

Cost-Effectiveness Analysis of Non-invasive Vagus Nerve Stimulation (nVNS) for the Treatment of Chronic Cluster Headache in Germany

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Introduction

- The debilitating nature of chronic cluster headache (CH) can negatively impact a patient's physical and emotional quality of life (QoL)
- CH sufferers typically face substantial healthcare costs, which include both direct (eg, medication and clinic visits) and indirect (eg, reduced working capacity) costs²
 - The costs of abortive medications can be 2-fold higher for patients with chronic CH than for those with episodic CH²
- The PREVA study³ found that treatment with a novel non-invasive vagus nerve stimulation (nVNS) device (gammaCore®; **Figure 1**) decreased abortive medication use and improved QoL outcomes in subjects with chronic CH
- A pharmacoeconomic model was developed using PREVA study data to quantify the economic impact of nVNS therapy compared with subjects' standard of care (SoC) treatment in chronic CH

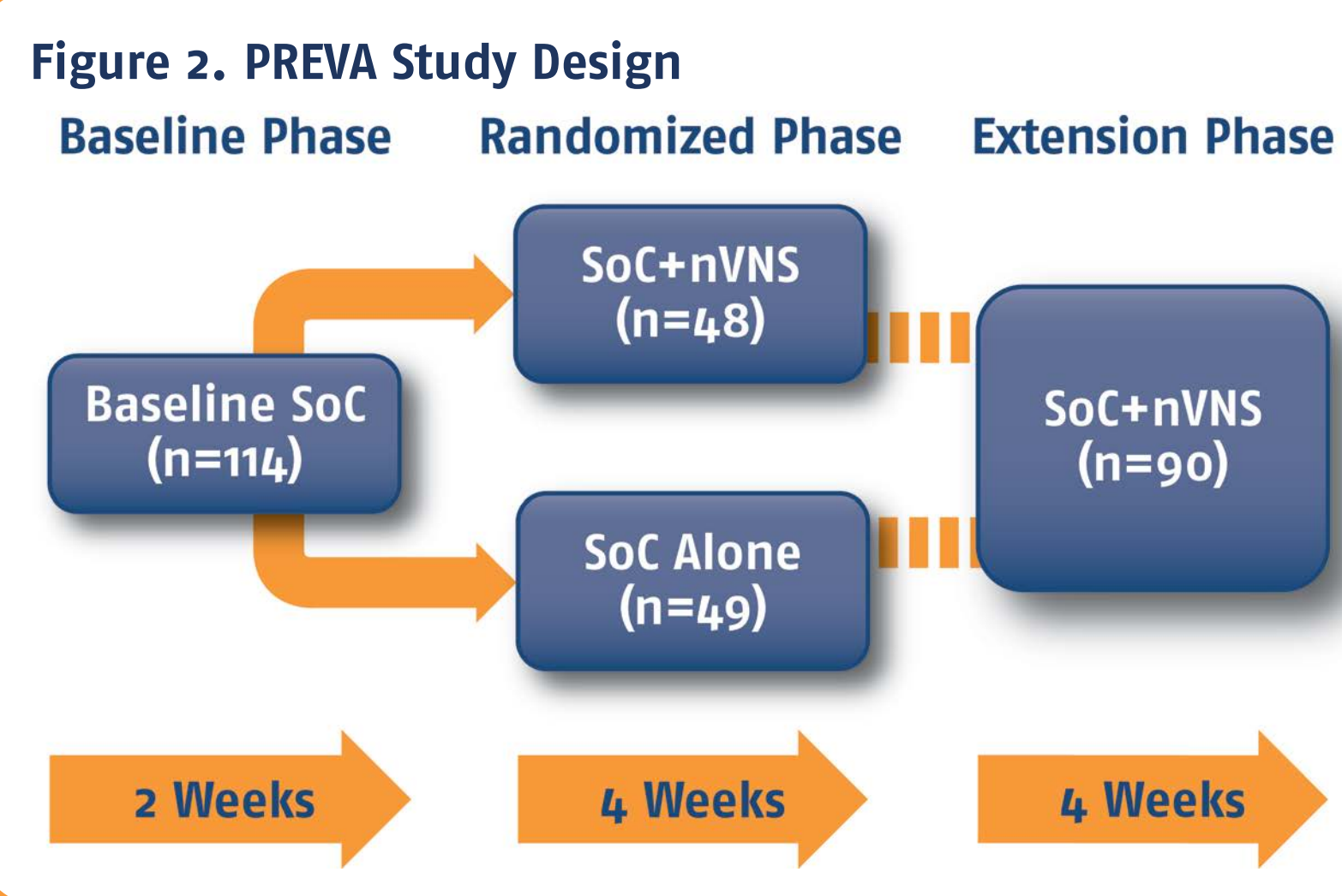
Figure 1. nVNS Device



Methods

PREVA Study Design

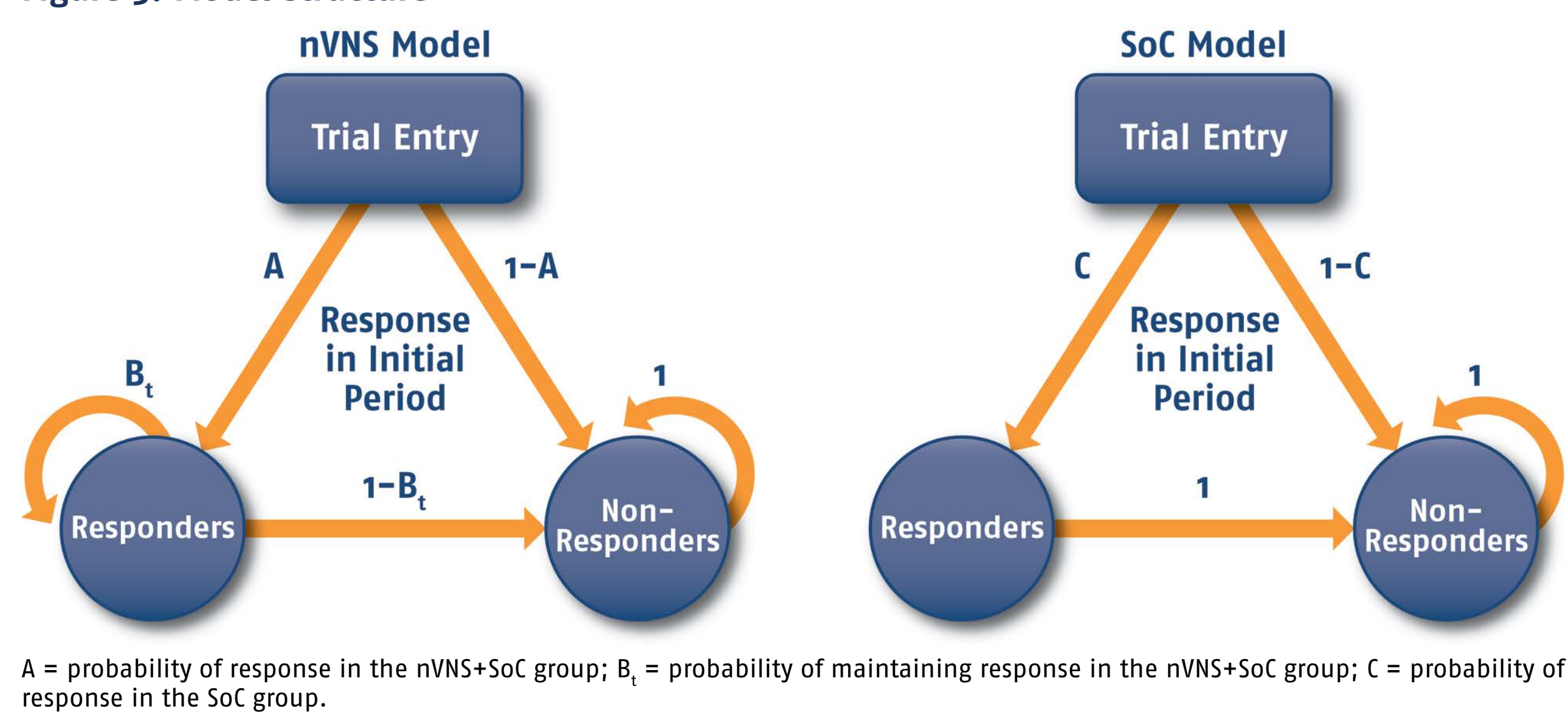
- PREVA evaluated the safety and efficacy of adjunctive nVNS therapy compared with SoC alone (**Figure 2**)
- Subjects delivered three 120-second stimulations prophylactically twice daily (mandatory) to the right side of the neck and optionally as acute treatment for CH attacks



