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Cost-effectiveness of a short stay admission programme for breast cancer surgery

MASCHA DE KOK[1], CARMEN D. DIRKSEN[2], ALFONS G. KESSELS[2], TRUDY VAN DER WEIJDEN[3], CORNELIS J VAN DE VELDE[4], JAN A. ROUKEMA[5], ANTOINE V. BELL[6], FRED W. VAN DER ENT[7] & MAARTEN F. VON MEYENFELDT[1]

[1]*Department of Surgery, Maastricht University Medical Center, PO Box 5800 Maastricht, the Netherlands,* [2]*Department of Clinical Epidemiology and Medical Technology Assessment (KEMTA), Maastricht University Medical Center, PO Box 5800 Maastricht, the Netherlands,* [3]*Department of General Practice/ School for Public Health and Primary Care (CAPHRI), Maastricht University Medical Center, PO Box 5800 Maastricht, the Netherlands,* [4]*Department of Surgery, Leiden University Medical Center, PO Box 9600 Leiden, the Netherlands,* [5]*Breast Unit, St. Elisabeth Hospital, PO Box 90151 Tilburg, the Netherlands,* [6]*Department of Surgery, Laurentius Hospital, PO Box 920 Roermond, the Netherlands and* [7]*Department of Surgery, Orbis Medical Center, PO Box 5500 Sittard, the Netherlands*

Abstract

Background. Short stay (admission, surgery, and discharge the same day or within 24 hours) following breast cancer surgery is part of an established care protocol but as yet not well implemented in Europe. Alongside a before-after multi-centre implementation study, an economic evaluation was performed exploring the cost-effectiveness of a short stay programme (SSP) versus care as usual (CAU). *Material and methods.* In the implementation study, 324 patients were included. In the economic evaluation a societal perspective was applied with a six week time horizon. Cost data were obtained from Case Record Forms and cost diaries. Effectiveness was assessed by calculating Quality Adjusted Life Years (QALYs), using the EuroQol-5D. Cost-effectiveness was expressed as the incremental costs per QALY. *Results.* Mean societal costs decreased by €955,- (95% CI € - 2104,- to €157,-) for patients in SSP (n=127) compared with CAU (n=135). Mean healthcare costs differed €883,- (95% CI € - 1560,- to €–870,-) in favour of SSP. The incremental cost-effectiveness ratio could not be calculated due to similar effectiveness for both groups, i.e. the difference in QALYs was zero. The cost-effectiveness acceptability curves showed that the probability that SSP was more cost-effective than CAU was over 90% in the base-case analysis. *Discussion.* A short stay programme as implemented is cost-effective compared with care as usual. In achieving good and more efficient quality of care, larger scale implementation is warranted.

Breast cancer is the most common malignancy in women worldwide [1]. One of every eight Dutch women will be diagnosed with breast cancer at some moment in her life [2].

The proportion of breast cancer related hospital admissions in Dutch women increased with 13% from 1995–2004. In 2005, breast cancer-related costs comprised 0.4% of the Dutch national healthcare budget, of which 54% were hospital-related costs [3]. With an ageing population and an increasing breast cancer incidence, a rise of breast cancer-related healthcare costs is expected. Therefore, efficient treatment regimens ensuring good quality of breast cancer care are important to continue to answer to every patient's needs.

A short hospital stay following breast cancer surgery provides the opportunity to reduce the burden on the healthcare budget, and allows recovery in the familiar home situation. In three RCT's on breast cancer surgery no significant increase in side effects was found comparing early discharge (two to four days) with traditional admission (five to 10 days) [4–6]. Several studies on reduction of mean admission periods following breast cancer surgery showed cost reductions due to savings on admissions [7–9].

Correspondence: M. D. M de Kok, Department of Surgery, Maastricht University Medical Center, P. Debeyelaan 25, 6202 AZ, Maastricht, the Netherlands. Tel: +31 433877477. Fax: +31 433875473. E-mail: m.dekok@ah.unimaas.nl

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At the Maastricht University Medical Center (MUMC), a short stay programme following breast cancer surgery was successfully introduced during a pilot study.

