

COST-EFFECTIVENESS OF SELECTIVE INTERNAL RADIATION THERAPY (SIRT) USING YTTRIUM-90 RESIN MICROSPHERES FOR THE TREATMENT OF PATIENTS WITH INOPERABLE COLORECTAL LIVER METASTASES IN FRANCE

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Introduction

Selective internal radiation therapy (SIRT) can be used to treat liver metastases resulting from colorectal cancer (CRC). Radioactive yttrium-90 (⁹⁰Y) resin microspheres (SIR-Spheres[®] microspheres; Sirtex Medical, Sydney, Australia) are delivered directly to the hepatic artery by a micro-catheter, destroying the tumour cells from within the tumour microvasculature by radiation.

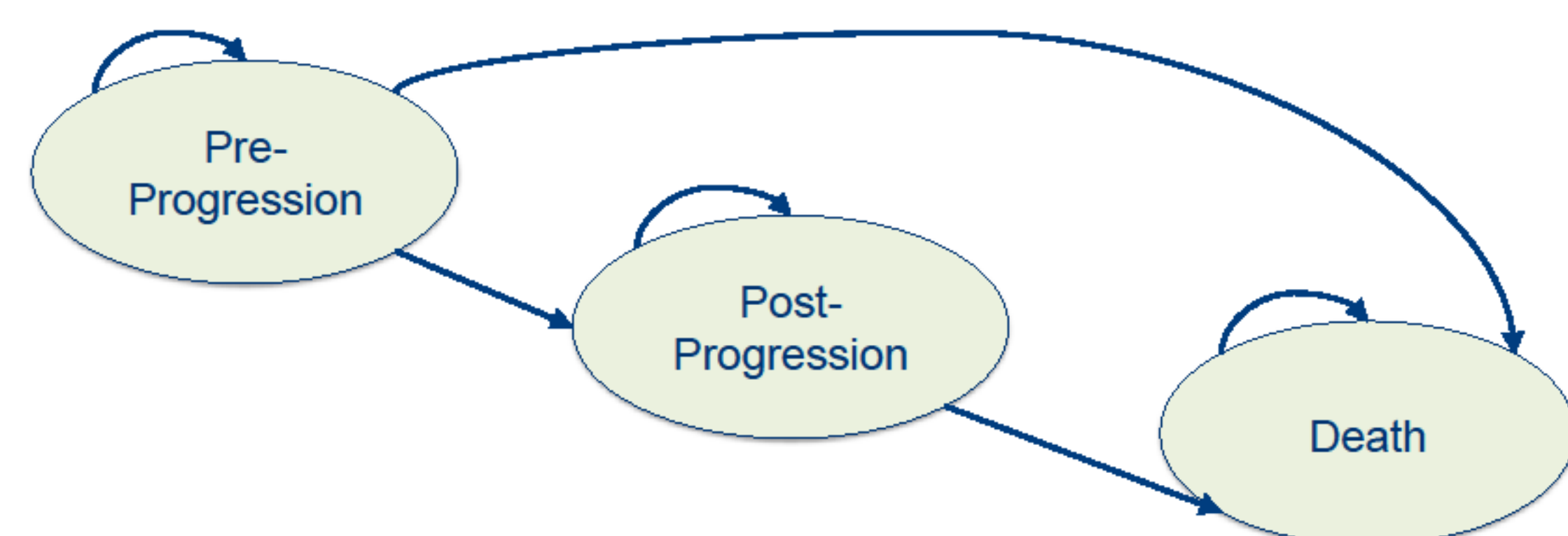
A retrospective cohort study (Bester, 2012) found a survival advantage from SIRT compared to Best Supportive Care (BSC) in patients with chemotherapy refractory liver-dominant metastatic CRC (mCRC).

Our objective was to develop a model to evaluate the cost effectiveness of SIRT using ⁹⁰Y resin microspheres compared to BSC in chemotherapy-refractory patients with liver-dominant metastases resulting from colorectal cancer in France.

Methods

A state-transition cost-effectiveness model was constructed (Figure 1). Survival data from the comparative retrospective cohort study (Bester, 2012) comparing ⁹⁰Y resin microspheres and BSC in patients with chemotherapy refractory mCRC were used.

