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Cost-effectiveness of Intensity-Modulated Radiation Therapy versus Robot-Assisted Radical Prostatectomy in Patients with Prostate Cancer: A Systematic Review

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Introduction:

Prostate cancer is one of the most prevalent malignancies among men worldwide. IMRT and RARP are established treatment modalities for localized prostate cancer. Evaluating their cost-effectiveness is essential to inform evidence-based clinical decision-making and optimize healthcare resource allocation.

Methods:

This systematic review evaluated the cost-effectiveness of IMRT and RARP in patients with localized prostate cancer. A systematic search was conducted across PubMed, Google Scholar, Europe PMC, and Springer. Of the 118 retrieved records, four studies satisfied the eligibility criteria and were included in the qualitative analysis.

Results:

Four studies were included. Hypofractionated IMRT achieved 11.55 QALYs versus 11.44 QALYs for RARP, with an ICER of JPY 143,685/QALY (USD 890.85/QALY). SBRT also yielded higher QALYs than RARP (8.373 vs. 6.845) with an ICER of €332/QALY (USD 378.48/QALY). Treatment costs were comparable between IMRT (USD 12,833) and RARP (USD 12,689), while active surveillance was the least costly strategy (USD 1,074).

Discussion:

This systematic review found that Active Surveillance (AS) is the most cost-effective strategy for low-risk prostate cancer, providing the highest QALYs at the lowest cost. These findings are consistent with Kang et al. (2021), who reported that AS improves quality of life while reducing unnecessary interventions. For patients requiring active treatment, hypofractionated IMRT and SBRT were more cost-effective than RARP, with greater QALY gains and ICER below the willingness-to-pay (WTP) threshold, consistent with the systematic review by Rezapour et al. (2023). Differences in cost-effectiveness were primarily influenced by post-treatment quality of life, treatment-related adverse effects, and variations in healthcare systems.

Prisma Flow

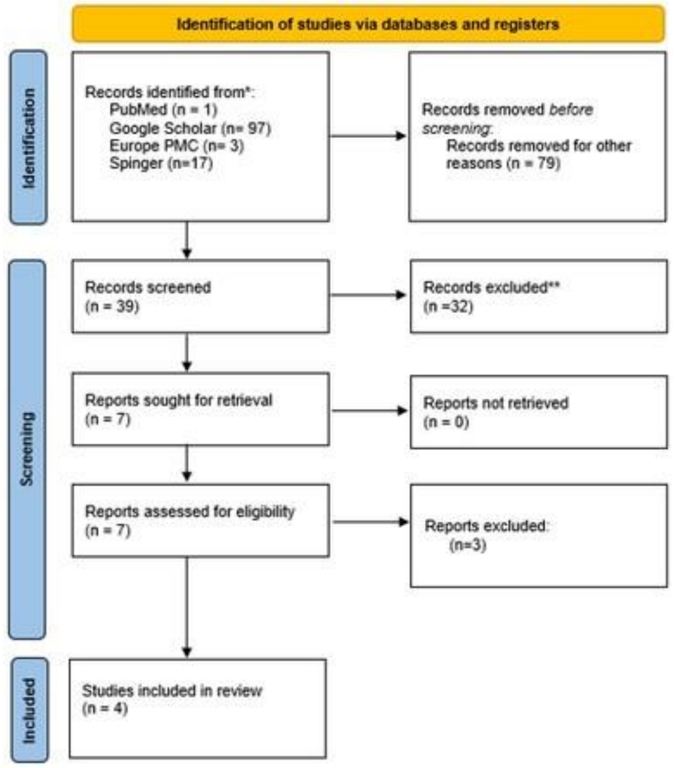

Table Characteristics of included studies

Author Year	Population & Sample	Variables	Outcomes
Farah L. (2022)	• Localized, low-risk prostate cancer patients in France. • 10-year Markov model simulation.	Robot-assisted stereotactic body radiotherapy (rSBRT) vs. robot-assisted radical prostatectomy (rRP).	Total costs: rRP (€18,968) and rSBRT (€19,475). QALYs: rSBRT (8.373) and rRP (6.845). ICER: rSBRT versus rRP was €332 per QALY gained.
Igarashi A. (2026)	• Localized low-risk prostate cancer patients in Japan. • 20-year Markov model simulation of 65-year-old men.	Hypofractionated IMRT in 20 fractions (IMRT-20) vs. robot-assisted radical prostatectomy (RARP).	Total costs: IMRT-20 (JPY 1.84 million) and RARP (JPY 1.82 million). QALYs: IMRT-20 (11.55) and RARP (11.44). ICER: JPY 143,685 per QALY gained.
Kato T. (2022)	• Low-risk prostate cancer patients eligible for Active Surveillance (AS) in Japan. • Estimated 5-year cohort of 2,808 patients using actual clinical data.	AS vs. RARP, Brachytherapy (BT), IMRT, and Hormone Therapy (HT).	Median treatment costs were US$1,074 for AS, US$12,689 for RALP, US$12,833 for IMRT, and US$7,607 for hormone therapy.
Muhler P. (2025)	• 60-year-old men with low- to favorable intermediate-risk prostate cancer in Germany. • Lifetime (40-year) Markov model simulation.	MR-TULSA vs. RARP, External Beam Radiation (EBRT), and AS.	Lifetime costs: RARP (€46,997) and AS (€52,449). QALYs: AS (12.67) and RARP (12.20). ICER: AS versus RARP was €11,600 per QALY gained.

Conclusions:

IMRT and RARP are effective for localized prostate cancer in clinical practice but have different toxicity profiles. Current evidence suggests that IMRT, especially hypofractionation IMRT and SBRT, is more cost-effective with higher QALY gains with little additional cost. These findings will need to be confirmed by more high-quality economic studies.

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