Results (unpublished data) pointed towards a cost saving of about €500,- per patient. However, costs outside the hospital were not available including potential additional costs (e.g. due to increased use of informal care), and possible savings (e.g. due to reduction of productivity losses). As the programme was primarily expected to have an effect on quality of care, and not on quality of life, only safety and satisfaction were explored in the pilot study. However, the national breast cancer union expressed concerns regarding the effects on short-term quality of life. To convince the breast cancer union and facilitate introduction of the programme, quality of life research seemed warranted.

Although all studies indicate that reduced hospital stay after breast cancer surgery is feasible and safe, no formal economic evaluation has yet been performed on this issue, including an assessment of societal costs and quality of life.

Following successful introduction of the programme in the MUMC, an implementation study evaluated the multi-center introduction of the programme [10]. Alongside this study an economic evaluation was performed from a societal perspective exploring the cost-effectiveness of the short stay programme (SSP) versus care as usual (CAU).

Material and methods

Study design

The economic evaluation was performed in four Dutch hospitals from December 2005 until July 2007. The implementation study consisted of three phases each lasting six months; a prospective assessment of CAU, the implementation phase, and a prospective assessment of SSP. A time horizon of six weeks (44 days exactly) was used. The incremental cost-effectiveness ratio (ICER) was computed as the difference in societal costs divided by the difference in Quality Adjusted Life Years (QALYs) between SSP and CAU.

Interventions

In CAU, stakeholders were not informed about the set of activities needed to introduce the programme. In other words, the admission lasted as long as deemed necessary by the surgeons without making arrangements for early recovery at home. In SSP, activities were performed to assess whether each individual patient's situation was suitable for short hospital admission. If suitable, patients were scheduled for short stay [10]. Patients scheduled for day care admission were discharged as planned, unless their medical condition demanded overnight stay.

Effectiveness

Effectiveness was assessed through a generic health-related quality of life instrument, the EuroQol (EQ-5D) [11]. This instrument has proven validity and reliability, and is commonly used in cost-effectiveness studies [12]. The descriptive system of the EQ-5D consists of five dimensions (mobility, self-care, daily activities, pain/discomfort, depression/anxiety). Each dimension has three response options (no problems, some problems, severe problems), leading to 243 possible health states. For each health state, a utility score (US) can be computed, based on preferences from a general UK population, i.e. the UK tariff [13]. The EQ-5D was administered at baseline (one day before first surgery), one day postoperatively, one week postoperatively, and six weeks postoperatively. Utility scores were used to calculate QALYs using the following formula [14].

QALY=((((US baseline + US one day postoperatively/ 2)*3) + (((US one day postoperatively + US one week postoperatively)/2)*7) +(((US one week postoperatively + US six weeks postoperatively) /2)*34))/365. With a 44-day time horizon, a maximum of 44/365= 0.12 QALYs can be obtained.

Cost analysis

The cost analysis was performed according to the Dutch guidelines for cost calculations in healthcare [15]. Direct healthcare-related costs, direct costs outside healthcare, indirect costs, and out-of-pocket costs were included. Hospital visits concerning adjuvant treatment were excluded from analysis, as 1) patients may start adjuvant therapy shortly after discharge causing potentially biased results, and 2) most costs related to surgical treatment are made within weeks after first hospital discharge. A detailed inventory and measurement of consumed resources is termed microcosting [16], which allows others to explore how results compare to their own organisational and financial situation.

Resource use was obtained through Case Record Forms (hospital costs) and through prospective cost diaries filled out by patients (all other costs). Only data indicated by patients as 'breast cancer related' were analyzed. Costs were expressed in 2008 euros (€1= US $0.64) [17]. If necessary, cost prices were actualised to 2008 using the Dutch Consumer Price Index [18]. Healthcare-related cost prices were obtained from published guidelines [15], internet databases [19], and financial departments of the participating hospitals. Hospital unit prices included

Table I. Socio-economic characteristics of participants at baseline and mean scores for the EQ-5D in the care as usual group (CAU), and for patients treated according to the short stay programme (SSP).

