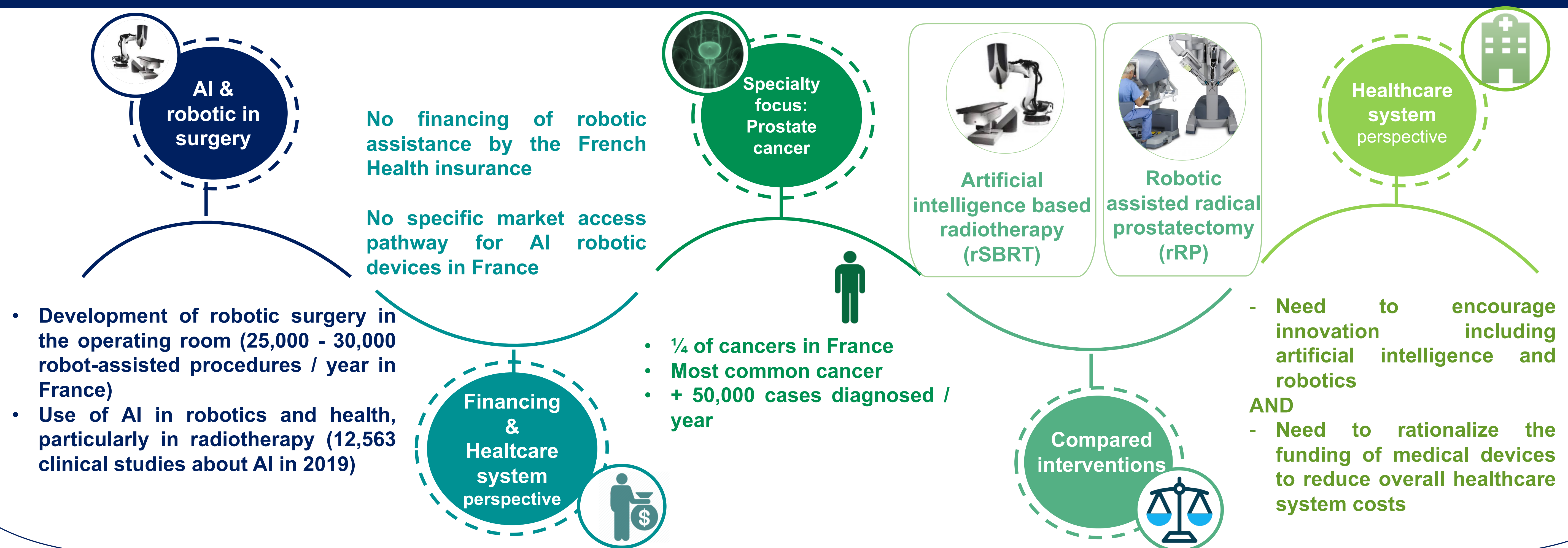# Cost-utility analysis comparing robot-assisted radical prostatectomy *versus* robotic Radiotherapy with artificial intelligence for the treatment of prostate cancer

