

Cost-effectiveness of Single Use Negative Pressure Wound Therapy system (sNPWT*) to reduce surgical site complications (SSC) following Coronary Artery By-Pass Surgery

Leo Nherera; Director Health Economics, Smith & Nephew, Hull, UK

Background

Despite the advances in infection control practices, ventilation systems in the operating rooms, preoperative antimicrobial prophylaxis, and wound dressings, surgical site infections (SSI) remains common in patients undergoing surgery.

European Centre for Disease Prevention and Control reports that surgical site infections (SSI) are among the most common healthcare-associated infections (HAIs) which occur after surgery in the area of the body where the surgery took place.¹

European-wide SSI incidence rates range from 0.7% in knee prosthesis to 9.7% in colon surgery,² another study reported that approximately 0.3-5% of median sternotomy incisions are affected by complications, such as infection and dehiscence.³

SSIs are associated with significant increases in length of stay (LOS), hospitalization costs, and mortality.^{1,2,4}

LOS doubles: One study estimated that patients with an SSI had a mean LOS of 10.56 days (95% CI, 9.50 to 11.62) vs 5.64 days (95% CI, 5.34 to 5.95) for patients without an SSI ($p < 0.001$)⁴ while another study found that attributable mean hospital length of stay due to SSI following cardiovascular surgery was estimated to be 13.7 (12.6- 14.9).⁵

Readmission rates increase: The 30-day readmission rate for patients with an SSI vs patients without an SSI was 51.94 vs 8.19 readmissions per 100 procedures (odds ratio, 12.12; 95% CI, 10.27 to 14.29).⁴

Mortality: There is increased mortality rates varying between 4.5% in those patients with superficial sternal surgical site infections to 19.2% in patients with deep sternal surgical site infection.⁶

Deep sternal wound infections following CABG surgery are associated with significant increases in costs and potential loss of hospital profit.^{4,6,7,8}

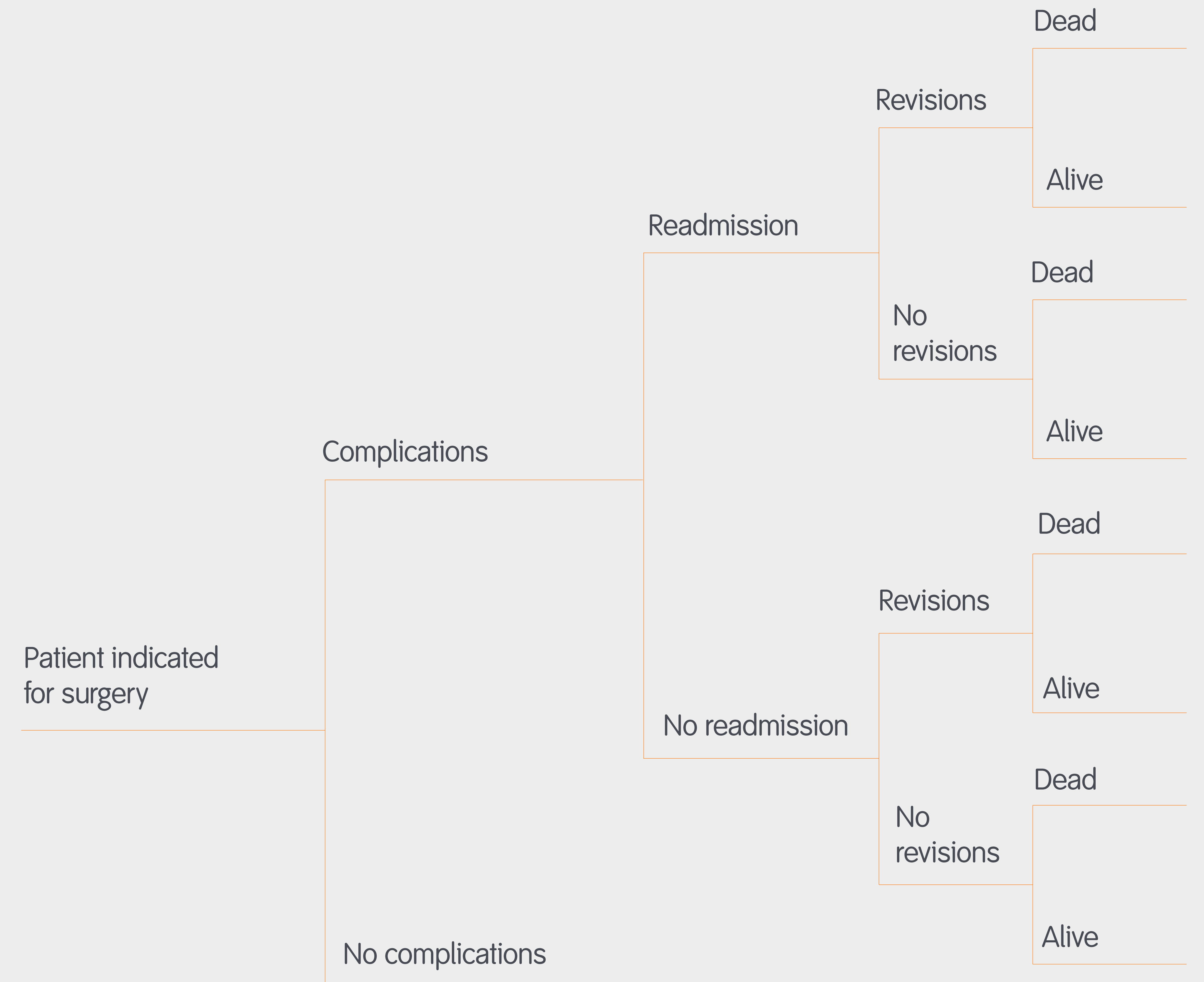
Graf et al reported median costs of deep sternal wound infections following for CABG to be €36,261 vs. €13,356 in controls without infection ($p < 0.0001$) in Germany, this was contrasted with the median reimbursement from health care insurance companies of €27,107 leading to a financial loss of €9,154 per person.⁷