	SSP (n=127) Mean ± SD (range)		CAU (n=135) Mean ± SD (range)		
Characteristic	n	%	n	%	p-value
Age (years)	56.1 ± 10.8 (33–89)		55.3 ± 11.6 (26–88)		0.577
Marital status					0.770
Married	95	74.8	97	71.9	
Not married	9	7.2	13	9.6	
Living together	5	3.9	9	6.7	
Widowed	13	10.2	11	8.1	
Divorced	5	3.9	5	3.7	
Highest educational degree					0.329
Primary school	4	3.1	10	7.4	
Secondary school	98	77.2	93	68.9	
College	19	15.0	25	18.5	
University	5	3.9	7	5.2	
Information missing	1	0.8	–	–	
Paid work					0.924
Yes	55	43.3	59	43.7	
Mean hours per week		10.4		10.5	
Performing housekeeping tasks					0.246
Yes	72	56.7	48	35.6	
Information missing	1	0.8	1	0.7	
Having a housekeeper					0.887
Yes	26	20.5	31	23	
Information missing	1	0.8	1	0.7	
Volunteer work					0.828
Yes	21	16.5	21	15.6	
Information missing	1	0.8	1	0.7	
Household					0.223
Living alone	15	11.8	24	17.8	
Living with others	104	81.9	108	80.0	
Information missing	8	6.3	3	2.2	
Having children					0.816
Yes	108	85.0	111	82.2	
No	18	14.2	23	17.1	
Information missing	1	0.8	1	0.7	
	Mean ± SD (range)		Mean ± SD (range)		
Utilities (before Delta-adjustment)					
1 day before surgery	0.84	0.02	0.80	0.02	
Utilities (after Delta-adjustment)					
1 day before surgery	0.80	0.02	0.80	0.02	

35% general overhead and 10% housing costs [15]. Prices for personnel included 38% social charges added to the gross salary. If cost prices differed between hospitals, an average price was calculated. If different cost prices were available within and between hospitals for a procedure (e.g. fine needle biopsies can be x-ray or ultra-sound guided), a weighed estimate was calculated. If cost prices were unavailable, as for multidisciplinary meetings, an integral cost price was calculated based on costs per hour per type of personnel involved, including materials, capacity, traveling and parking costs, added with overhead and housing. Productivity losses due to sick leave were calculated using the friction costs method, in which production losses are confined to the period needed to replace a sick worker: the friction period [15].

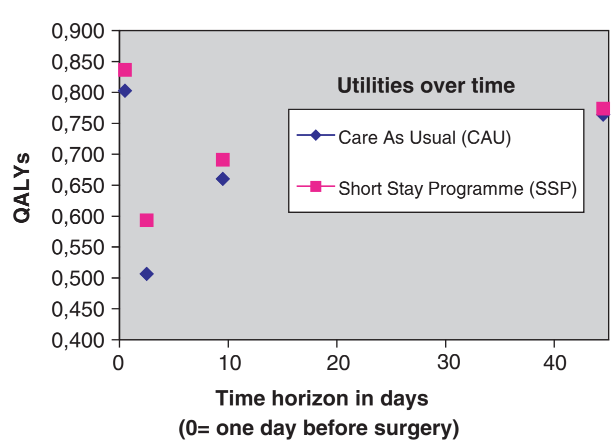

Figure 1. Utilities at the four consecutive time points. The graph shows a baseline difference between the two groups in favour of SSP.

Table II. Mean costs, resource use, subtotal, and total costs in euros for the short stay programme (SSP) and care as usual (CAU).