Figure 1. State-Transition Cost-Effectiveness Model Structure



The model included costs for treatment acquisition, pre-treatment work-up and delivery of microspheres, obtained from the Programme de Médicalisation des Systèmes d'Information Hospitaliers (PMSI) 2009-2013 (Table 1). Cost of chemotherapy and monitoring were obtained from the L'Assurance Maladie en ligne website (Ameli, 2014). Cost of adverse events were calculated using the Programme de Médicalisation des Systèmes d'Information Hospitaliers (PMSI) 2009-2013 and the L'Assurance Maladie en ligne website. A cost of death was incorporated in the model to reflect the cost of terminal care for patients with end-stage cancers. This was obtained from the PMSI 2009-2013.

Table 1. SIRT Costs

Parameter	Cost (2014)	Source
Total diagnosis and work-up	€2,366	PMSI, 2009-2013 (inflated to 2014)
Total delivery	€2,534	PMSI, 2009-2013 (inflated to 2014)
Acquisition of SIR-Spheres	€12,000	Personal communication with Sirtex, December 2014
Total SIRT	€16,900	

Key: PMSI: Programme de Médicalisation des Systèmes d'Information Hospitaliers; SIRT: Selective Internal Radiation Therapy.

Utility data were not available from the study (Bester, 2012) and so were taken from a recent National Institute for Health and Care Excellence (NICE) economic evaluation in the same indication (Hoyle, 2013). These were 0.75 for the pre-progression state and 0.69 for the post-progression state. A utility decrement of 0.10 was applied over the final 28 days of a patient's life to reflect the poorer quality of life patients experience shortly before death (informed by expert clinician opinion).

Threshold values for cost-effectiveness were chosen according to the recommendations by the Commission on Macroeconomics and Health, accepted by the World Health Organization - Choosing Interventions that are Cost-Effective initiative (WHO-CHOICE, 2014). WHO-CHOICE derives three categories of cost-effectiveness:

- 1) Highly cost-effective (less than Gross Domestic Product (GDP) per capita).
- 2) Cost-effective (between one and three times GDP per capita) and
- 3) Not cost-effective (more than three times GDP per capita)

The GDP in France was €33,506 in 2014 (World Economic Outlook Database 2014)

References

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Further information is available on request.
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SIR-Spheres[®] is a registered trademark of Sirtex Medical Pty Ltd.

Results

In the base case, treatment with SIRT using ⁹⁰Y resin microspheres compared to BSC was associated with an increase in costs of €25,252 and a quality-adjusted life year (QALY) gain of 0.82, resulting in an incremental cost-effectiveness ratio (ICER) of €30,610. The costs of SIRT, monitoring and further treatment were greater in the SIRT arm with partial cost-offset through a reduction in adverse events.