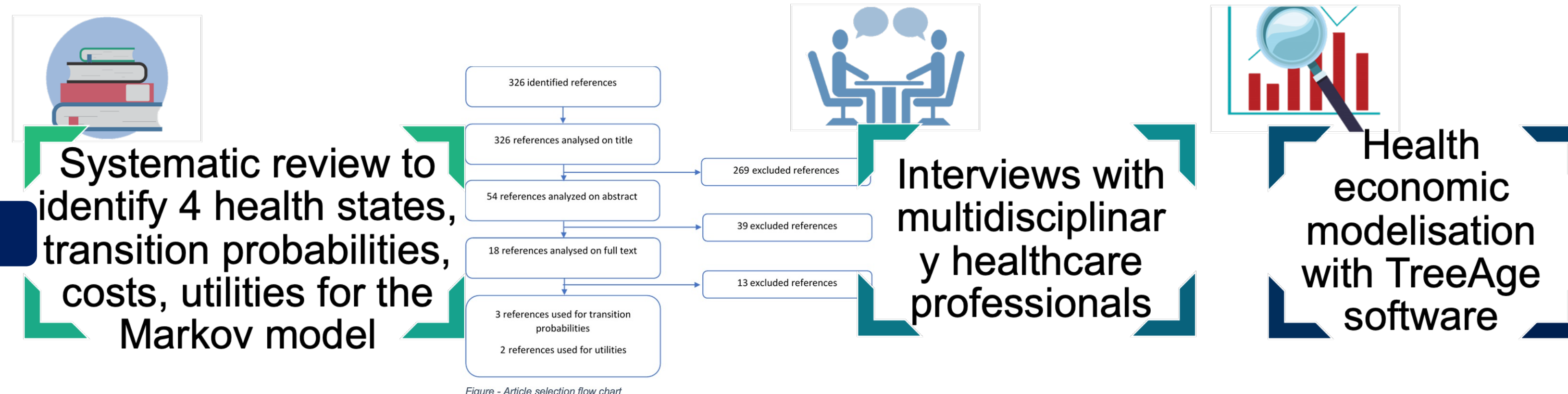**ISPOR** Improving healthcare decisions — université PARIS-SACLAY FACULTÉ DE PHARMACIE — **GRADES** Université Paris-Saclay

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Context

- **AI & robotic in surgery**
- **Development of robotic surgery in the operating room (25,000 - 30,000 robot-assisted procedures / year in France)**
- **Use of AI in robotics and health, particularly in radiotherapy (12,563 clinical studies about AI in 2019)**

No financing of robotic assistance by the French Health insurance

No specific market access pathway for AI robotic devices in France

Financing & Healtcare system perspective

Specialty focus: Prostate cancer
- ¼ of cancers in France
- Most common cancer
- + 50,000 cases diagnosed / year

Artificial intelligence based radiotherapy (rSBRT) **Robot assisted radical prostatectomy (rRP)**

Compared interventions

Healthcare system perspective

- Need to encourage innovation including artificial intelligence and robotics AND
- Need to rationalize the funding of medical devices to reduce overall healthcare system costs