All patients	Cost per unit, € (2008)[a]	Volumes of use for SSP	Costs for SSP per patient, Pooled means (€) (n=127)		Volumes of use for CAU	Costs for CAU per patient, Pooled means (€) (n=135)		Difference in costs (€) (95% CI) SSP-CAU
			Costs[i]	% of total		Costs[i]	% of total	
DIRECT HEALTHCARE COSTS								
Before hospital admission								
Tests and procedures (various)[b]	Various/Procedure[3]	n.a.	628.19	8.4	n.a.	652.54	7.8	
Multidisciplinary meeting	74/Patient[3]	0.94	69.34	0.9	0.87	64.13	0.8	
Outpatient clinic	55–125/Visit[1,3]	3.09	239.92	3.2	3.28	255.86	3.0	
Preoperative screening	44.78/Contact[3]	0.75	34.99	0.5	0.96	45.05	0.5	
Subtotal			972	13.0		1018	12.1	−46 (−98 to 5)
During hospital admission								
Wire localization	307.65/Procedure[3]	0.40	122.40	1.6	0.44	134.45	1.6	
Surgery incl. Sentinel node procedure (various)[b]	Various /Procedure[3]	n.a.	1515.37	20.3	n.a.	1615.58	19.2	
Admission period[c]	248.14–515.79/Day[1,3]	0.98	465.96	6.3	2.30	998.06	11.9	
Subtotal			2104	28.2		2748	32.7	−646 (−1000 to – 342)
After 1st hospital admission								
Multidisciplinary meeting	88/Patient[3]	0.97	85.23	1.1	0.95	83.44	1.0	
Outpatient clinic	46–92/Visit[1,3]	1.91	138.00	1.9	2.27	170.31	2.0	
Surgery incl. Sentinel node procedure (various)[b]	Various /Procedure[3]	n.a.	336.52	4.5	n.a.	416.44	5.0	
Readmission period(s)	248.14–515.79/Day[1,3]	n.a.	374.94	5.0	n.a.	475.04	5.6	
Emergency department	150.61/Visit[1]	0.14	21.35	0.3	0.21	31.24	0.4	
GP practice	21.89/Contact[1]	1.17	25.51	0.3	0.98	21.50	0.3	
GP home	43.78/Contact[1]	0.56	24.41	0.3	0.67	29.19	0.3	
GP telephone	10.95/Contact[1]	0.44	4.86	0.1	0.45	4.96	0.1	
GP post	67.08/Visit	0.06	4.23	0.1	0.04	2.58	0.0	
Home care, domestic help	13.76–28.93/Hour	1.78	45.79	0.6	1.41	39.77	0.5	
Home care, nursing	36.96–63.83/Hour	2.99	129.19	1.7	2.13	103.33	1.2	
Paramedic care (various)[b]	Various/Contact[1,5]	0.36	11.27	0.2	n.a.	13.75	0.2	
Medication (various)[b]	Various/DDD[2]	n.a.	46.43	0.6	n.a.	51.79	0.6	
Pharmacist's fee	6.10/Prescription	1.09	6.66	0.1	0.92	5.59	0.1	
Other[d]	Various	n.a.	4.76	0.1	n.a.	3.60	0.0	
Subtotal			1259	16.9		1453	17.3	−194 (−766 to 342)
Subtotal healthcare costs			4335	58.2		5218	62.1	−883 (−1560 to −870)
DIRECT NON-HEALTHCARE COSTS								
Informal care	8.99/Hour[1]	28.97	262.87	3.6	57.19	514.49	6.1	
Paid housekeeper	8.99/Hour[1]	1.92	17.22	0.2	2.06	18.55	0.2	
Meal service	5.66/Meal[5]	0.16	0.89	0.0	0	0.00	0.0	
Subtotal			281	3.8		533	6.3	−252 (−599 to 51)

INDIRECT COSTS								
Sick leave	39.46/hour[1]	56.54	2230.98	30.0	51.37	2026.96	24.1	
Loss of voluntary work	8.99/hour[1]	5.82	52.30	0.7	3.42	30.74	0.4	
L oss of leisure time	8.99/hour[1]	6.70	60.23	0.8	9.03	81.19	1.0	
Loss of household tasks	8.99/hour[1]	40.46	363.71	4.9	45.46	408.72	4.9	
Other[e]		n.a.	13.31	0.1	n.a.	6.11	0.1	
Subtotal			2721	36.5		2554	30.5	167 (−657 to 1050)
OUT OF POCKET COSTS								
Alternative treatment/programme	52.07/contact[5]	0.12	6.48	0.1	0.16	8.49	0.1	
Aids bought[f]	Various[4]	n.a.	60.16	0.8	n.a.	38.51	0.5	
Travelling expenses[g]	0.16/Km[1]	n.a.	1.67	0.0	n.a.	1.81	0.0	
Other[h]	Various[4]	n.a.	49.17	0.7	n.a.	55.06	0.6	
Subtotal			117	1.6		104	1.2	13 (−59 to 93)
Subtotal costs outside healthcare			3119	41.8		3191	37.9	−72 (−1055 to 86)
TOTAL COSTS	/patient	n.a.	7454		n.a.	8409		−955 (−2104 to 157)