Pharmacoeconomic Model Development

- A 1-year model (**Figure 3**) was developed to estimate the cost-effectiveness of adjunctive nVNS therapy from the German Statutory Health Insurance perspective
 - Benefits were defined as quality-adjusted life years (QALYs)
 - Healthcare utilization costs were estimated from abortive medication use and the cost of the nVNS device
- Model parameter estimates were derived using efficacy and abortive medication use data from the randomized phase of the PREVA study
 - Data from the extension phase were used to generate a survival analysis to extend the model to 12 months

Figure 3. Model Structure



Estimating Treatment Response and Maintenance of Response

- Treatment response was defined as >50% reduction in the number of CH attacks from baseline
 - SoC treatment responders were modeled as nonresponders beyond the randomized phase
 - Subjects from the nVNS+SoC group who responded through the extension phase were assumed to maintain this response
- These assumptions were modified in alternative scenarios to test the sensitivity of the model

Estimating QALYs

- QALYs for both groups were estimated using the EQ-5D™ index data from the randomized phase in an ordinary least squares regression analysis

Estimating Healthcare Utilization and Costs

- Healthcare utilization was assessed from abortive medication use during the last 14 days of the randomized phase
- nVNS unit cost was the listed price in Germany
- Intranasal (IN) zolmitriptan and subcutaneous (SC) sumatriptan unit costs were determined from the German pharmaceutical directory, Rote Liste®
- Unit costs for inhaled oxygen canisters were estimated from a previously published treatment cost study⁴

Results

Parameter Estimates

- The nVNS+SoC arm had a greater probability of response (0.49) than the arm that received SoC alone (0.09)
- Frequency of abortive medication use by both groups is presented in **Table 1**
- Unit costs of abortive medications and nVNS are presented in **Table 2**

Table 1. Number of Times Abortive Medications Were Used During the Last 14 Days of the Randomized Phase

Abortive Medication	nVNS+SoC (n=33)*	SoC (n=46)*
IN zolmitriptan	1.6 (5.5)	1.3 (3.6)
SC sumatriptan	2.7 (4.0)	7.7 (9.8)
Inhaled Oxygen	6.5 (10.9)	11.1 (14.9)

Data are presented as mean (SD). *n Values represent any subject who reported using an abortive medication.

Table 2. Unit Cost of Treatments

	Description	Cost/Dose (€)
IN zolmitriptan	AscoTop® Nasal 5 mg/Dosis Nasenspray, Solution: €90.63; 6 single-dose nasal sprays	15.11 (90.63 ÷ 6)
SC sumatriptan	Sumatriptan-Hormosan® Inject 6 mg/0.5-mL Solution: €199.92; 6 prefilled syringes	33.32 (199.92 ÷ 6)
Inhaled Oxygen	Inhaled oxygen: €2.93 per day in CH patients ⁷	2.87 (2.93 ÷ 1.02 uses per day)
nVNS	gammaCore: €375.00; loaded with 150 stimulations	2.50 per stimulation (375 ÷ 150)

Since completion of this analysis, a gammaCore device loaded with 300 stimulations has been made available in the European Union for €454 (€1.51 per stimulation)

Cost-Effectiveness Analysis

- The cost of abortive medications was 30% lower in the nVNS+SoC group than in the SoC alone group (**Figure 4**)
 - Compared with the SoC alone group, the nVNS+SoC group had 36% lower sumatriptan costs, 39% lower inhaled oxygen costs, and 85% higher IN zolmitriptan costs
- Estimated costs and mean QALY per subject are shown in **Table 3**
- The incremental cost-effectiveness ratio, or the expense of gaining an additional QALY with adjunctive nVNS therapy, was €4,746
 - This falls well below the €20,000 per QALY gained that commissioners of healthcare services are willing to pay for new technologies⁴
- Altering the model by increasing or decreasing the likelihood of loss of response in either the nVNS+SoC or the SoC alone group had a limited effect on the cost-effectiveness ratio

