



Economic evaluation of a person-centred care intervention in head and neck oncology: results from a randomized controlled trial

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Received: 26 December 2017 / Accepted: 20 August 2018 / Published online: 31 August 2018
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Abstract

Purpose Head and neck cancer and its treatment deteriorate quality of life, but symptoms improve with person-centred care. We examined the cost-effectiveness of a person-centred care intervention versus standard medical care.

Methods In this randomized clinical trial of a person-centred intervention, patients were planned for outpatient oncology treatment in a Swedish university hospital between 2012 and 2014 and were followed during 1 year. Annual healthcare costs were identified from medical records and administrative register data. Productivity costs were calculated from reported sick leave. Health-related quality of life was collected using the EuroQol Group's five-dimension health state questionnaire.

Results Characteristics were similar between 53 patients in the intervention group and 39 control patients. The average total cost was Euro (EUR) 55,544 (95% confidence interval: EUR 48,474–62,614) in the intervention group and EUR 57,443 (EUR 48,607–66,279) among controls, with similar health-related quality of life.

Conclusions This person-centred intervention did not result in increased costs and dominated the standard medical care.

Trial registration [ClinicalTrials.gov](https://clinicaltrials.gov) (registration number: NCT02982746).

Keywords Person-centred care · Head and neck neoplasms · Health care costs · Randomized controlled trial · Patient care management

Introduction

Head and neck cancers (HNC) are a heterogeneous group of tumours affecting the upper aerodigestive tract, with the two major identified causes being tobacco/alcohol use and human papilloma virus (HPV) [1]. Globally, larynx cancer, lip and oral cavity cancer, nasopharynx cancer and other pharynx cancer are reported as the main cause of 380,000 deaths annually and 4.3% of deaths due to cancer [2]. The incidence of approximately 1400 new cases per year in Sweden¹ is slightly increasing, in

particular for HPV-related oropharyngeal cancers. Treatment of HNC includes surgery, in particular for oral tumours, and radiotherapy, mainly in laryngeal tumours or in combination with chemotherapy for more advanced tumours [3].

One important issue in HNC is the patient's health-related quality of life, associated not only with the disease itself but also with side effects of cancer treatments on, e.g. physical functioning and nutrition [4]. An important aspect of such side effects are the challenges met by patient with HNC related to eating ability, weight loss and changed meaning of food [5], but the picture is further complicated by the large symptom burden identified also before treatment is initiated [6]. The quality of life of patients with HNC has been reported to deteriorate, in particular, in the immediate period after finishing treatment [7]. It has thus been suggested that patients with HNC could benefit from support also in the post-treatment period [8]. Carlström et al. [9] reported that patients to a large extent conducted unannounced ad hoc visits to their specialized healthcare clinics also after having been discharged to primary care, e.g. to address treatment side effect.

However, patients are different and how they perceive or react to the treatment of HNC can vary, and it is difficult to

¹ The National statistics from the National Board of Health and Welfare is available at: <http://www.socialstyrelsen.se/statistik/statistikefteramne/cancer>

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develop a standardized care suitable for all patients. Person-centred care aims towards strengthened self-confidence and recruiting the individuals own resources. Person-centred care has been reported to result in improved health outcomes and patient satisfaction [10]. Carlström et al. [9] found that person-centred care resulted in both more effective use of resources in the oncology unit and better service to the patients. However, interventions should also be followed by an economic evaluation to aid decision making [11] to ensure that a decreased resource use in one unit is not the results of, e.g. redistribution towards more costly healthcare use in other units. Due to the reported increasing proportion of young patients with HNC, associated with an increase in HPV-positive cancers [1, 12], such analyses should acknowledge the potential effect of HPV tumour status on healthcare and productivity.

The aim was to examine the cost-effectiveness, including healthcare and productivity costs, of a person-centred care intervention versus standard medical care among patients with HNC. In a post hoc analysis, costs were compared between patients in the intervention group and controls by HPV tumour status, as HPV-positive HNC are increasing.

Materials and methods

An economic analysis was conducted alongside a randomized controlled study examining the health effects (with regard to symptoms and health-related quality of life) of a person centred intervention versus standard medical care among patient with HNC [9, 13]. Costs resulting from HNC were followed for 1 year after inclusion in the study.