[a]Source of unit price: [1]Dutch guidelines (Oostenbrink et al.[(17)]); [2]Gip databank[(21)]; [3]Participating hospitals; [4]as reported by the patient or caregiver; [5]Internet resources, e.g. http://www.nza.nl. [b]As tests, procedures, surgeries paramedic care (physiotherapist, psychologist, and social work), and medications varied in type and costs, n.a. (not applicable) is shown for the volumes of use. [c]Day care admission =0; 24-hours-admission=overnight stay=1 day; 2 days=2, etc. [d]Other direct healthcare costs consisted of repeat recipes at the GP, home visits by the breast nurse, and telephone calls between breast nurse and the patient. A cost price and volume exists for each medical activity. [e]Other indirect costs consisted of kindergarten, and time taken off as holidays (€8,99/hour). f Aids bought consisted of bandages, prosthesis, bra, wig, head-scarf, drain bag, bed elevator, squeeze ball, toilet chair, cherry pit pillow. [f]The mean distance to the general practitioner or healthcare professional was set at 1.8 km; the mean distance to the hospital and GP post was set at 7.0 km[(17)]. [h]Other out of pocket costs included for example: parking costs, over the counter medication, telephone costs, scar cream, massage, etc. [i]Total costs may not be exactly be the product of cost per unit and volumes of use due to rounding.

Statistical analysis

Analysis was performed based on intention to treat. Multiple imputation was used to replace missing values with plausible estimates, and generated five data sets [20]. Results were provided as pooled estimates of these sets.

Bootstrapping was performed to determine 95% confidence intervals (CI) around cost-differences between SSP and CAU and to quantify the uncertainty around the ICER. It is an appropriate method compared with traditional parametric and non-parametric tests to analyze skewed cost distributions and to yield information about the joint distribution of cost and effect differences [21]. It estimates the sampling distribution of a statistic through 1 000 simulations, based on sampling with replacement from the original data. Results are plotted in an incremental cost-effectiveness plane in which the horizontal axis represents the incremental effect, and the vertical axis represents the incremental cost between SSP and CAU. This results in four quadrants: 1) southeast quadrant (SE): SSP is less costly and more effective than CAU meaning that SSP is dominant 2) northwest quadrant (NW): SSP is more costly and less effective than CAU meaning that SSP is inferior; 3) southwest quadrant (SW): SSP is less costly and less effective than CAU meaning that the cost-effectiveness of SSP depends on the minimum amount of money society is willing to accept for loss of effectiveness and 4) northeast quadrant (NE): SSP is more costly and more effective than CAU meaning that the cost-effectiveness of SSP depends on the maximum amount of money society is willing to pay for a gain in effectiveness.

The probability that SSP is cost-effective varies according to the ceiling ratio, i.e. the maximum amount society is willing to pay for a health gain or the minimum society is willing to accept for a health loss. The bootstrapped ICERs are plotted in a cost-effectiveness acceptability curve showing the probability that SSP is cost-effective using a range of ceiling ratio's [22]. Bootstrapping was performed using Excel 2000. Other analyses were performed using the SPSS package, version 17.0® for Windows (SPSS INC 2009).

Secondary analyses

Sensitivity analyses were performed to explore the robustness of the results, i.e. the impact of changing (a) parameter(s) on the ICER. An analysis was performed on the only cost item that showed a substantial difference between SSP and CAU, for which a change in unit price might have an influence on the ICER; the cost price of an admission day was calculated using respectively the lowest and highest value. Next, analyses were performed from the patient's and healthcare perspective. Then, the Dutch EQ-5D tariff was used instead of the more commonly used

