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Comparing the Cost-Effectiveness of a Novel Minimally Invasive Surgical Therapy for Benign Prostatic Hyperplasia (BPH): A Swedish Perspective

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INTRODUCTION

Benign prostatic hyperplasia (BPH) is an enlargement of the prostate gland, which can slow or block the stream of urine. BPH is common in older men, up to half of all men over the age of 50 and up to 80% of men over the age of 80[1].There were an estimated 193,000 cases of BPH in Sweden in 2019, a 39.5% increase since the year 2000[2]. The past 10 years have seen an increase in the number of available interventions to treat benign prostatic hyperplasia (BPH) across multiple healthcare systems in Europe. Whilst conventional cavitating surgical procedures remain common, many newer interventions adopt alternative, less invasive techniques and are often referred to as “Minimally Invasive Surgical Therapies” (MISTs). In most cases, these MISTs require less postoperative hospital stay and have fewer associated adverse events than cavitating procedures, however they do not deliver the same level of improvement in functional outcomes. To date, little evidence has been published determining the cost-effectiveness of these interventions to the healthcare system.

OBJECTIVE

In Sweden, transurethral resection of the prostate (TURP) is the most common surgical intervention to treat patients with BPH, with 3,421 procedures performed in 2022[3]. TURP is well-established and delivers a substantial improvement in functional outcomes, though it carries risk of adverse events and has an average length of stay of 2.4 days[4]. The second-generation temporary implantable nitinol prostatic device (Temporary Device) procedure is a novel MIST. Once inserted, the device gradually expands over a period of 5-7 days, during which time the prostatic urethra is remodelled via ischaemic necrosis caused by the three struts exerting pressure on the tissue. The device is then removed and maximum symptomatic improvement is generally seen 4-6 weeks post-removal. By considering the costs associated with each treatment, the health utility gain from improvements in functional outcomes and the disutility associated with adverse events, we aimed to model the cost-effectiveness of the Temporary Device procedure versus TURP and two other BPH procedures available in Sweden.

METHODS

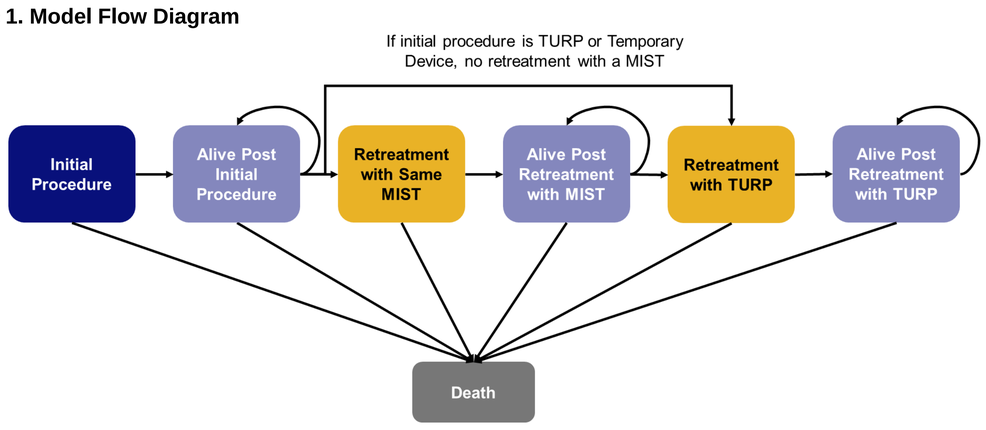
A semi-Markov model was developed in Microsoft Excel to compare the cost-effectiveness of the Temporary Device procedure with TURP and two other MISTs: water vapour therapy (WVT) and transurethral microwave therapy (TUMT). The treatment pathway begins with BPH patients eligible for treatment. Patients are treated with either a MIST or TURP. Following the initial intervention, patients either require no further treatment or are retreated if required. A proportion of initial MIST patients are retreated with the same MIST. Proportions of patients retreated with TUMT and WVT were taken from the literature[5, 6]. For the Temporary Device, this was assumed to be zero since no retreatment data with the Temporary Device was available, therefore retreatment was assumed to be with TURP. If a second retreatment is required following a retreatment with a MIST, this is assumed to be TURP. For initial TURP patients, only one retreatment is modelled and assumed to be TURP again.