Study population

The study was conducted in a university hospital in Sweden, in an oncologic department specialized in HNC. In the regions Västra Götaland and Halland, approximately 300 patients with HNC (20% of all diagnosed in Sweden) are diagnosed annually.² Patients diagnosed between 1 March 2012 and 13 February 2014 were asked to participate if eligible for receiving the adjuvant therapy in an specialized care outpatient clinic (as opposed to being hospitalized). Approximately 100 patients were required to detect a 20% improvement in the European Organization for Research and Treatment of Cancer quality of life questionnaire (EORTC QLQ-C30) at a 5% significance level with 80% power [13]. Of the 101 patients eligible for inclusion, five declined to participate and thus 54 (56%) of 96 consenting patients were randomized to the intervention group using a computerized imbalance

randomization (60:40) and sealed opaque envelopes provided by the coordinating nurse. The drop-out rate during the study period was 8.3%: four patients died during the study, one were excluded due to confusion, one patient due to relapse and resulting transfer to an inpatient department and two patients choose to end their participation (Fig. 1).

Age, sex, peer or family support and occupation were collected by the research nurses. Person characteristics of the final 53 patients in the intervention group and 39 patients in the control group are presented in Table 1. Additional information regarding tumour site, clinical stage and treatment in this study population has been published elsewhere [13].

Person-centred care intervention and standard medical care

All patients received standard medical care according to the national care programme [3], which included post-treatment follow up visits to an oncologist at 6–8 weeks and from then on every third month for 2 years.

In addition, patients randomized to the intervention group received an add-on person-centred care intervention. Key components were the patient narrative, partnership and shared decision making between professional and patient and documentation in the form of care plans. A multidisciplinary team was formed, coordinated by an oncology nurse. Patients in the intervention group were invited to a baseline meeting with the oncology nurse, together with their next of kin. During the study, patients and their relatives were provided phone consultations and visits to the oncology nurse during office hours and with the department during weekends. The coordinating nurse was responsible for setting up, together with the patient and next of kin, a care plan.

Costs

Annual healthcare costs for specialized outpatient care and inpatient care, and productivity costs, were calculated. Other costs associated with HNC, such as travel to and from treatment, primary care use or informal care provided by next of kin, were not valued.

Healthcare resource use and direct costs

Costs of healthcare resulting from HNC were obtained from the hospitals administrative register in August 2014, including specialized outpatient and inpatient healthcare. Allocation of resource use to HNC was conducted by a trained hospital administrator blinded to the treatment group of each patient. For patients transferred to their local hospital after the initial treatment, length of hospitalization was collected from the medical records and translated to costs using a unit cost per inpatient day (Swedish krona (SEK) 6813 according to the

² The statistics from the Regional Cancer Centre in the Western region is available at: <http://www.cancercentrum.se/vast/cancerdiagnoser/huvud-och-hals/regional-wardprocess/>