Health economic assessment to compare AI radiotherapy *versus* robotic radical prostatectomy
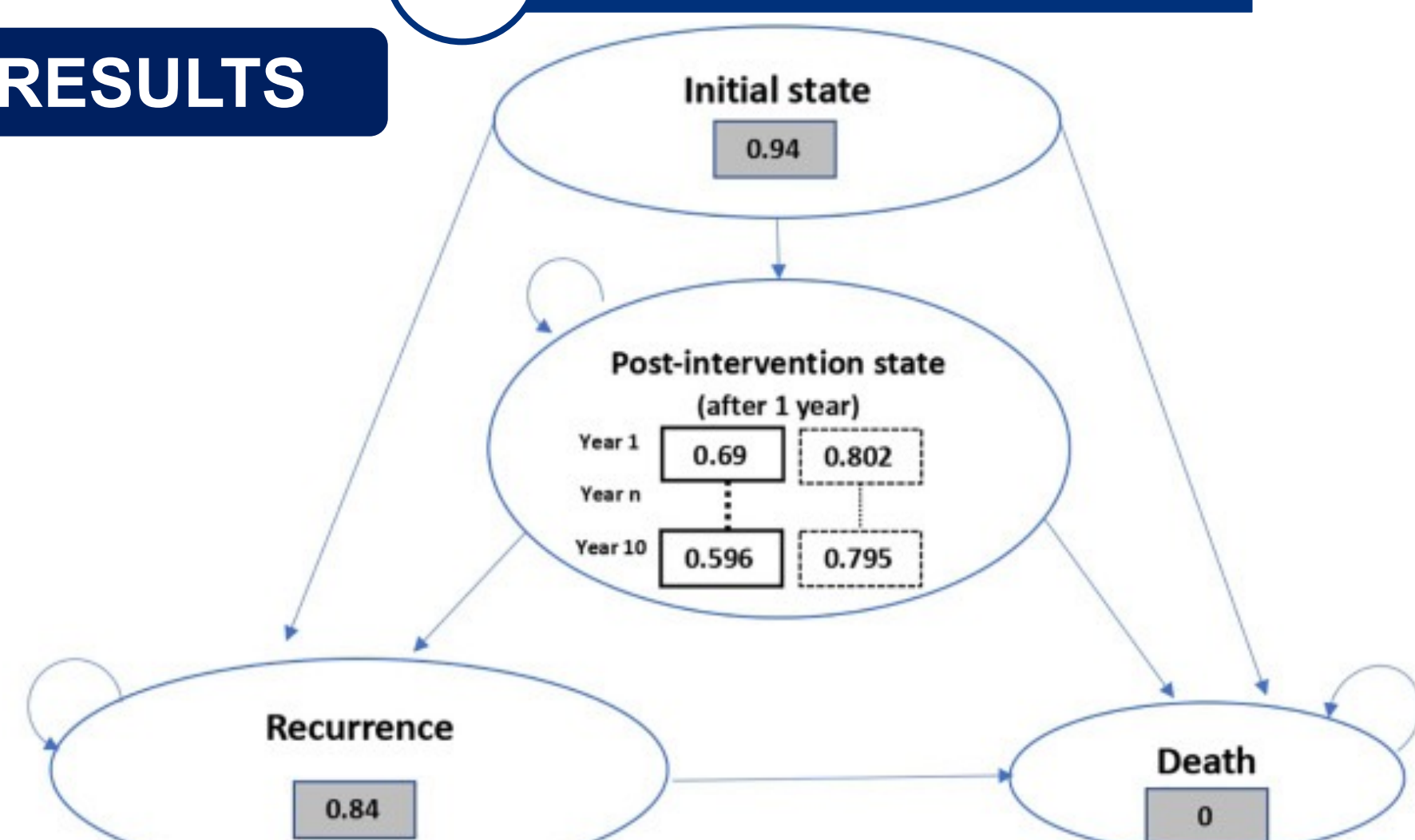
OBJECTIVE
To compare economic and clinical impacts of prostate cancer treatments with artificial intelligence robotic assisted radiotherapy compared to robotic radical prostatectomy in France

METHOD

Systematic review to identify 4 health states, transition probabilities, costs, utilities for the Markov model

326 identified references
326 references analysed on title — 269 excluded references
54 references analysed on abstract — 39 excluded references
18 references analysed on full text — 13 excluded references
3 references used for transition probabilities
2 references used for utilities
Figure : Article selection flow chart

Interviews with multidisciplinary healthcare professionals

Health economic modelisation with TreeAge software

DISCUSSION

MODEL ANALYSIS

- Robotic surgery is less expensive than AI based radiotherapy in France
- But AI based radiotherapy is cost-effective compared to robotic surgery in a 10 year horizon
- 1st health economic evaluation comparing AI based radiotherapy to robotic surgery in prostate cancer
- Need of specific French quality of life data
- Reproducibility of utilities values at international level to be verified
- Patients treated by AI radiotherapy are older than those eligible for robotic surgery

RESULTS

1 Markov model creation

Initial state 0.94
Post-intervention state (after 1 year)
Year 1: 0.69 | 0.802
Year n: —
Year 10: 0.596 | 0.795
Recurrence 0.84
Death 0