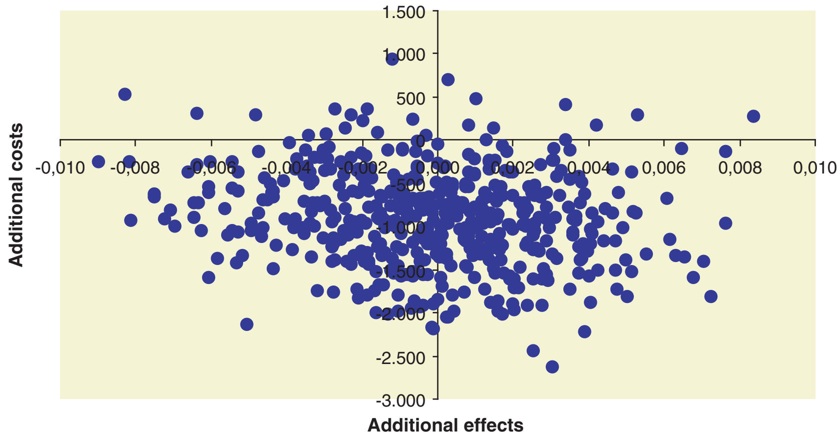

Figure 2. Cost-effectiveness plane for the Short Stay Programme (SSP) compared with Care As Usual (CAU). Effects (QALY); Costs (€).

UK tariff to calculate utilities [23]. In the Dutch tariff the anxiety/depression dimension 'weighs' more than in the UK tariff. As anxiety plays an important role with (breast) cancer we expected that the Dutch tariff might have an effect on the outcomes.

Subsequently, subgroup analyses were performed, starting with analyses on hospital level from a societal and healthcare perspective. Next, types of surgeries (breast conserving/ablative) were compared. Then, a per-protocol analysis was performed, comparing the subgroup of patients in which surgery in short stay in SSP really succeeded, to the subgroup of patients in CAU that underwent surgery in long stay (i.e. hospital stay longer than 24 hours). The outcome of this analysis provides an 'optimal' estimate of cost-effectiveness of the programme compared to CAU (sometimes referred to as treatment cost-effectiveness), assuming that patients in CAU are always admitted longer than 24 hours, and patients treated in the SSP are always treated within 24 hours.

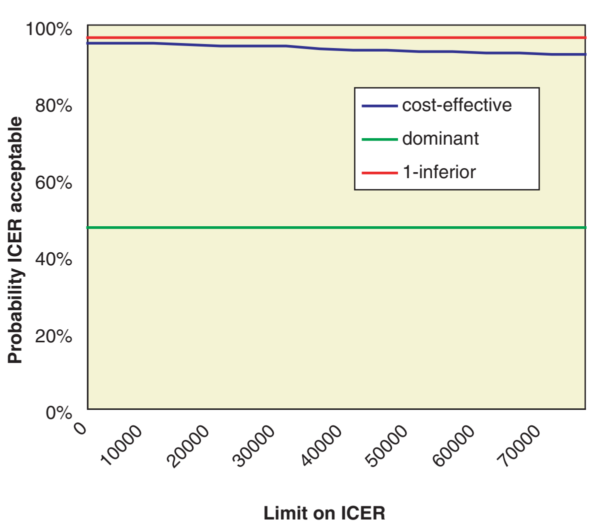

Figure 3. Cost-effectiveness acceptability curve for base-case analysis.

Results

Participants

A total of 262 of the 324 patients participating in the implementation study returned filled out EQ-5D questionnaires. As data on health-related quality of life were necessary for the cost-effectiveness analysis, patients' data were not analyzed if all EQ-5D data were missing (n=62). Of 35 of these 62 patients cost diaries and a questionnaire on baseline characteristics were also missing. The proportion of values missing at random on the EQ-5D for the remaining 262 patients was 0.03. These values and missing values on cost diary data were imputed. Logistic regression analysis showed that the 262 patients included in the economic evaluation were not statistically different from the 62 excluded patients with respect to age, hospital, and type of surgery (breast conserving/ablative). Patients in SSP and CAU were comparable on socio-economic characteristics (Table I). The proportion of patients actually treated in short admission was 0.81 (103/127) in SSP and 0.45 (61/135) in CAU (p=0.000). Groups were comparable regarding safety items [10]. During the study no mortality was recorded.

Effectiveness

Baseline utility was slightly (0.03) higher in SSP than in CAU. Values at the follow-up measurements were also slightly and consistently higher in SSP (Figure 1). Calculation of QALYs based on uncorrected data would lead to an outcome in favour of SSP, which

Table III. Mean (pooled) costs, effects, and incremental cost-effectiveness ratio of the Short Stay Programme (SSP) compared with Care As Usual (CAU); results from base-case analyses and secondary analyses.