Figure 4. Breakdown of Modeled 1-Year Abortive Medication Costs by Category

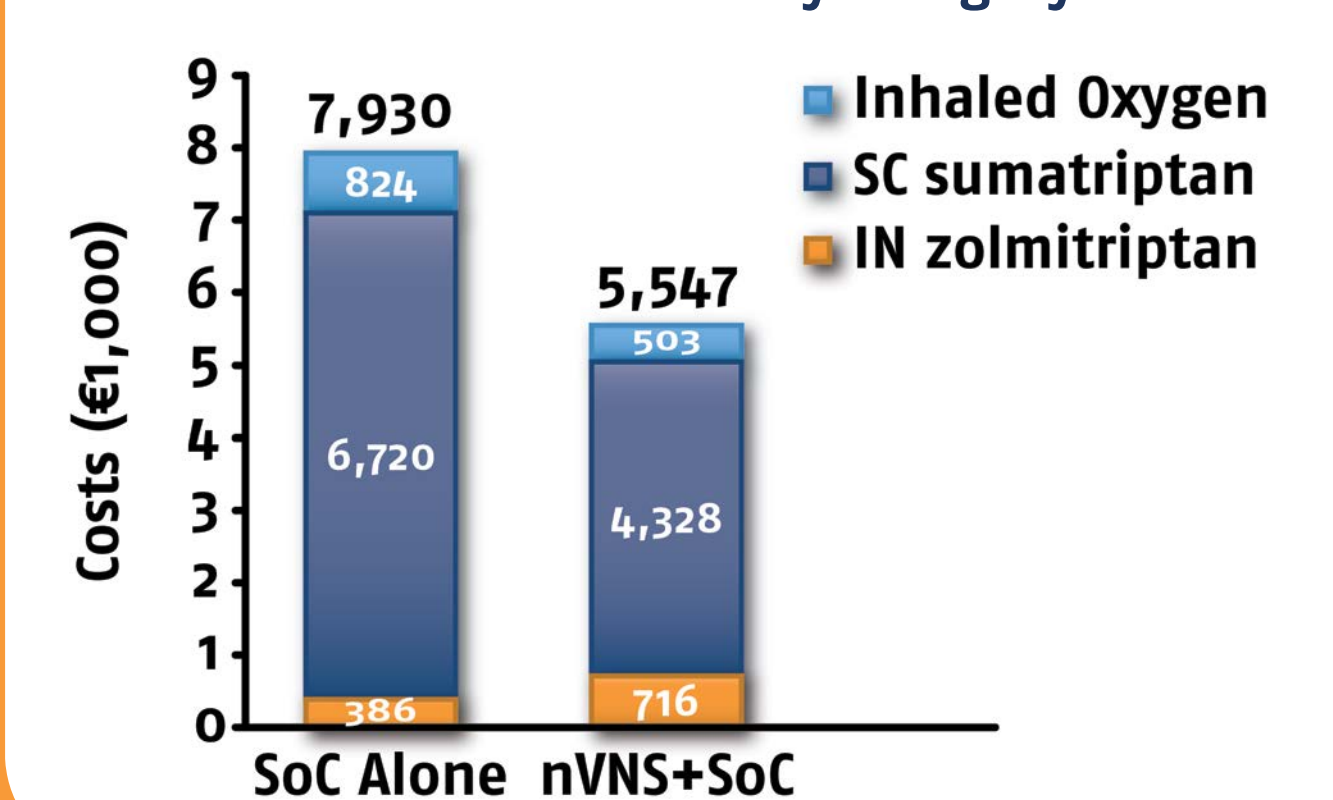


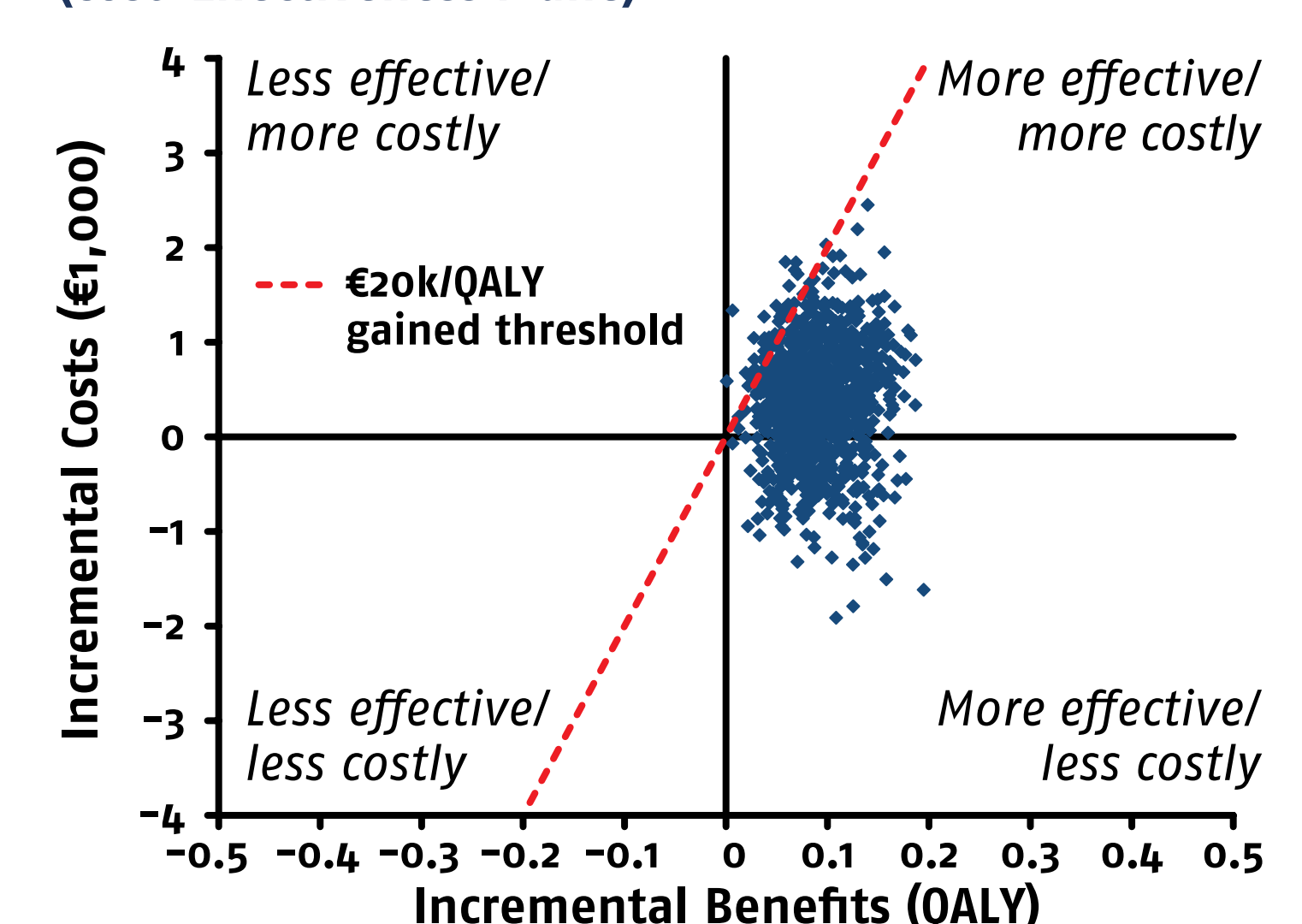
Table 3. Total Costs and QALYs from the 1-Year Model

	Mean Costs (€)	Mean QALYs
nVNS+SoC	8,346	0.620
SoC alone	7,930	0.532

Probabilistic Sensitivity Analysis

- The model was replicated 1,000 times to determine its certainty (**Figure 5**)
 - All plots fell to the right of the vertical axis, indicating that nVNS is more effective than SoC
 - ~25% of the plots fall in the southeast quadrant, suggesting nVNS has potential to reduce costs
 - More than 95% of plots fell below the €20,000/QALY gained threshold⁴

Figure 5. Scatterplot of Base Case Model Simulations (Cost-Effectiveness Plane)



Conclusions

- Adjunctive nVNS therapy improved QoL outcomes and reduced the need for abortive medication in patients with chronic CH
- The cost-effectiveness of nVNS was shown to compare favorably to other treatment options
 - Factoring the consumption of additional healthcare resources (eg, clinic visits) not included in the model may translate to further cost savings associated with nVNS therapy
- Doctors, patients, and payors lack information on the economic impact of treatments for CH; this study complements previous studies demonstrating the efficacy of nVNS in treating CH by revealing the health economics benefit that nVNS provides

References

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