Figure: Markov model of the cost-utility analysis comparing robotic surgery (rRP) and artificial intelligence-based radiotherapy (rSBRT) in prostate cancer
Legend: ☐ robotic surgery (rRP) utilities / ☐ artificial intelligence-based radiotherapy (rSBRT) utilities / ☐ similar utilities for both strategies
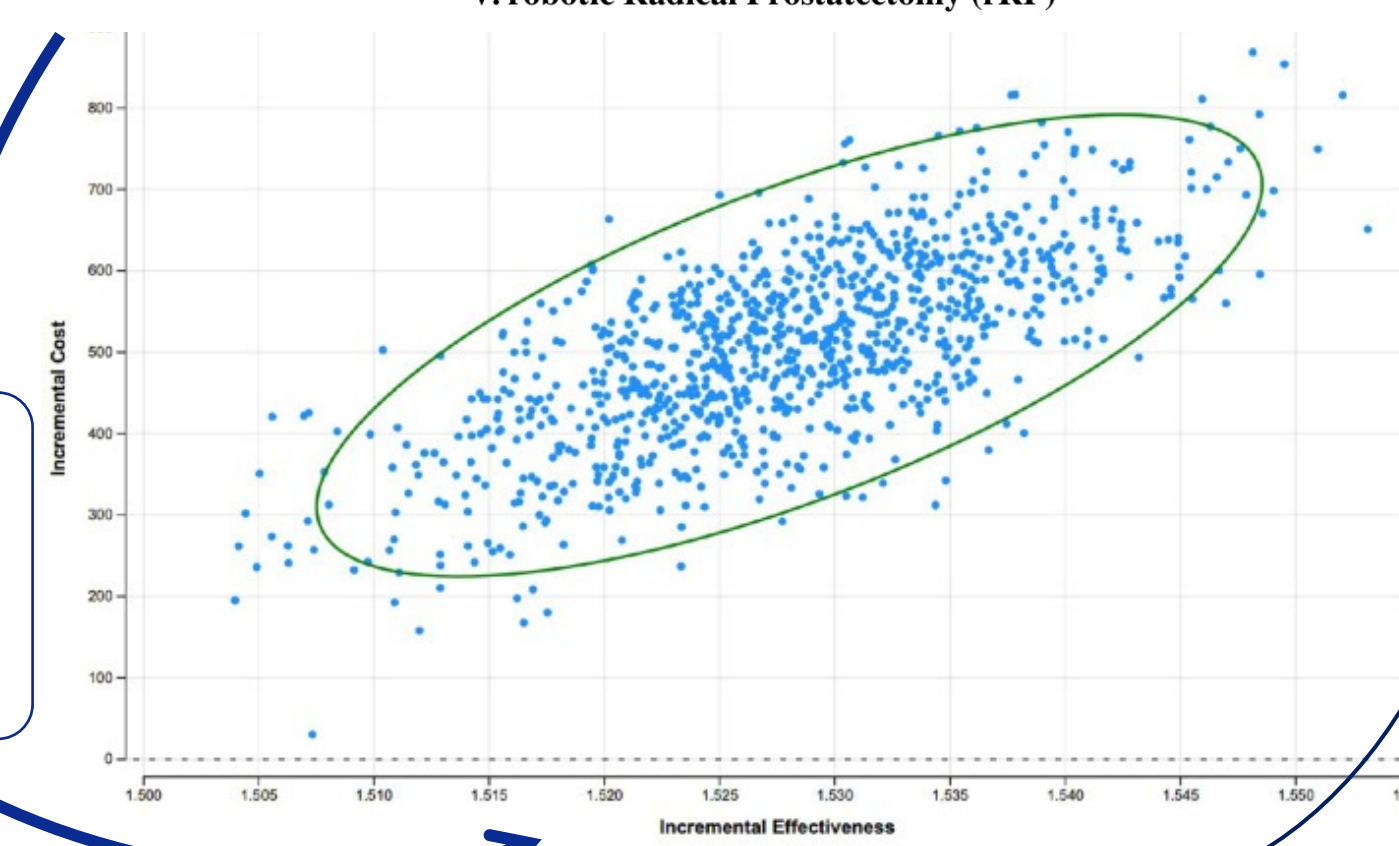
2 Parameters