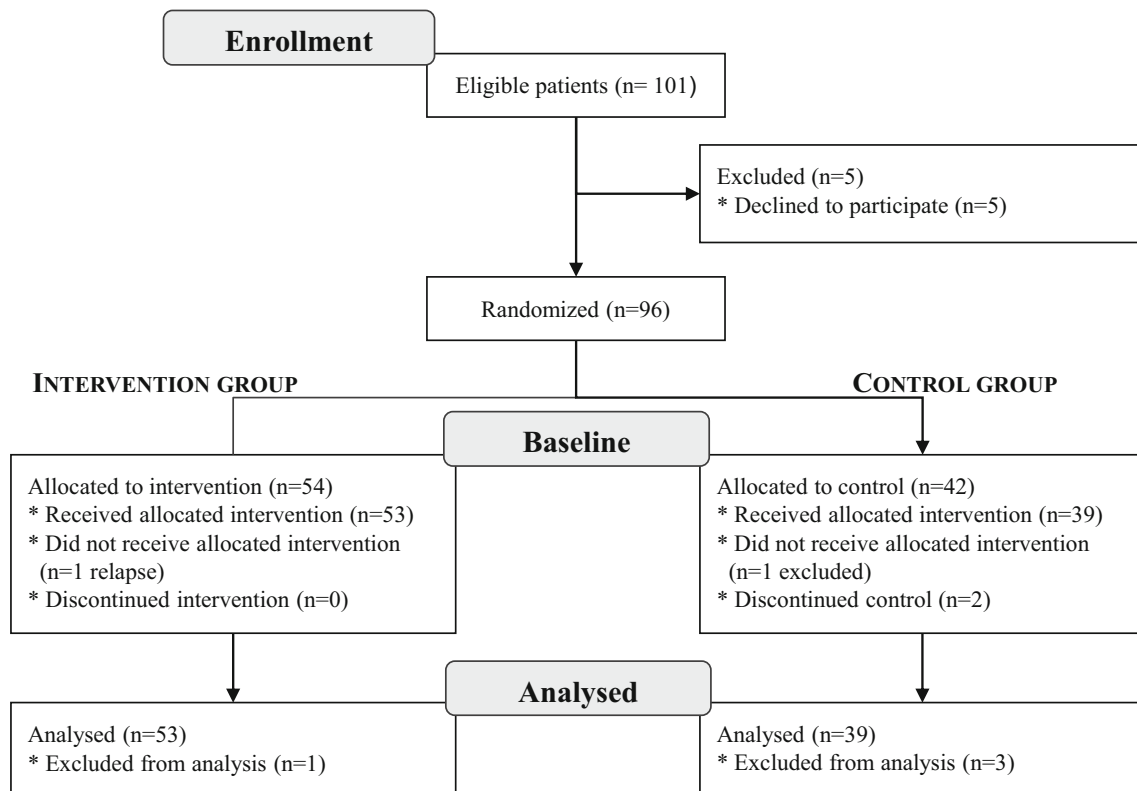


Fig. 1 Study flow diagram

hospital data file (information from Leif Sundberg, Region Västra Götaland)). Two patients in the intervention group were transferred to their local hospital but not remaining overnight and thus incurred no additional costs. For patients

remaining in the study after data linkage, additional healthcare contact were collected from the medical records, and costs were imputed using median costs of previous healthcare encounters (physician visits, nurse visits, dietitian visits) or using

Table 1 Descriptive statistics for the study population

	Intervention group	Control group
Randomized study population, <i>N</i>	54	42
Excluded/withdrawn, <i>n</i>	1 ^a	3 ^b
Analysed population	53	39
Died during the study period, <i>n</i>	2	2
Time remaining in the study, mean ± SD	360 ± 25	356 ± 43
Age at inclusion, mean ± SD	60.6 ± 7.9	60.7 ± 10.0
Men, <i>n</i> (%)	37 (70)	28 (72)
Cohabitant with partner, %	41 (77)	32 (82)
In active work, %	38 (72)	25 (66)
HPV positive ^c , <i>n</i> (%)	36 (84)	24 (71)
Health-related quality of life at baseline, median (1st quartile–3rd quartile) ^d	0.76 (0.73–1.0)	0.74 (0.53–0.85)
	0.88 (0.87–0.97)	0.88 (0.75–0.91)

There were no statistically significant differences in characteristics between treatment groups

HPV human papillomavirus

^a Due to relapse and consecutive transfer to another clinic

^b Two declined to continue the study, one excluded due to confusion

^c HPV tumour status was available for 77 persons

^d Translated using the UK society-based value set (upper row) and Swedish experience-based value set (bottom row), respectively, from EQ-5D reported at baseline by 46 participants in the intervention group and 33 controls

the reported unit cost per inpatient day. Healthcare costs were inflated to 2014 value using the Swedish healthcare inflation index (price index for the counties, including drugs [14]).

Resource use for the coordinating nurse in the intervention, and for unannounced ad hoc visits for controls, is not registered in the hospitals administrative registers. For the intervention was thus included an initial interview taking approximately 1 h, and subsequent contacts with the coordinating nurse were approximated to 15 min. The cost per hour for these contacts was estimated to SEK 265 based on an expected monthly wage of SEK 30,000, social security contributions and other personnel costs to the department, divided by hours working with patients during each month (information from Andreas Pålsson Hult, Sahlgrenska University Hospital). Unannounced visits among controls were not recorded unless included in the administrative register.

Lost production and productivity costs

Information about sick leave was collected by the research nurses from medical records of each patient. The calculated productivity costs thus include all lost productivity due to sick leave acknowledged by the caregiver, regardless of payer or reimbursement status. Identified sick leave was translated to productivity costs [15] (often called indirect costs [16]) using the human capital approach, by multiplying the reported time off from work by the mean wage and social security contributions, i.e. wage statistics in 10-year age categories (35–44 years, SEK 32,200; 45–54 years, SEK 33,100; 55–64 years, SEK 32,200; and 65–66 years, SEK 32,000) [17] and social security contributions (27–65 years, 31.42%; 66–75 years, 10.21%; and > 75 years, 0%) [18] for 2014.