	SSP		CAU			
	Mean total costs, €	QALYs	Mean total costs, €	QALYs	ICER, €	Probability cost-effectiveness with ceiling ratio's varying from €0,– to €75.000,–
Base-case analysis	7454	0.08	8409	0.08	Cost saving	95%–93%
Resource use of hospital admission days						
Low estimate: €248,14	7132	0.08	7807	0.08	Cost saving	89%–87%
High estimate: €515,79	7692	0.08	8746	0.08	Cost saving	96%–95%
Analysis from patient perspective[a]	623	0.08	646	0.08	Cost saving	54%–57%
Analysis from healthcare perspective[b]	4335	0.08	5218	0.08	Cost saving	99%–98%
Dutch EQ tariff *(after Delta-adjustment)*	7454	0.09	8409	0.09	Cost saving	94%–91%
Type of hospital						
Hospital 1 (n= 72)						
Societal perspective	8025	0.08	8669	0.08	Cost-saving	68–59%
Healthcare perspective	5006	0.08	6536	0.08	Cost-saving	98–81%
% Patients treated in short stay	77%		6%			
Hospital 2 (n= 54)						
Societal perspective	6436	0.09	9841	0.08	Dominant	100%–100%
Healthcare perspective	4009	0.09	5801	0.08	Dominant	100%–99%
% Patients treated in short stay	67%		30%			
Hospital 3 (n= 69)						
Societal perspective	5965	0.09	7512	0.09	Cost-saving	95%–93%
Healthcare perspective	3235	0.09	3611	0.09	Cost-saving	93%–82%
% Patients treated in short stay	93%		100%			
Hospital 4 (n= 67)						
Societal perspective	8833	0.08	7908	0.08	Cost-increasing	18–28%
Healthcare perspective	4767	0.08	5270	0.08	Cost-saving	87%–85%
% Patients treated in short stay	85%		33%			
Type of surgery						
Breast conserving (n=157)	7213	0.09	7826	0.09	Cost saving	82%–71%
Ablative (n=105)	7864	0.08	9183	0.08	Cost saving	91%–91%
Type of admission[c]						
Short stay	7129	0.09	7603	0.09	n.a.	n.a.
Long stay	8851	0.07	9073	0.08	n.a.	n.a.

[a]paid housekeeper, meal service, loss of voluntary work, loss of leisure time, loss of household tasks, other indirect costs, costs of alternative treatment, aids bought, traveling expenses.
[b]general practitioner, home care nursing, paramedic care, hospital care.
[c]comparing patients in short stay in SSP with patients in long stay in CAU would lead to dominance for SSP due to lower costs and higher effectiveness.

would not be attributable to SSP. Using a conservative approach, a Delta-adjustment was performed to correct for the baseline utility difference [24]. The 0.03 difference was subtracted from the values at all measurements in SSP, as shown for the baseline measurement in Table I.

Cost analysis

Pooled total societal costs per patient differed €955,- in favour of SSP though not significantly. Total healthcare costs were significantly lower for SSP compared with CAU. This was mainly due to significantly lower costs of first admission for SSP compared with CAU. Although not significant, costs of informal care were lower for SSP, whereas productivity costs due to sick leave were higher for SSP than for CAU (Table II).

Cost-effectiveness

Calculation of the point estimate of the ICER was impossible due to the fact that the difference in QALYs between SSP and CAU is zero. However, bootstrap analyses showed that SSP is cost-saving and more effective (dominant) in 47% of the bootstrap replicates (southeast quadrant) and cost-saving and less effective in 48% (southwest quadrant) (Figure 2). These results point towards the conclusion that SSP is cost-saving and equally effective compared to CAU. The cost-effectiveness acceptability curve illustrates that the probability that SSP is cost-effective compared with CAU is over 90%, irrespective of the ceiling ratio (Figure 3).

Secondary analyses (Table III)

All but one secondary analyses revealed that SSP was either cost saving or dominant compared with CAU, which was also confirmed by bootstrap analyses. Only in hospital four, SSP was more costly than CAU from a societal perspective, confirmed by low probabilities for SSP being cost-effective (18–28%). This was explained by higher costs of informal care and productivity losses in the SSP group.