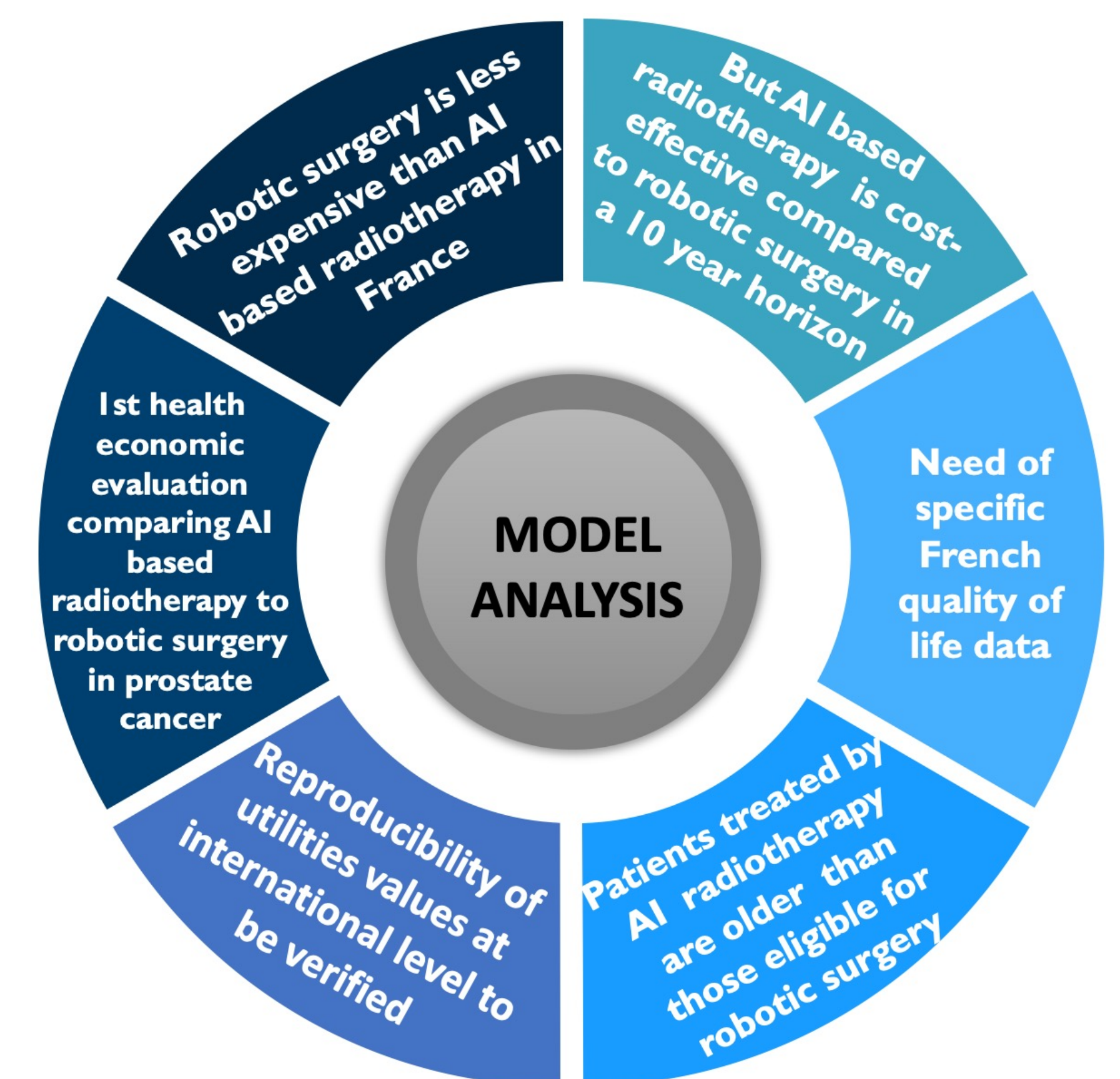| Parameters	Selection
Type of evaluation	Cost-utility analysis
Perspective	Societal
Targeted population	low risk localized (non-metastatic) prostate cancer cases as defined by the Amico classification (intracapsular cancer (T1 or T2a), PSA <10 and Gleason score <7), for which the therapeutic decision as discussed at a urology tumor board was a robot-assisted intervention (by surgery or by AI radiotherapy); eligible for radiotherapy or surgery,
Interventions	Robot assisted-radicalprotatectomy (rRP); Artificial intelligence assisted rediotherapy (rSBRT)
Timeline horizon	10 years