Health-related quality of life

Health-related quality of life was collected using the EuroQol Group's five-dimension health state questionnaire (EQ-5D™), with three levels of severity, at baseline, 4 weeks, 10 weeks, 18 weeks and 52 weeks. It is a generic measure including the dimensions: mobility, self-care, usual activities, pain/discomfort and anxiety/depression [19].

Analyses

Healthcare costs (including intervention costs and unannounced visits) resulting from HNC and productivity costs (by all causes) were compared between treatment groups, overall, by HPV tumour status and by patient characteristics, using two-tailed *t* tests with unequal variances (statistical significance assumed if $p < 0.05$). Baseline characteristics were compared for statistical significance between groups, using *z* tests for proportions and *t* tests for continuous variables.

The average total cost in each treatment group were translated to Euro (EUR) using the 2014 exchange rate (EUR 1 = SEK 9.0968) [20]. Due to skewness of costs and health utilities, bootstrapped confidence intervals were presented [21]. Unadjusted comparisons are presented, as was initially planned, but adjustments for baseline characteristics were also conducted during the bootstrap analysis to control if this would influence the results.

Sensitivity analyses were conducted using lower and higher quartiles of each imputed cost component (including registered costs of previous hospitalizations in addition to visits with physicians, nurses and dietitians). Moreover, a sensitivity analysis was conducting to account for higher wages among the coordinating nurses, SEK 35,000 per month, resulting in a cost per hour of SEK 310. The effect of alternative cost levels was explored for each cost component separately, as a most conservative (lowest cost assumed for each component) to highest total cost estimate.

The EQ-5D results were translated to utilities using the UK society-based value set [22], with a sensitivity analysis using the Swedish experience-based value set [23]. To handle missing data, we conducted multiple imputations with 20 imputations in a chained predictive means matching imputation on the five nearest neighbours [24]. Covariates included in the imputation were age at inclusion, sex, if the patient was cohabitant with a partner, work status and HPV status. Participants who died during the study were excluded from the cost-effectiveness analysis. The quality-adjusted life years were estimated and incremental costs, and effects were compared using a published method [25].

Analyses were conducted in Stata/SE 14.2 (StataCorp).

Results

There were no statistically significant differences in characteristics between treatment groups (Table 1). In total, 2964 specialized outpatient healthcare contact were conducted by the intervention group and 2391 by the controls. This corresponds to a mean number of contacts of 55.9 ± 16.0 (range 1–92) among the intervention group and 61.3 ± 15.7 among controls (range 12–101). In addition, the intervention group had 656 contacts with the coordinating nurse (Table 2), costing on average EUR 112 per patient in the intervention group.

Average healthcare costs for specific resources are presented in Table 3.

Overall, the intervention group had on average SEK 4772 lower costs for specialized outpatient care and SEK 35,975 lower inpatient costs than controls. In addition to healthcare costs, mean numbers of days with sick leave were 120 (95% confidence interval (CI) 91–149) in the intervention group and 104 (CI 66–142) among controls. Mean productivity costs in the intervention group were SEK 16,7645 (CI 126,724–

Table 2 Quantity and costs of used healthcare resources among patient with HNC, by cost components (2014 values)

Cost component	Intervention group Quantity	Control group Quantity	Cost Mean (95% CI), SEK
Specialized outpatient healthcare			
Physician contact	567	441	2199 (1200; 2399)
Incl. radiation therapy	155	121	6210 (6014; 6406)
Nurse contact	2138	1661	324 (285; 364)
Incl. radiation therapy	1058	792	6550 (6430; 6670)
Speech therapy contact	24	38	3873 (2025; 5721)
Dietitian contact	146	125	627 (511; 743)
Psychiatric contact	29	30	1350 (883; 1818)
Other outpatient contact	60	96	137 (38; 237)
No. of outpatient contacts	2964	2391	
Intervention contacts			
Interview (1 h each)	53	0	
Phone call/visit (15 min each)	603	0	
Estimated in hours	204	0	265 /hour
Inpatient healthcare			
Registered hospitalizations, <i>n</i> /days	80 / 771	63 / 577	
Additional hospitalizations, days	203	256	6813 /day
Hospital costs incl. acute care	79	63	68,703 (57,180; 80,227)
Incl. radiation therapy	7	3	19,146 (4212; 34,079)
X-ray examination	33	25	4749 (2412; 7086)
Other laboratory tests	74	59	1702 (1304; 2101)
Surgery (incl. intensive care and post-operative costs)	33	28	18,664 (6957; 30,370)
Drugs and other materials	28	21	2911 (1470; 4351)

h hour, *HNC* head and neck cancer, *min* minutes, *n* number/occasions

208,565) compared to SEK 144,172 (CI 95,408–192,936) among controls, a mean difference of SEK 23,472. The differences were not statistically significant.

