

Versus Open Radical Prostatectomy for Localized Prostate Cancer:

a U.S. Health-System Perspective

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Background

Use of robotic prostatectomy has expanded rapidly, although high capital and per-case costs continue to limit broader adoption. AI augmentation has the potential to improve precision, safety, and efficiency.

Objective

To evaluate the cost-effectiveness of AI-enhanced robotic-assisted radical prostatectomy (AI-RARP) versus conventional open radical prostatectomy (ORP) from a U.S. health-system perspective.

Methods

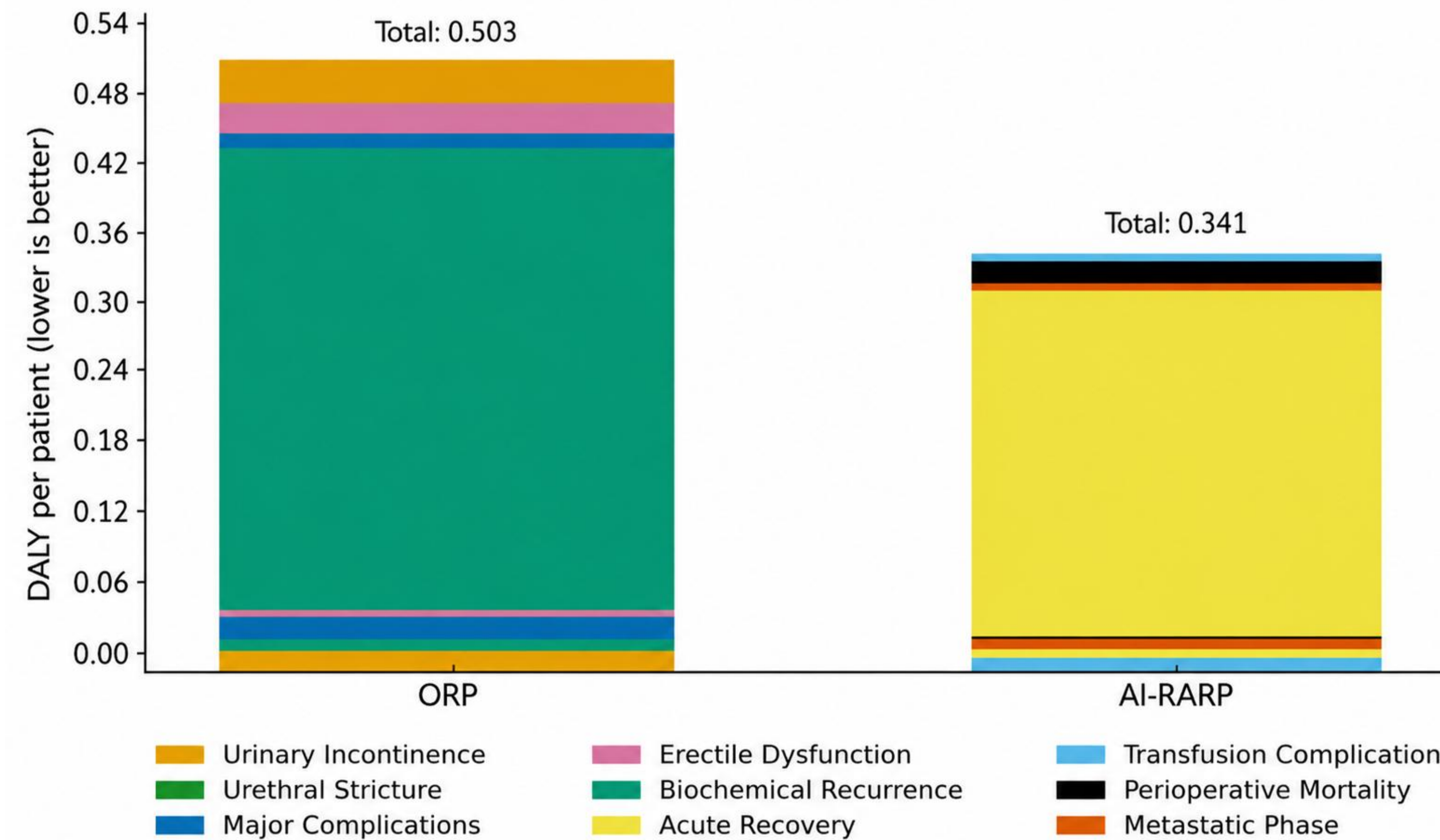
- A state-transition Markov model with 9 health states was developed from a U.S. health-system perspective.
- Quality-adjusted life-years (QALYs) were derived from disability-adjusted life-years (DALYs) using disability weights and a 3% annual discount rate.
- Direct costs (2025 USD) included robotic capital allocation, operating room time, disposables, hospitalization, and complication management.
- Five-year scenario analyses incorporated plausible reductions in capital costs, operating room time, and complication rates.