3 Incremental Cost Effectiveness Ratio

From a societal perspective, robotic prostatectomy (rRP) represented a cost saving when compared to AI based radiotherapy (rSBRT) with an ICER of €332/QALY over a 10-year time horizon, in France.

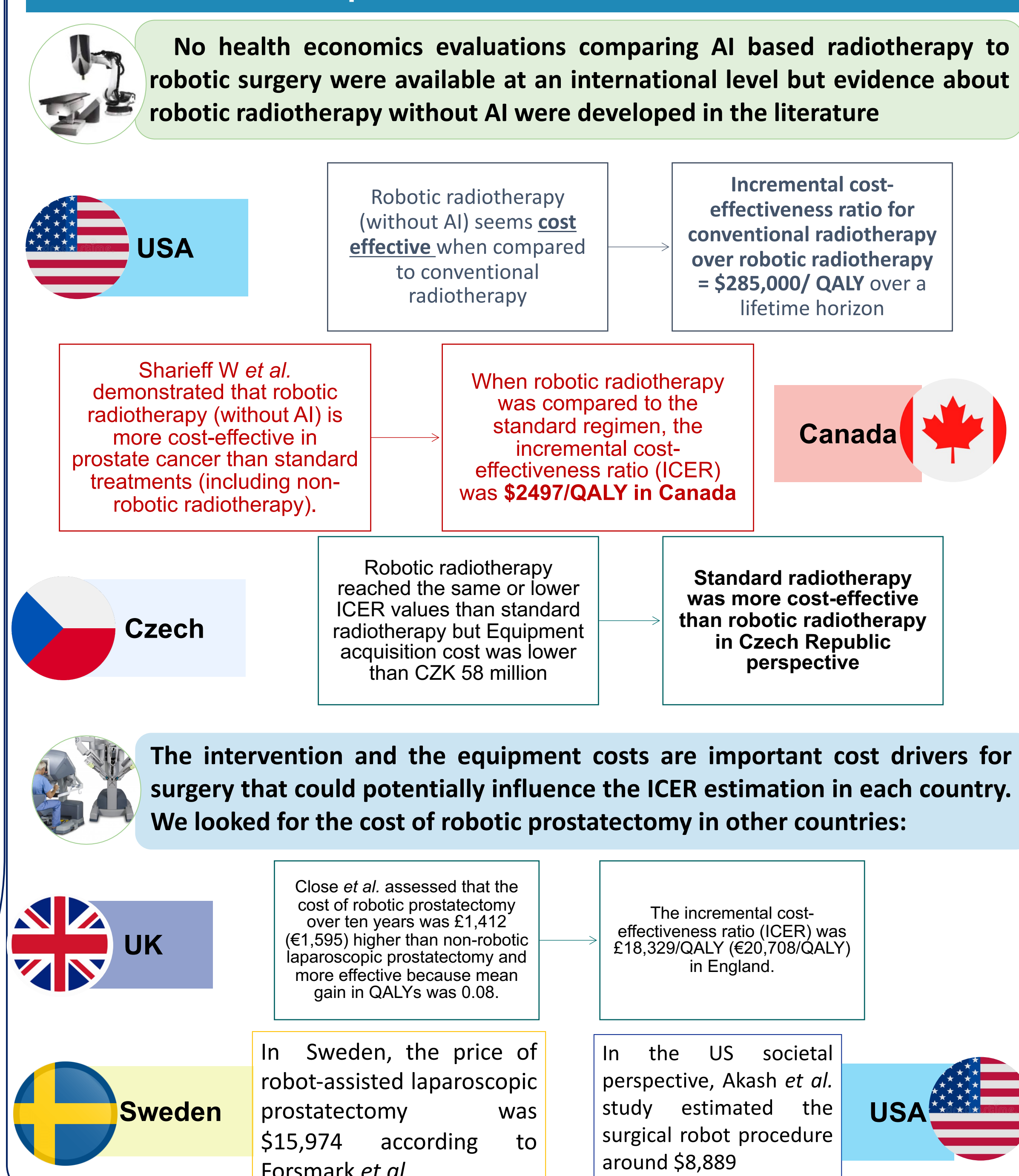| Compared therapies	Cost (€)	Incremental Cost (€)	QALY	Incremental QALY	ICER
Robotic radical Prostatectomy (rRP)	18,968		6.845		
Robotic radiotherapy with artificial intelligence (rSBRT)	19,475	507	8.373	1.528	332