The average total cost (Table 4) corresponds to SEK 505,272 (CI 440,960–569,584) in the intervention group and SEK 522,546 (442,167–602,926) among controls (corresponds to EUR 55,544 (48,474–62,614) and EUR 57,443 (CI 48,607–66,279), respectively). Although non-significant statistically, there was a trend towards lower mean specialized outpatient and inpatient healthcare costs in the intervention group, while mean productivity costs were lower among controls. These trends remained after adjusting for baseline characteristics. The graphical examination of the distribution of cost over time illustrated this trend (Fig. 2). Productivity costs represented 33% of the total costs in the intervention group and 28% of the total cost among controls. Patients with positive HPV represented a large proportion of patients in this study, and their results were in line with results in the intervention (Table 4), with trends towards lower specialized outpatient costs among HPV-positive intervention group patients compared to HPV-negative patients and higher average productivity costs among all HPV-positive patients.

The sensitivity analysis showed moderate effects on costs of using lower or higher quartiles of cost instead of median; for outpatient contacts with nurses, physicians or dietitians, the changes in cost per contact were <0.1% and <3% per patient; for hospitalizations, costs decreased by 9% or increased by 12%, respectively. Using the higher wage level for contacts with the coordinating nurse increased the costs for the intervention by 17%, from SEK 1019 to SEK 1192 (CI 1060–1324). The average cost ranged, in the intervention group, from SEK 506,399 (using the most conservative estimation) to SEK 513,022, and for controls from SEK 526,682 to SEK 537,516. Cost was mainly sensitive to the higher end estimates, with costs for the intervention group increasing by 1.5% and for controls 2.9%.

The quality-adjusted life years were similar between the groups after imputation, although the trend was towards slightly higher estimates among patients in the intervention group (0.015, CI –0.035–0.065). Combined with the lower mean costs (–SEK 22,921, CI –127,742–81,899) in the intervention group, in particular costs to the healthcare system, this means that the care provided to the intervention was dominating the standard medical care (i.e. had both lower

Table 3 Average costs per patient for healthcare resulting from HNC, for the intervention and control groups, respectively (2014 values)

Cost component	Intervention group Mean cost (95% CI), SEK	Control group Mean cost (95% CI), SEK	Difference ^a Mean cost (95% CI), SEK
Specialized outpatient healthcare			
Physician contact	23,463 (18,283; 28,644)	24,997 (18,966; 31,028)	− 1534 (− 9562; 6494)
Incl. radiation therapy	17,743 (14,471; 21,015)	18,721 (15,306; 22,135)	− 978 (− 5812; 3856)
Nurse contact	13,510 (10,236; 16,784)	13,238 (7877; 18,599)	272 (− 5851; 6395)
Incl. radiation therapy	129,867 (114,569; 145,164)	132,202 (115,040; 149,364)	− 2335 (− 25,356; 20,686)
Speech therapy contact	2050 (450; 3649)	3372 (861; 5883)	− 1322 (− 4221; 1577)
Dietitian contact	1996 (1407; 2585)	1645 (1119; 2172)	350 (− 464; 1165)
Psychiatric contact	767 (− 201; 1736)	1000 (166; 1834)	− 233 (− 1496; 1030)
Other outpatient contact	228 (− 22; 479)	239 (18; 461)	− 11 (− 319; 297)
Intervention contacts	1019 (906; 1132)		1019 (906; 1132)
Inpatient healthcare			
Hospitalizations (not registered)	27,381 (11,961; 42,800)	44,721 (19,301; 70,141)	− 17,341 (− 46,174; 11,493)
Hospital costs incl. acute care	102,411 (71,061; 133,760)	110,978 (74,331; 147,625)	− 8567 (− 61,567; 44,432)
Incl. radiation therapy	1198 (152; 2244)	3281 (− 1111; 7673)	− 2083 (− 6548; 2382)
X-ray examination	3337 (391; 6282)	2528 (648; 4408)	809 (− 2831; 4448)
Other laboratory tests	2348 (1339; 3358)	2164 (1370; 3860)	− 267 (− 2008; 1475)
Surgery (incl. intensive care and post-operative costs)	9212 (3080; 15,344)	16,673 (− 1001; 34,347)	− 7461 (− 26,867; 11,944)
Drugs and other materials	1099 (262; 1936)	2164 (187; 4140)	− 1065 (− 3288; 1158)