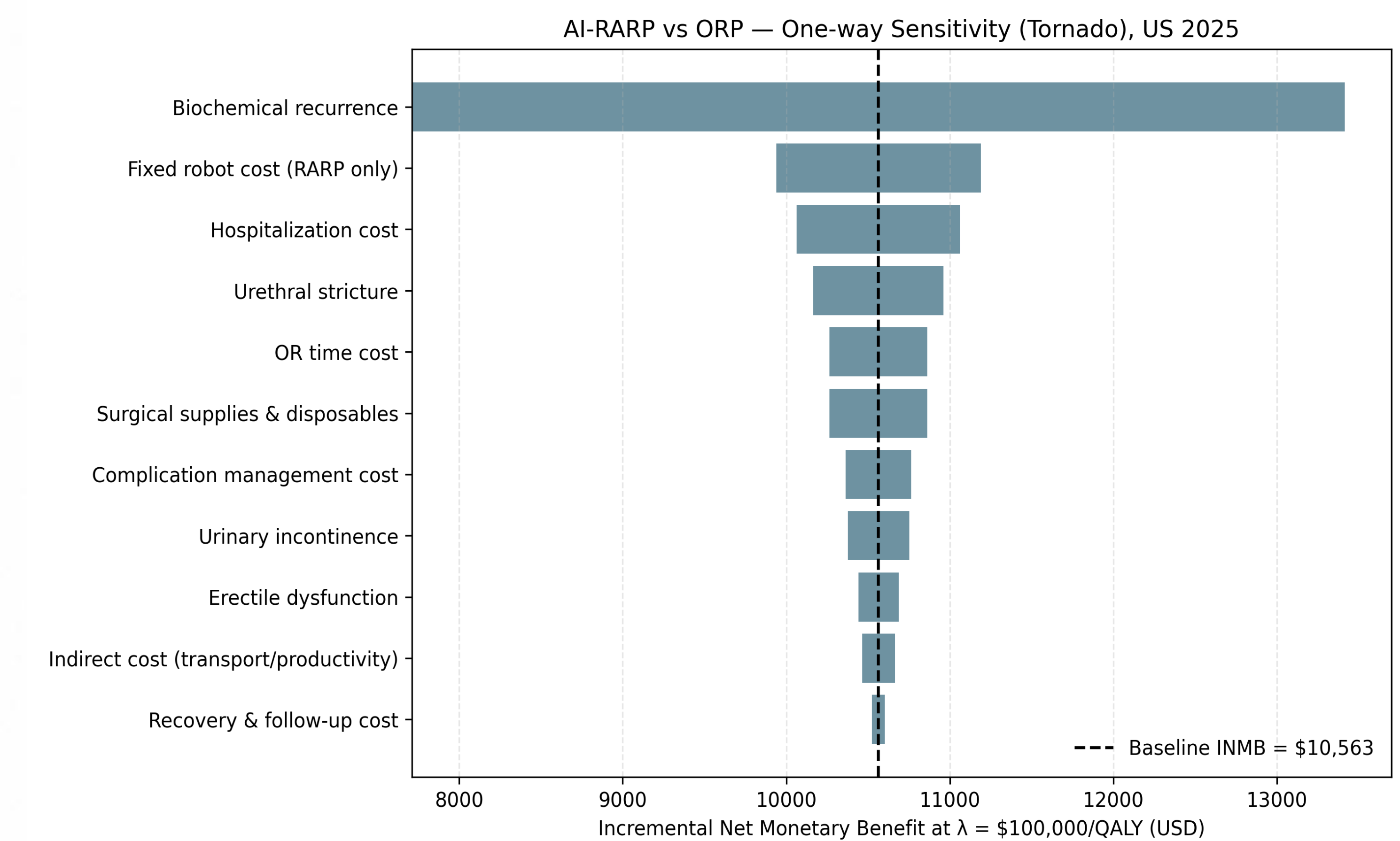
Key Results

- AI-RARP was associated with an incremental gain of 0.1622 QALYs at an additional cost of \$1,800 per patient.
- The incremental cost-effectiveness ratio (ICER) was \$11,095/QALY, approximately 10-fold lower than the U.S. threshold of \$115,180/QALY.
- In 5-year scenario analyses, AI-RARP approached cost parity and became cost-saving in the breakeven case.

DALY Components by Health State: ORP vs AI-RARP



One-Way Sensitivity Analysis



Implications for AI in Surgery and HEOR

- May support value-based care and precision oncology
- May reduce healthcare system burden through improved efficiency and outcomes
- Could improve equity in access to advanced interventions if implementation is appropriately targeted
- May support broader adoption of AI-augmented technologies across surgical specialties

Equity Perspective

AI-RARP may either widen or reduce existing disparities in access to robotic surgery, depending on implementation. Prior studies have shown that Black patients had 19% lower odds and Hispanic patients 23% lower odds of receiving robotic prostatectomy than White patients, while Medicaid patients were 30% less likely to be treated at robotic-equipped hospitals. Future AI-enabled diffusion should incorporate targeted strategies to promote equitable access.

Next Steps

- Real-world evidence studies linking registries and claims data
- Subgroup analyses by center volume and patient risk
- Equity-focused implementation strategies

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Health Outcomes Per Patient

Health State	Risk Reduction	DALYs Averted
Biochemical recurrence	4.0%	0.0950
Perioperative mortality	0.2%	0.0269
Urethral stricture	4.4%	0.0133
Acute recovery	0.0%	0.0077
Remaining health states (combined)	10.2%	0.0193
TOTAL	—	0.1622

Strengths

- Transparent Markov framework linking clinical states to DALYs and QALYs
- Plausible 5-year efficiency projections
- Decision-relevant costing in 2025 U.S. dollars

Cost-Effectiveness Results

Parameter	Now	5-Year Projection	Breakeven
Incremental cost	\$1,800	\$975	\$0
QALYs gained	0.1622	0.1622	0.1622
ICER (\$/QALY)	\$11,095	\$6,010	Cost-saving
US threshold	\$115,180	\$115,180	\$115,180
Cost-effective?	YES	YES	YES + cost-saving

Limitations

- AI-specific evidence remains limited, and several inputs were extrapolated from broader robotic surgery literature
- Forward-looking assumptions require validation using real-world data
- Indirect costs were included only to a limited extent