One study estimated \$20,012 in additional costs in the first year⁸ and another found that attributable mean costs due to SSI following cardiovascular surgery are \$37,513 (\$33,136-\$41,606).⁵ SSI also results in potential loss of profit and one study estimated a change in profit due to SSIs of \$2 268 589.⁴

Aims of the study

- Healthcare providers need to be more efficient and are expected to provide higher quality service with falling budgets.
- Managing the SSC requires the use of technologies with proven clinical evidence such as Single Use Negative Pressure Wound Therapy (sNPWT) PICO[®] (Smith & Nephew Healthcare Ltd, Hull, UK).
- This work aimed to evaluate the cost-effectiveness of sNPWT in patients undergoing primary Coronary Artery By-Pass Surgery (CABG) compared to those treated with standard of care from a German healthcare payer's perspective.

Model structure



A decision analytic model was developed from a Germany National Health Service perspective using data from a single centre non-blinded RCT in accordance with standard methodology.

Baseline data

Baseline data was obtained from a single centre prospective study in 2,621 patients who underwent CABG in Germany. 4.85% of patients were diagnosed with SSI according to the CDC criteria. Outcomes collected included SSI, LOS, readmission and revision surgery.⁹

Effectiveness and cost data

Effectiveness data

- Data was taken from a randomised open label trial conducted in Poland (80 patients underwent CABG using the internal mammary artery) which measured SSC as absence and SSI using the European Centre for Disease Prevention and Control (ECDC) definition.¹⁰
- The study showed that 37/40 (92.5%) patients had their wounds healed without complications in the sNPWT compared to 30/40 (75%) patients in the standard care group (p=0.03).

Cost data

- Cost data, including those associated with procedure, hospital stay, physician and follow-up such as rehabilitation, were taken from published literature and Germany Diagnosis Related Group Report Browser as reported in the cost data table.