There were no statistically significant differences in characteristics between treatment groups

HNC head and neck cancer

^a Mean cost in the intervention group compared to control group; positive figure indicates costs are higher among intervention group patients

incremental costs and higher incremental effect). Taking into account the uncertainty of the estimates, it was a 74% probability that the intervention would be cost-effective at a willingness to pay threshold of SEK 500,000 per quality-adjusted life year gained.

Discussion

This study found very similar costs between control patients receiving only standard medical care and those in the intervention group receiving also the person-centred care intervention. The trend was towards lower healthcare costs, in particular specialized outpatient care costs, in the intervention group. Moreover, the intervention, which has previously been found to be beneficial with regard to disease symptoms [13], represented a very small additional cost in this patient group with HNC. HPV-positive patients displayed lower specialized outpatient costs (in the intervention group) and higher productivity costs (in both groups) compared to HPV-negative patients.

The main strength of the study was the availability of medical records and information also from other regions to complete data when patients moved region/care producer, thus giving a fairly complete picture of the costs of illness among these patients. Moreover, the data collection was further promoted by the dedicated research nurses delivering the intervention

also being involved in collecting data. Additionally, Fig. 1 indicates that the chosen 1-year study period was an appropriate time of follow up for this disease, as resource use for the disease decreased largely over the year. Furthermore, there were no statistically significant differences between the intervention group and controls, in disease stages [13], or examined baseline characteristics.

The main limitations of the study were associated with lack of data: Although previously reported, “unannounced visits” in specialized outpatient care were not registered for the control group [9], thus probably underestimating the decrease in costs among patient receiving the intervention. Moreover, no register of primary care use was available for this study. Although cancers should primarily be treated in specialized healthcare in Sweden, it can be speculated that use of primary care should have been lower or similar among intervention group patients compared to controls, due to lower symptom burden [13] and better support through the intervention. This would further increase the difference between groups. Finally, due to data retrieval already in July 2014 and to a group of participants belonging to other home hospitals in the region, some of the costs for healthcare were not identified in the administrative register. However, our sensitivity analyses indicated that the overall effect was small of alternative methods for imputing costs. The cost estimation was most sensitive to the imputed costs of hospitalizations. Moreover, the reported

Table 4 Average costs for healthcare resulting from HNC and productivity costs (for all causes), categorized by HPV tumour status and socio-demographic factors (2014 values)