Table – Cost-utility analysis comparing AI radiotherapy (rSBRT) with robotic radical prostatectomy (rRP) during a ten-year timeline horizon

Probabilistic sensitivity analyses, showing the dispersion of 1,000 ICER simulations, indicate that the ICERs are distributed in the northeast quadrant. The cost-effectiveness of AI based radiotherapy relative to robotic surgery was generally robust to changes in input variables. Dispersion is low.

4 Acceptability curve

The acceptability curve highlights that, over a 10-year period, Artificial intelligence based radiotherapy rSBRT becomes more cost-effective than robotic prostatectomy rRP, beyond the €710 threshold (corresponding to the "willingness to pay" of the financial decision-maker i.e. the health insurance)

5 Monte Carlo analysis

Incremental Cost-Effectiveness, robotic Stereotactic Body RadioTherapy (rSBRT) v. robotic Radical Prostatectomy (rRP)

Comparison with other countries

No health economics evaluations comparing AI based radiotherapy to robotic surgery were available at an international level but evidence about robotic radiotherapy without AI were developed in the literature

USA — Robotic radiotherapy (without AI) seems **cost effective** when compared to conventional radiotherapy → Incremental cost-effectiveness ratio for conventional radiotherapy over robotic radiotherapy = $285,000/ QALY over a lifetime horizon

Sharieff W *et al.* demonstrated that robotic radiotherapy (without AI) is more cost-effective in prostate cancer than standard treatments (including non-robotic radiotherapy). → When robotic radiotherapy was compared to the standard regimen, the incremental cost-effectiveness ratio (ICER) was **$2497/QALY in Canada**

Czech — Robotic radiotherapy reached the same or lower ICER values than standard radiotherapy but Equipment acquisition cost was lower than CZK 58 million → Standard radiotherapy was more cost-effective than robotic radiotherapy in Czech Republic perspective

The intervention and the equipment costs are important cost drivers for surgery that could potentially influence the ICER estimation in each country. We looked for the cost of robotic prostatectomy in other countries:

UK — Close *et al.* assessed that the cost of robotic prostatectomy over ten years was £1,412 (€1,595) higher than non-robotic laparoscopic prostatectomy and more effective because mean gain in QALYs was 0.08. → The incremental cost-effectiveness ratio (ICER) was £18,329/QALY (€20,708/QALY) in England.

Sweden — In Sweden, the price of robot-assisted laparoscopic prostatectomy was $15,974 according to Forsmark *et al*

USA — In the US societal perspective, Akash *et al.* study estimated the surgical robot procedure around $8,889

Keys messages to deliver with the evaluation of AI in curative therapies

CONCLUSION

- AI radiotherapy = cost-effective technique compared to robotic prostatectomy over a spending of 710€ during 10 years in France
- Real world evidence and randomized controlled trials are needed
- This health economic model for AI needs to be assessed in other countries to validate results

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