Although the point estimate of the analysis from a patient perspective indicated that SSP is cost-saving, the uncertainty around the point estimates (54–57%) suggests that SSP and CAU have almost equal chances of being cost-effective. This stands to reason as this perspective consisted only of costs outside healthcare, which were not different between groups.

Discussion

To our knowledge, this is the first formal economic evaluation comparing SSP with CAU for breast cancer surgery from a societal perspective.

This study revealed that SSP is cost-effective compared to CAU. Although societal costs were not significantly lower for SSP compared to CAU and the difference in QALYs was zero, bootstrap results showed a very high probability of SSP being cost-effective from a societal perspective and even more pronounced from a healthcare perspective.

Secondary analyses showed that cost-effectiveness results were robust. Only the analysis on hospital level revealed that in hospital four SSP was cost-increasing from a societal perspective, confirmed by bootstrap results showing a very low probability of SSP being cost-effective. Detailed analysis showed that an increased use of informal care was reported in SSP, which was four times as high as in CAU. This was mainly due to one patient reporting the maximum amount of informal care during the time horizon of the study. Furthermore, costs due productivity losses and informal care increased to a level that SSP became cost-increasing compared with CAU. This could be explained by a pre-existent difference in marital status, full-time employed patients, and type of household within hospital four between SSP and CAU (not in table). This difference was not observed at comparison of the whole group in SSP and CAU.

It is difficult to compare our results with other studies, since the RCT's did not report QALYs or indirect costs such as costs due to productivity losses [6,7]. Although Purushotham reported costs outside healthcare generally, no explicit cost calculations were provided. In contrast to Bonnema et al. [7], and in contrast with our expectations, overall the use of informal care decreased in SSP compared with CAU. In SSP, patients and informal caregivers are informed extensively about needs at home and they know exactly (except from unforeseen changes) when the patient is discharged. Possibly, this makes tasks and time frames for caregivers clearer than in CAU, allowing them to use their time more efficiently.

Regarding costs due to productivity losses, no comparison with other studies can be made, but our results suggest that strategies to stimulate work rehabilitation may be worthwhile.

A strength of our study compared with published RCTs is that it was performed multi-centric, which increases the generalizability of the results. Moreover, our results confirm that SSP is safe and cost-saving, and add to the literature that from both a societal and healthcare perspective SSP is cost-effective compared to CAU.

Ideally, a 'gold standard' RCT would be performed. However, this is often not feasible with an organizational change; caregivers are not likely to change behaviour based on randomisation for a guideline, especially when internal motivation is the strongest driver for change. In such cases, logical alternatives are a before-after study or a study comparing different geographical areas. Since patient populations and routines may differ between hospitals, a before-after design seemed the 'purest'. As both groups were comparable on socio-economic characteristics, we believe that the design did not compromise our study findings.

It can be argued that our time horizon is too short to provide a valid estimate of cost-effectiveness. However, most costs and effects relating to the surgical period take place in the first weeks after discharge. Moreover, after this period, results are likely to be biased due to other interventions.

As it was impossible to calculate ICERs due to equal effectiveness, one may suggest that a cost-minimization approach would have been better. However, as the implementation study was not specifically designed to show equivalence in effectiveness between SSP and CAU, such an approach would be inappropriate. Nevertheless, a post-hoc power calculation showed that, with at least 127 patients per group, our study was powered at 73% to reject a minimally important difference of 0.074 or greater in mean QALY between both groups [25]. Moreover, in this case a cost-minimisation approach would have led to the same conclusions, as bootstrap results confirmed equal effectiveness between SSP and CAU.

Our results support the decision to substitute CAU with SSP. Especially when a hospital perspective is taken, our results point towards significant cost-savings when changing form CAU to SSP, and we state that the programme can be transferred to other settings.

Our micro-costing results can be used to assess one's own situation, and to predict the success of the programme in terms of costs. In line with this, it is important to assess costs related to such an implementation.

In conclusion, we advise broad implementation of the short stay programme with special attention for strategies to stimulate work rehabilitation. The results of this multi-center study should be used to improve quality of care for breast cancer patients. Nevertheless, individual decisions are not only based on cost-effectiveness arguments but also on patients' acceptance of the increasingly important role of home care and informal caregivers in exchange for hospital admission.

Trial registration: Current Controlled Trials ISRCTN77253391.

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