Cost component	Intervention group Mean cost (95% CI), SEK	Control group Mean cost (95% CI), SEK
Total cost		
Outpatient care	190,643 (169,082; 212,204)	195,415 (170,899; 219,930)
Inpatient care	146,984 (105,979; 187,990)	182,959 (124,511; 241,408)
Productivity costs	167,645 (126,724; 208,565)	144,172 (95,408; 192,936)
Men	<i>n</i> = 37	<i>n</i> = 28
Outpatient care	186,805 (162,208; 211,402)	196,959 (165,891; 228,027)
Inpatient care	130,367 (91,121; 169,612)	168,428 (101,003; 235,853)
Productivity costs	179,422 (137,178; 221,667)	114,171 (62,225; 166,118)
Women	<i>n</i> = 16	<i>n</i> = 11
Outpatient care	199,518 (157,078; 241,958)	191,484 (156,698; 226,269)
Inpatient care	185,413 (90,719; 280,107)	219,949 (93,151; 346,747)
Productivity costs	140,409 (60,257; 220,561)	220,539 (117,736; 323,341)
HPV negative	<i>n</i> = 7	<i>n</i> = 10
Outpatient care	244,246 (196,891; 291,601)	183,677 (123,156; 244,197)
Inpatient care	145,513 (46,553; 244,473)	217,746 (59,124; 376,367)
Productivity costs	128,115 (− 23,609; 279,839)	50,125 (− 24,135; 124,386)
HPV positive	<i>n</i> = 36	<i>n</i> = 24
Outpatient care	180,215 (153,844; 206,587)	199,735 (170,563; 228,907)
Inpatient care	158,004 (104,281; 211,728)	147,988 (89,912; 206,065)
Productivity costs	190,919 (146,501; 235,337)	176,270 (118,775; 233,766)
Age ≤ 54 years	<i>n</i> = 13	<i>n</i> = 10
Outpatient care	195,123 (168,379; 221,867)	201,758 (167,110; 236,406)
Inpatient care	140,377 (92,665; 188,088)	198,002 (56,710; 339,295)
Productivity costs	237,914 (174,593; 301,236)	227,716 (120,789; 334,644)
Age 55–64 years	<i>n</i> = 29	<i>n</i> = 15
Outpatient care	195,692 (160,716; 230,669)	195,211 (154,417; 236,005)
Inpatient care	131,946 (66,146; 197,745)	219,897 (121,554; 318,240)
Productivity costs	187,759 (1353; 240,167)	196,987 (133,302; 260,673)
Age ≥ 65 years	<i>n</i> = 11	<i>n</i> = 14
Outpatient care	172,038 (142,430; 201,643)	191,101 (144,399; 237,804)
Inpatient care	194,441 (116,432; 272,450)	132,638 (62,009; 203,267)
Productivity costs	31,569 (− 14,295; 77,433)	27,910 (− 25,575; 81,396)
Average cost	505,272 (440,960; 569,584)	522,546 (442,167; 602,926)

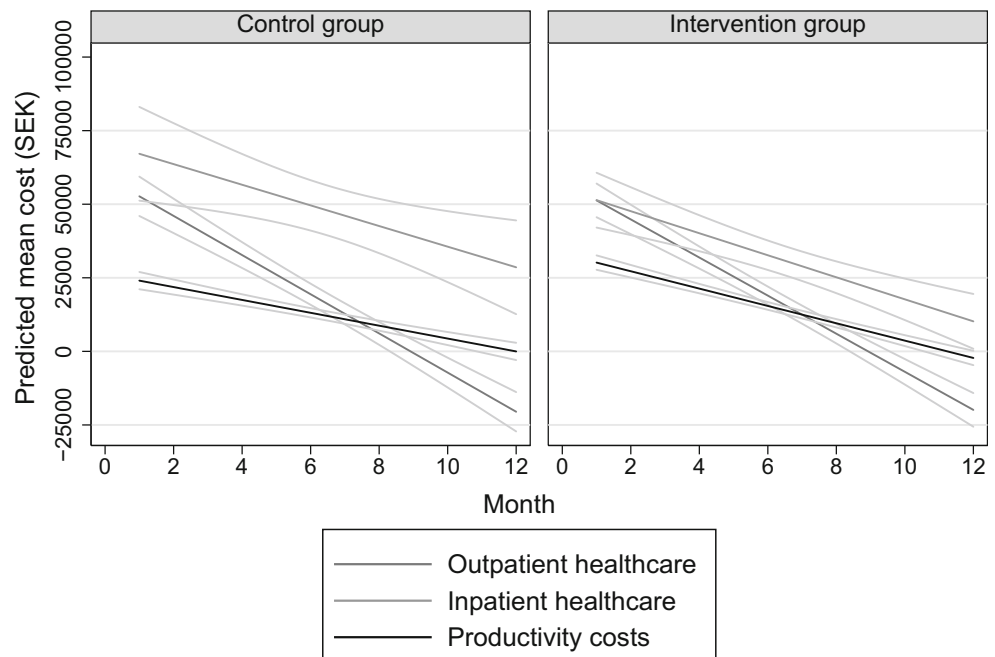
There were no statistically significant differences in characteristics between treatment groups
HNC head and neck cancer, *HPV* human papillomavirus

cost per day was SEK 6813 while the mean cost per day for registered hospitalizations in this study was SEK 10,631 and median SEK 8145 (quartiles SEK 7443 to SEK 9194). This was further complicated by the large proportion of controls with other home hospitals than Sahlgrenska university hospital (> 60% vs approximately 50% among the intervention group). Thus, the main analysis probably underestimated the costs of hospitalizations, although the effect on the overall cost estimate was moderate and, if anything, in favour of the intervention group having lower costs than controls. In addition to costs overlooked in the study, in particular among controls, the lack of statistically significant differences between the groups

was probably also the result of the power calculation being based on the EORTC-QLQ-C30 questionnaire and not the economic evaluation [13]. The medical care itself was not expected to be affected by the intervention, and the randomization was expected to ensure small differences between the treatment groups. Thus, individual level data on tumour site and therapy was not collected, which makes more detailed analyses based on these factors unfeasible.