Clinical data applied in the model

Outcome	Mean	N	Events
Mortality with SSI	0.025	118	3
Mortality without SSI	0.006	2503	16
Readmission with SSI	0.331	118	39
Readmission without SSI	0.007	2503	18
Revision with SSI	0.593	118	70
Revision without SSI	0.059	2503	148
Utility with SSI ²	0.640	0.560	0.700
Utility with no SSI ²	0.840	0.720	0.900
Length of stay with SSI	Mean	Lower CI	Upper CI
Intensive care unit	15.2	1	87.2
Intermediate care	4.8	0.5	25.2
General ward	22.3	0.5	68.4
Length of stay without SSI	Mean	Lower CI	Upper CI
Intensive care unit	3.8	1	26
Intermediate care	2.4	0.5	10
General ward	8.3	0.5	19
Effectiveness of sNPWT (Odds ratio and 95% CI) ¹⁰	0.220	0.060	0.810

Data in the table was taken from Cristofolini 2012⁹ unless stated otherwise

Cost data applied in the model

Cost component	Mean cost
Cost of hospital stay in ICU ward (inclusive of all done inpatient)	1,400.00 € ^a
Intermediate ward	850.00 € ^a
General ward cost/day	200.00 € ^a
Inpatient rehabilitation	2,006.00 € Zeidler
Outpatient rehabilitation	1,502.00 € Zeidler
CABG procedure (code 5-361.*: "Application of an aortocoronary bypass")	15,135.58 € ^b
Cost of revision CABG procedure	24,740.45 € ^b
Community Dr consultation fee per quarter	16.53 € ^c
Electrocardiography	16.53 € ^c
Community Cardiologist	21.06 € ^c
Duplex-Electrocardiography	71.50 € ^c
Rehabilitation (3 weeks)	
Physiotherapy ; 25-30 min	22.90 € ^c
Home visits	11.53 € ^c
sNPWT unit cost	153.00 €

(a) Inpatient ward costs: <https://www.aerzteblatt.de/archiv/43690/Krankenhaus-Management-Kompetenzzentren-sind-zukunftstraechtig>

(b) Revision cost were the weighted mean of DRG (A09B,F36B,F07C,F07A,A13B,F07B,F06A)

(c) Rehabilitation (in/outpatient): Zeidler, J, 2008 <https://doi.org/10.1007/s00059-008-3126-0>
https://www.vdek.com/vertragspartner/heilmittel/rahmenvertrag/_jcr_content/par/download_19/file.res/Verg%C3%BCtungvereinbarung_West_2016_UF_160321.pdf

We assumed that costs of standard care dressings and nursing costs were all included in the DRG costs

