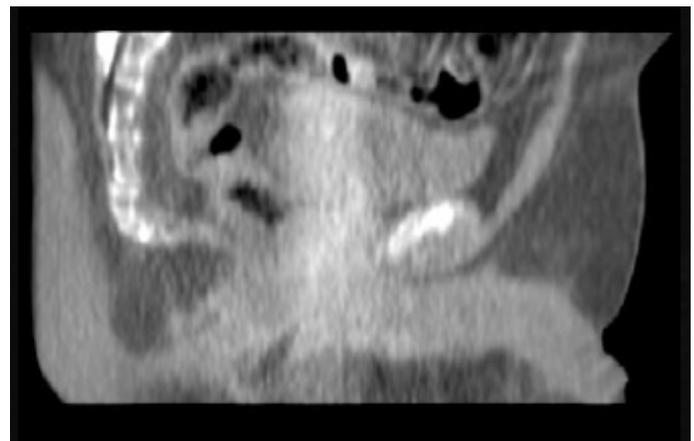
- 174,650 new cases each year
- 31,620 deaths each year
- Second leading cause of cancer death

Given that prostate cancer is often slow growing in combination with significant concerns around associated complications including incontinence, erectile dysfunction, and rectal bleeding, any treatment recommendation is focused on selecting a course of treatment that offers the lowest toxicity and side-effect profile and still achieves good local tumor control and disease-free survival.

A significant consideration is overall duration of a treatment course, with surgery and brachytherapy generally being delivered in a single day, while EBRT may be delivered over courses spanning up to 9 weeks. SBRT is typically delivered over 5 treatment days.



MRIdian MRI Image Example



Conventional Radiotherapy CBCT Example

### Noteworthy Clinical Findings

Amsterdam University Medical Center (Amsterdam UMC) recently completed the first prospective clinical trial to study MR-guided radiation therapy (MRgRT) for prostate cancer. Patients included intermediate- and high-risk prostate cancer patients, a challenging patient population to treat.

The phase II prospective study of 101 men demonstrated early outcome benefits of MR-guided adaptive SBRT.

#### Study Specifics

- SBRT was delivered in 5 fractions at 7.25 Gy/fraction using on-table adaptive delivery
- No implanted markers or tissue spacers used because treatments were delivered under MR-guidance

### Key Findings

- No early grade 3 GU or GI toxicity was observed at 3-month follow-up
- Fewer than 25% of prostate cancer patients were documented to experience grade 2 early GU toxicity, supporting the value of daily on-table plan re-optimization
- Grade 2 GI toxicities were seen in about 5% of patients, a roughly 50% reduction compared to reposted data

Bruynzeel, A. M. E., Tetar, S. U., Oei, S. S., Senan, S., Haasbeek, C. J. A., Spoelstra, F. O. B., et al. (2019). A prospective single-arm phase 2 study of stereotactic magnetic resonance guided adaptive radiation therapy for prostate cancer: Early toxicity results. *International Journal of Radiation Oncology • Biology • Physics*, 105(5), 1086–1094. [doi:10.1016/j.ijrobp.2019.08.007](https://doi.org/10.1016/j.ijrobp.2019.08.007)

### The MRIdian Advantage

MR-imaging affords superior visualization of the prostate and the nearby organs-at-risk, with the integrated ability to react to changes in the position of the target between treatment days (interfraction organ motion) and during radiation dose delivery (intrafraction organ motion).

With the ability for on-table adaptive dose re-planning, MRIdian offers precise and accurately controlled radiation delivery with real-time soft tissue MRI guidance and automated beam gating. MRIdian's ability to see and track the tumor and adapt the treatment allows for more precise radiation therapy and minimizes dose to surrounding critical structures.

In the treatment of prostate cancer, these unique capabilities enable:

- High-contrast, high-resolution MR soft tissue imaging, unachievable with simulation CT and conventional IGRT including on-board cone beam computed tomography (CBCT)

“SBRT offers significant promise in the treatment of prostate cancer. Our clinical trial takes that a step further in showcasing its value in patients with intermediate- and high-risk disease, with a focus on evaluating associated toxicities and quality-of-life outcomes.

We see a **lower incidence of GI and GU toxicity with MR-guidance** as compared to similar SBRT prostate cancer studies. The results reinforce the value of MRIdian's real-time on-table adaptive treatment with automatic beam gating for prostate patients.”