The cost for the intervention in the current study was low and was not intended to interfere with the medical treatment of HNC. It is an addition directed to support and guide patients through a very challenging treatment period lined with side

Fig. 2 Distribution of costs over time after inclusion in the study, for patients in the intervention group and controls (2014 values)



effects. Patients with HNC report experiences of being left alone with their worries and problems after the treatment, with limited support from care providers [26, 27]. As has previously been reported, the intervention has been successful in providing better service than the traditional ad hoc organization [9] and resulted in higher scoring on health-related quality of life and improvements in cancer-specific problems, such as swallowing, social eating and feeling ill [13]. Moreover, it has been suggested that there are large variations in preferences of treatment priorities within the patient group [28]. In combination with large variations in patient groups and treatments between different studies in this group [29], little can be said of what are the general needs for follow-up and support in the daily life of patients with HNC. The identified proportion of patients with HPV-positive HNC was, for example, large, compared to the 20–40% described in the literature [30]. One possible explanation is the eligibility criteria of receiving therapy in an outpatient clinic, as opposed to being hospitalized. Thus, our study population was probably biased towards younger patients with better disease prognosis than the average patient with HNC.

In supporting patients with HNC, team-based approaches have been advocated, including, e.g. medical, radiation and surgical oncologists, dieticians, speech and swallow experts, radiologists and social services [31]. According to a person-centred approach [10], this team should also include the patient with HNC working in partnership with the healthcare personnel. Our person-centred intervention was coordinated by oncology nurses, which is in line with several previous projects addressing not only the needs in this patient group [8, 32, 33] but also the formation of such a multidisciplinary team. Using nurses to coordinate the project should result in acceptable costs for the intervention, and their general interest

in this type of follow-up has been described previously [32, 34]. According to our results, they also conduct a large part of the healthcare provided to patient with HNC.

Together with the previously described improvements in symptoms burden [13], this cost-effectiveness analysis indicates that a person-centred care initiative would benefit patients with HNC without increasing costs for healthcare. Moreover, the similar costs between treatment groups for inpatient care were to be expected, as length of stay and resource use during the initial hospitalization should be mainly associated with the cancer disease. In particular, the intervention should benefit the younger patient population, with HPV-positive HNC cancers, that should be more likely to attend outpatient care. Conversely, the incidence of tobacco-related HNC is decreasing in some countries due to changes in the tobacco use [1]. This trend towards more HPV-positive cancers has been associated with an increased survival rate, potentially due to more treatment responsive cancers among this patient group [12]. The slightly higher mean productivity cost identified in the intervention group could be explained by the, non-significant, higher proportion of intervention group participants being in active work. Due to the non-significant results from this study, it would be relevant to continue following resource use and costs during introduction of person-centred care in standard medical care for patients with HNC, e.g. through clinical and administrative registers.

Conclusions

This person-centred intervention did not result in increased costs, and the statistically non-significant trend was towards

lower costs for specialized outpatient care among patients in the intervention group compared to patients receiving standard medical care. Moreover, the costs for the intervention represented approximately a half percent of specialized outpatient care costs in the intervention group. The decreased total costs and a slight increase in health-related quality of life indicated that the care provided to patients in the intervention group was dominating the standard medical care provided to controls. In particular, the intervention is expected to benefit the younger patient population, who should be more likely to attend outpatient care.

Acknowledgements We acknowledge the work of research nurses Camilla Sandberg and Anna Henberg in collecting data for this study. We further acknowledge the help received by Leif Sundberg, controller, Region Västra Götaland, in retrieving register data on healthcare use and corresponding costs.

Funding information This work was supported by the Centre for Person-Centred Care (GPCC), funded by the Swedish Research Council, under Grant [number 2009-1088], and Regional Health Technology Assessment Centre, Region Västra Götaland, Sweden.

Compliance with ethical standards

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The study was approved by the Regional Ethics Committee in Gothenburg (Ref. 025-12). Informed consent was obtained from all individual participants included in the study.

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