Model states were based on treatment status and history, and a one-month cycle length was implemented. The states and model flow are outlined in **Figure 1**. Each state has unique costs and utilities. The costs and disutility associated with patients requiring retreatment(s) are also considered. The model time horizon was set at 5 years and a discount rate of 3% applied to costs and outcomes.

Targeted literature searches were conducted to collect clinical input data for each treatment. The analysis population was men with a mean starting age of 68 years old, and baseline clinical measures for the population were developed using average values from the included studies for each treatment. Base utilities by age were sourced from a publication on EQ-5D-5L data from the Swedish general population[7]. Disease severity relative utilities, as well as procedure and adverse event disutilities, sourced from a published model[8] were applied to the base utilities by age. Associated treatment costs were modelled using expected DRG payment values, derived using the NordDRG Grouper and prospective weight list for hospital care 2024 (Socialstyrelsen).

A second round of research yielded additional information used to update our analysis. National cost data for each DRG were found in the cost per patient database[9], replacing the expected DRG payment values used to model treatment costs. Clinical measures and adverse event rates for the Temporary Device procedure (PVR, Qmax, IPSS, IPSS QoL and incidence of urinary retention) were also updated, as well as the rate of post-operative catheterisation following TUMT. In the updated analysis, one-way sensitivity analysis (OWSA) was run varying 332 inputs and probabilistic sensitivity analysis (PSA) was performed for 1,000 replications.

Figure 1. Model Flow Diagram



RESULTS

Our initial analysis over a five-year time horizon showed the Temporary Device procedure was dominant versus TURP, yielding 0.177 more QALYs with 72,978 SEK (Swedish Krona) less cost. The Temporary Device procedure was also dominant versus WVT, yielding comparable QALYs (0.034 more) but with 15,338 SEK less cost. When compared with TUMT, the Temporary Device procedure again yielded comparable QALYs (0.062 less), but with 41,068 SEK less cost, producing an ICER value for TUMT of 666,588 SEK (approximately €60,000) per QALY gained. In all instances, the Temporary Device procedure had lower expected total treatment costs.

The results of our updated analysis showed that the Temporary Device procedure was dominant versus all three therapies. The sequential cost-effectiveness results are displayed in **Table 1.**

Table 1. Sequential Cost-effectiveness Results

Treatment	Total costs	Incremental Costs vs. Temporary Device	Total QALYs	Incremental QALYs vs. Temporary Device	Total cost per QALY ICER vs. Temporary Device
TURP	SEK 113,674	SEK 54,002	2.966	-0.302	Dominated
TUMT	SEK 95,387	SEK 35,714	3.188	-0.08	Dominated
WVT	SEK 63,528	SEK 3,856	3.095	-0.174	Dominated
Temporary Device	SEK 59,673	Base	3.268	Base	Base

OWSA and PSA found that in the overwhelming majority of cases, the Temporary Device procedure remained dominant compared to all three other therapies. The distribution of results by quadrant for 1,000 replications of the PSA can be found for the Temporary Device versus each treatment in **Table 2.**