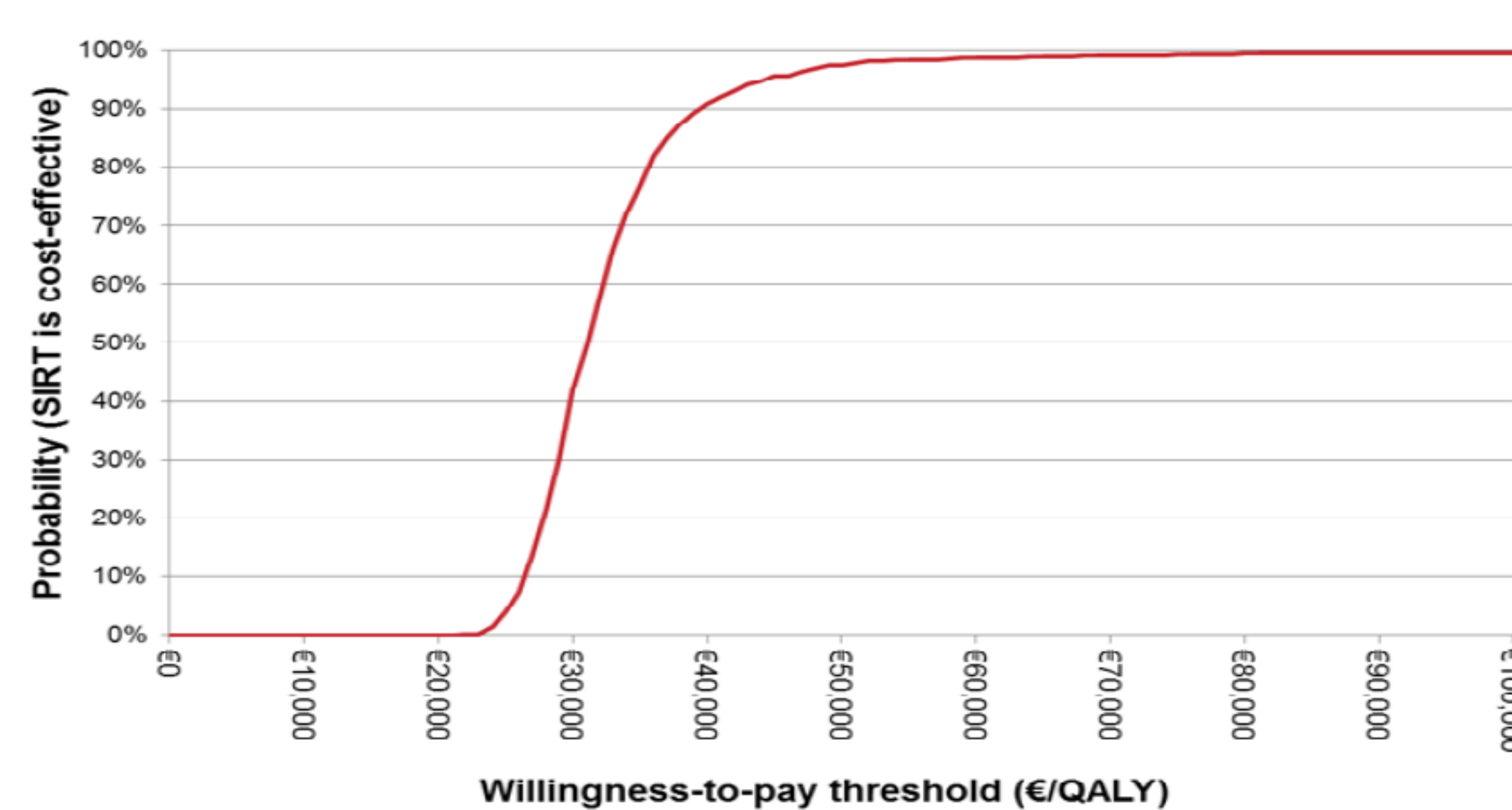
Scenario analysis showed the results to be robust to changes in structural assumptions, varying only between €28,363 and €31,940.

Table 2. Base-Case and Scenario-Analysis Results

	Discounted		Incremental		ICER (cost/QALY)
	Cost	QALYs	Cost	QALYs	
Base case					
BSC	€23,300	0.70			
SIRT	€48,552	1.52	€25,252	0.82	€30,610
Sensitivity analysis – stratified lognormal curve (2nd best fit according to AIC)					
BSC	€23,033	0.68			
SIRT	€48,638	1.53	€25,606	0.85	€30,238
Sensitivity analysis – 25% of time spent in pre-progression					
BSC	€23,300	0.68			
SIRT	€48,552	1.49	€25,252	0.81	€31,261
Sensitivity analysis – 75% of time spent in pre-progression					
BSC	€23,300	0.71			
SIRT	€48,552	1.55	€25,252	0.84	€29,985
Sensitivity analysis – 100% of time spent in pre-progression					
BSC	€23,300	0.72			
SIRT	€48,552	1.58	€25,252	0.86	€29,385