Results

A. Cost effectiveness results

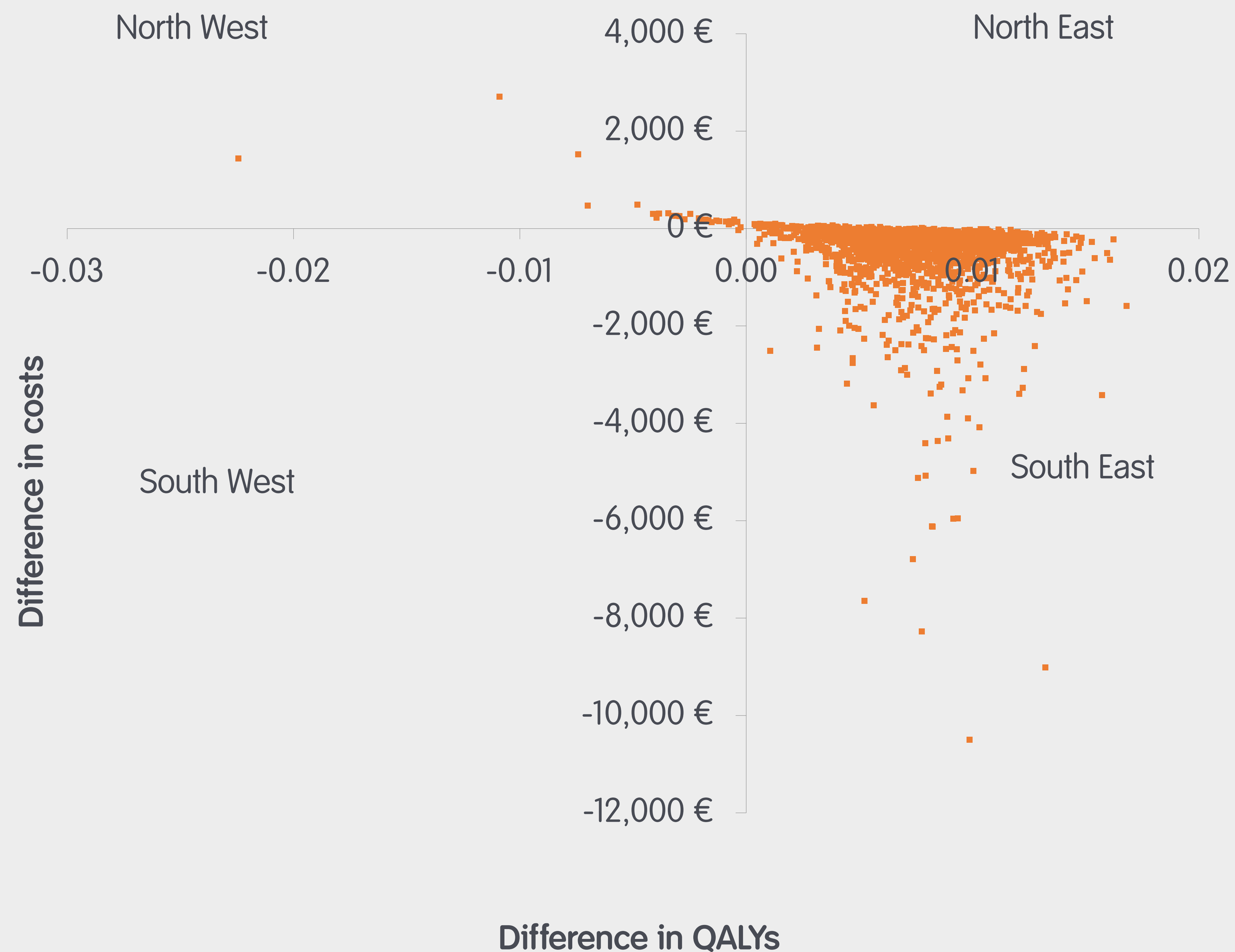
Intervention	Costs	Complications avoided	QALYs
Usual care	17,496 €	0.945	0.8244
PICO ^o	17,205 €	0.982	0.8321
Cost savings 290 € per patient over 6 weeks			

B. Sub-group results and sensitivity analysis

Input parameter	Lower value	Upper value
Baseline infection risk	-78 €	-567 €
Treatment impact of sNPWT complications	-381 €	41,856 €
Cost of sNPWT	-313 €	-273 €
Number of sNPWT used (1 and 2)	-290 €	-137 €
Sub-group analysis		
BMI>30		-1,619 €
Diabetes		-955 €
Smoking		-1,043 €

Cost-effectiveness/decision plane

Probabilistic sensitivity analysis results, sNPWT was dominant in 94% of the 2000 trials that were performed



Discussion

- sNPWT has been shown to be effective in reducing SSC following surgery for instance after Hip and Knee replacement, breast surgery, C-section and CABG compared to standard care (SC).
- The use of sNPWT was associated with fewer complications, better quality of life and bigger studies are warranted in CABG to confirm this finding.
- Overall, the sNPWT strategy was on average 290 € cheaper than the SC, these findings were robust in sensitivity analysis. More savings were estimated when subgroups of higher risk patients with BMI \geq 30, diabetes and smokers were analysed, with savings of 1,619€, 955€ and 1,043€ respectively.
- We therefore conclude that sNPWT is a cost-saving intervention if used prophylactically in patients following CABG surgery compared to SC.
- Additional prospective studies are needed to compare sNPWT with other active negative pressure devices.

For detailed product information, including indications for use, contraindications, effects, precautions and warnings, please consult the product's Instructions for Use (IFU), prior to use.

*PICO[®] Smith & Nephew, Hull, UK.

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