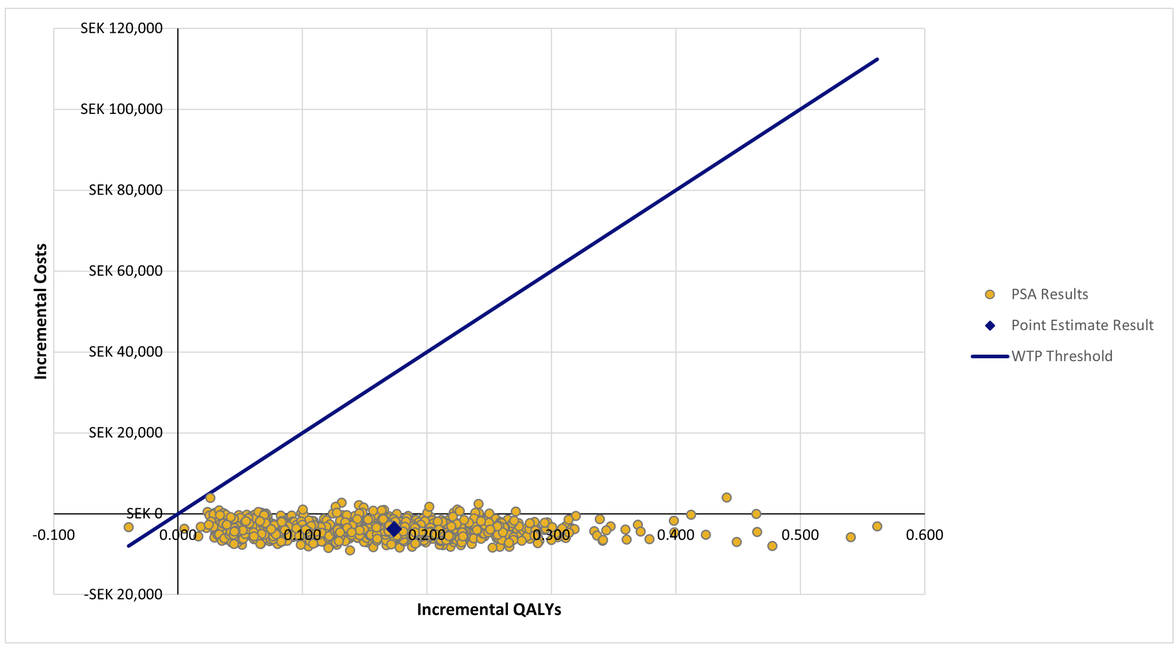
Table 2. Distribution of PSA Results by Quadrant for Temporary Device vs Each Therapy

Temporary Device	vs. TURP % of 1,000 Replications	vs. WVT % of 1,000 Replications	vs. TUMT % of 1,000 Replications
North-East Quadrant (Inc. Cost > 0, Inc. QALYs > 0)	0.0%	3.2%	0.0%
South-East Quadrant (Inc. Cost <= 0, Inc. QALYs > 0)	100.0%	96.7%	99.2%
South-West Quadrant (Inc. Cost <= 0, Inc. QALYs <= 0)	0.0%	0.1%	0.8%
North-West Quadrant (Inc. Cost > 0, Inc. QALYs<= 0)	0.0%	0.0%	0.0%

The sensitivity analyses for the Temporary Device versus WVT produced results in all quadrants, except the north-west quadrant **(Figure 2.)**, with the mean incremental cost and QALYs showing the Temporary Device procedure dominant versus WVT. The Temporary Device was cost-effective at ICER thresholds of 200,000 SEK and 600,000 SEK per QALY in 99.9% of replications. The OWSA found three variables that produced a result where the Temporary Device was not dominant: lowering the treatment cost of WVT by 20% (ICER = 9,139 SEK), lowering the number of outpatient visits associated with WVT in months after the procedure by 20% (ICER = 2,598 SEK) and increasing the number of outpatient visits associated with the Temporary Device in months after the procedure by 20% (ICER = 1,176 SEK). All three produced ICERs well below any generally accepted threshold.

Versus TUMT, the PSA returned 99.2% of replications in the south-east quadrant. 100.0% of the PSA replications showed the Temporary Device procedure to be cost-effective at ICER thresholds of 200,000 SEK and 600,000 SEK per QALY.

Figure 2. PSA Result for Temporary Device vs. WVT 1,000 replications



CONCLUSIONS

A recent analysis of TLV (Tandvårds-läkemedelsverket) willingness to pay thresholds in Sweden suggests these thresholds to be around 200,000 SEK, 600,000 SEK, 750,000 SEK and 1,000,000 SEK per QALY for low, medium, high and very high disease severity respectively[10]. In the case of BPH, we would expect the disease severity to be considered either low or medium.

Both our initial and updated analyses suggest that the Temporary Device is a cost-effective procedure for treating BPH in Sweden. The dominant position versus TURP is driven largely by lower initial treatment costs and greater health utility associated with fewer adverse events. In the limited scenarios within our sensitivity analyses where the Temporary Device was not dominant versus other therapies, we would still expect the Temporary Device to be considered cost-effective, given the likely disease severity and respective willingness to pay thresholds in Sweden.

A key consideration for the introduction of MIST procedures must also be patient choice. Differing demographics of BPH patients can influence the importance placed upon procedural outcomes. Some patients may value maintaining continence or normal sexual function greater than experiencing the largest improvement in symptomatic relief. These variances could be given further consideration in future research. The introduction of this technique can enhance choice for patients seeking treatment for BPH in Sweden.

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