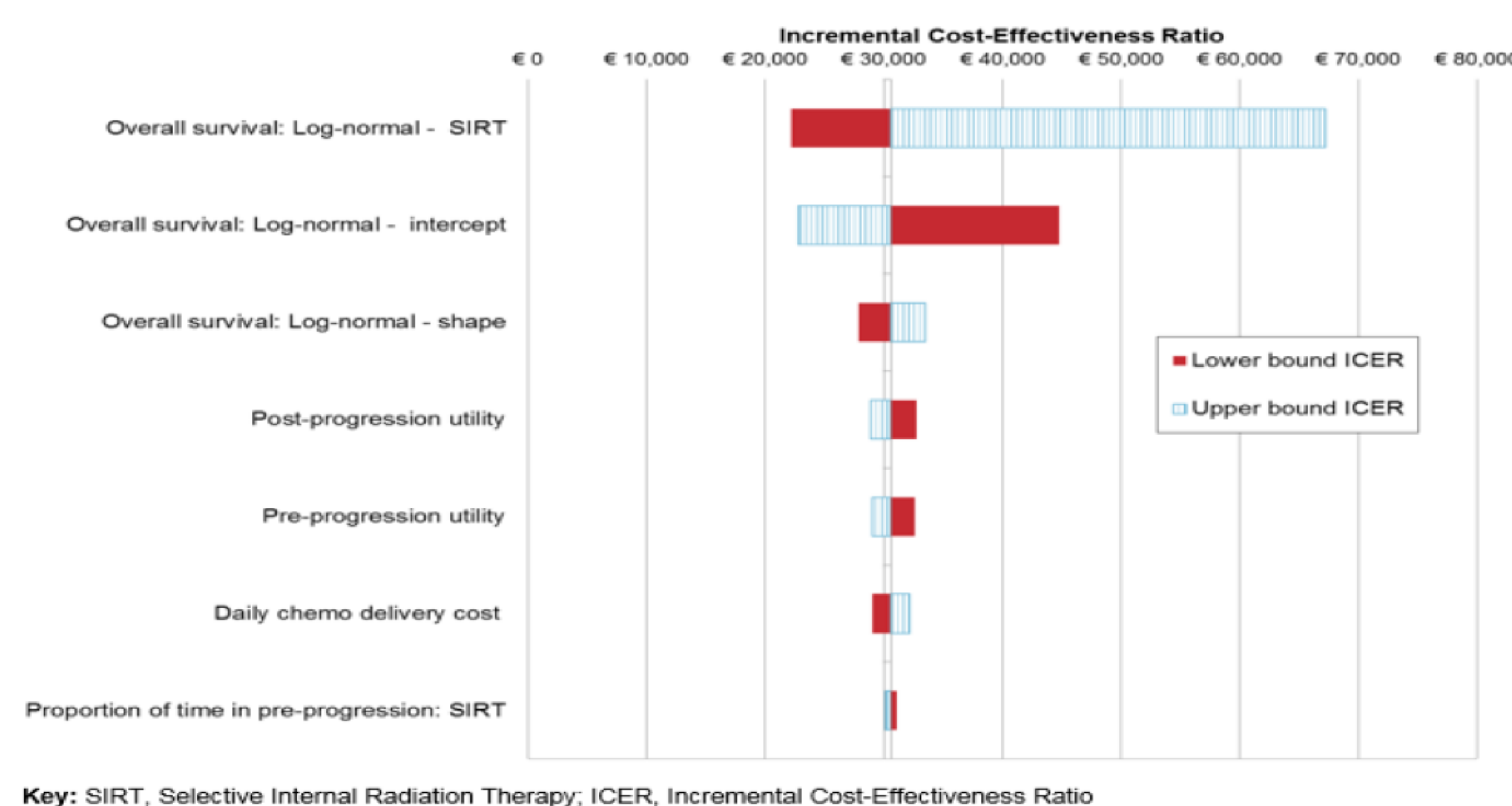
The probabilistic sensitivity analysis found that there is approximately a 69% chance that SIRT is highly cost-effective at a willingness-to-pay threshold of €33,506 (1 x GDP) and a 100% chance that it is cost-effective at a willingness-to-pay threshold of €100,518 (3 x GDP) (Figure 2).

Figure 2. Cost-Effectiveness Acceptability Curve



One-way sensitivity analysis showed the model to be most sensitive to the survival curve parameters (Figure 3).

Figure 3. Tornado Diagram



Conclusion

This analysis has demonstrated that use of ⁹⁰Y resin microspheres is a highly cost-effective option in France for the treatment of patients with chemotherapy-refractory liver-dominant metastases resulting from colorectal cancer. In an area of considerable unmet need, treatment with ⁹⁰Y resin microspheres offers a cost-effective treatment option.