Anna Bruynzeel, MD, PhD  
Radiation Oncologist at Amsterdam UMC  
Principal Investigator



On-board MRI real-time, cine showing how gas passing through the bowel impacts the position of tumor.

- Clinical confidence to safely escalate dose and shorten treatment courses (deliver hypofractionated treatments including SBRT)
- On-table adaptive therapy allows clinicians to customize the radiation treatment plan on a daily basis, as needed to maintain the physician's dose-prescription intent. Intrafraction, automated, imaging-based beam control in real-time allows delivery of the radiation dose precisely to the target while reliably avoiding organs at risk
- Daily plan re-optimization with real-time beam control may allow for tighter margins and maximal normal tissue sparing
- Eliminating the need for implanted fiducial markers or tissue spacers, thereby avoiding an invasive procedure, potentially associated complications, delays in treatment initiation, and additional costs

### Clinical Presentations: ASTRO 2019

#### MR-Guided Daily Adaptive SBRT for Prostate Cancer – A Phase 2 Prospective Study

Ben Slotman, MD, PhD  
Amsterdam UMC

<https://vimeo.com/368126717>

#### MRI-Guided Prostate RT: See the Cancer, Spare the Toxicity

Himanshu Nagar, MD  
The NewYork-Presbyterian Hospital  
and Weill Cornell Medicine

<https://vimeo.com/362435244>

#### ViewRay SBRT of Prostate: Seeing is Believing

Prof. Jin Ho Kim, MD  
Seoul National University Hospital

<https://vimeo.com/362441864>

Go to <https://viewray.com/clinical-spotlight/scientific-presentations/> for additional talks.

### Supporting Peer-Reviewed Publications

Magnetic resonance imaging guidance mitigates the effects of intrafraction prostate motion during stereotactic body radiotherapy for prostate cancer. Hegde, J. V., Cao, M., Yu, V. Y., Kishan, A. U., Shaverdian, N., Lamb, J., et al. (2018). *Cureus*, 10(4), e2442. doi:10.7759/cureus.2442

MRI-guided dose-escalated salvage radiotherapy for bulky bladder neck recurrence of prostate cancer. Kishan, A. U., Tyran, M., Steinberg, M. L., Holden, S. B., Cao, M. (2018). *Cureus*, 10(3), e2360. doi:10.7759/cureus.2360

Clinical implementation of magnetic resonance imaging guided adaptive radiotherapy for localized prostate cancer. Tetar, S., Bruynzeel, A. M. E., Lagerwaard, F. J., Slotman, B. J., Bohoudi, O., Palacios, M. A. (2019). *Physics and Imaging in Radiation Oncology*, 9, 69–79. doi:10.1016/j.phro.2019.02.002

### Supporting Presentations & Videos

Video produced by ViewRay featuring a prostate cancer patient story: <https://vimeo.com/406039056>

Video produced by ViewRay featuring a prostate cancer patient story: <https://vimeo.com/398900535>

Video produced by NewYork-Presbyterian/Weill Cornell Medicine featuring a prostate cancer patient story: <https://www.youtube.com/watch?v=1s3NTYQTWtHc>

Video produced by HenryFordTV (Henry Ford Cancer Institute) featuring a prostate cancer patient story: <https://www.youtube.com/watch?v=SFyAdhAbqRU>

Presentation on 'Post-Prostatectomy Radiotherapy: Roles for MRI-Guided RT' given by Amar Kishan, MD, from UCLA Health, Jonsson Comprehensive Cancer Center at ASTRO 2018: <https://vimeo.com/300873628>

Presentation on 'Novel Applications for MRI-Guided Radiotherapy in the Treatment of Soft Tissue Sarcomas and Prostate Cancer' given by Zachary Morris, MD, PhD, from Carbone Cancer Center, University of Wisconsin, given at ASTRO 2018: <https://vimeo.com/298647448>

### References:

1. Silberstein, J. L., Pal, S. K., Lewis, B., & Sartor, O. (2013). Current clinical challenges in prostate cancer. *Translational Andrology and Urology*, 2(3), 122–136. doi:10.3978/j.issn.2223-4683.2013.09.03
2. National Cancer Institute: Surveillance, Epidemiology, and End Results Program. Cancer Stat Facts: Prostate Cancer. Retrieved from <https://seer.cancer.gov/statfacts/html/prost.html>
3. Ferlay, J., et al. Global Cancer Observatory: Cancer Today. Lyon, France: International Agency for Research on Cancer. Retrieved August 30, 2019 from <https://gco.iarc.fr/today>



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