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## **Costs from a healthcare and societal perspective among cancer patients after total laryngectomy: are they related to patient activation?**

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Supportive Care in Cancer (in press)  
This study was funded by the Michel Keijzer Fund.

## ABSTRACT

**Purpose.** To investigate the associations between patient activation and total costs in cancer patients treated with total laryngectomy (TL).

**Methods.** All members of the Dutch Patients' Association for Laryngectomees were asked to participate in this cross-sectional study. TL patients who wanted to participate were asked to complete a survey. Costs were measured using the medical consumption and productivity cost questionnaire and patient activation using the patient activation measure (PAM). Socio-demographic and clinical characteristics were self-reported, and health-related quality of life (HRQOL) measured using the EQ-5D. The difference in total costs from a healthcare and societal perspective among four groups with different PAM levels were compared using (multiple) regression analyses (5,000 bootstrap replications).

**Results.** In total, 248 TL patients participated. Patients with a higher (better) PAM (level 2, 3 and 4) had a probability of 70%, 80% and 93% that total costs from a healthcare perspective were lower than in patients with the lowest PAM level (difference €-375 to €-936). From a societal perspective this was 73%, 87% and 82% (difference €-468 to €-719). After adjustment for time since TL, education and sex, the probability that total costs were lower in patients with a higher PAM level compared to patients with the lowest PAM level changed to 62% - 91% (healthcare) and 63% - 92% (societal). After additional adjustment for HRQOL, the probability to be less costly changed to 35% - 71% (healthcare) and 31% - 48% (societal).

**Conclusion.** A better patient activation is likely to be associated with lower total costs from a healthcare and societal perspective.

## INTRODUCTION

Current healthcare systems increasingly focus on the ability of cancer patients to manage and cope themselves with the consequences of being treated for cancer, defined as self-management<sup>1-4</sup>. Several self-management interventions, including eHealth interventions, have been developed to guide cancer patients in their self-management<sup>2,5-14</sup>. It has been hypothesized that self-management may improve patients' health outcomes and reduce (healthcare) costs<sup>4,15</sup>.

A previous systematic review of Panagioti et al.<sup>16</sup> indeed found that self-management interventions for different populations with chronic illnesses may reduce healthcare utilization without compromising patients' health outcomes. In cancer patients specifically, only few studies focused on the impact of self-management interventions on (healthcare) costs so far, although several researchers are planning to<sup>8-10,12</sup>. A recent study comparing psychologist-led care with a nurse-led self-management intervention in distressed cancer patients, showed no evidence for cost-effectiveness of the self-management intervention<sup>13</sup>. However, a stepped care program targeting psychological distress in cancer patients consisting of four steps, including a self-help intervention, was found to be more effective and highly likely to be less costly compared to care-as-usual<sup>14,17</sup>.

Although previous studies thus indicated that self-management interventions have the potential to be cost-effective or even cost saving, the pathway via which self-management may influence costs is still partly unknown. A recent study by Howell et al.<sup>7</sup> provided a conceptual framework to assess performance of self-management education support in clinical practice. This framework conceptualizes that self-management interventions influence patients' acquired skills, such as self-efficacy, problem-solving skills, and self-monitoring behavior, which in turn may influence patients' confidence to manage (e.g., manage symptoms, emotional impact of illness, and role and relationship changes). Patients' acquired skills as well as patients' confidence to manage may consequently influence patient outcomes, such as increased health-related quality of life (HRQOL) and lower healthcare use and costs.

Previous studies in non-cancer populations indeed found that patients' knowledge, confidence and ability to manage the disease, defined as patient activation<sup>18</sup>, may influence healthcare usage and costs<sup>19-27</sup>. It was generally found that patients with better patient activation levels used preventive care (e.g., mammography screening, care for feet

and eyes or low density lipoprotein cholesterol testing in diabetes patients) more often than less activated patients<sup>19-23</sup>, while other forms of healthcare use (e.g., hospitalization) was reduced<sup>19,21,23-26</sup>. In addition, activated patients had lower total healthcare costs than less activated patients<sup>19,27</sup>. This suggests that although activated patients may use preventive healthcare more often, total healthcare costs of these activated patients are lower, because they use other (and potentially more expensive) types of healthcare less often. However, these studies did not take costs from a societal perspective into account. Also, no such studies have yet been performed among cancer patients.

Therefore, this study aimed to investigate the associations between patient activation and total costs in cancer patients from both a healthcare and societal perspective. To answer this research question, we studied patients with laryngeal or hypopharyngeal cancer treated with total laryngectomy (TL). As a consequence of TL, several body functions including breathing, smell, swallowing and voice production are changed<sup>28-32</sup>. In addition, many TL patients experience head, neck and shoulder mobility problems as well as more generic cancer-related problems such as fatigue, anxiety and depression<sup>30,31,33</sup>. As a result of these problems and changes in body functions, TL patients are expected to report high healthcare and societal costs, even a long time after treatment, as was also reported in a previous study among laryngeal cancer patients in general<sup>34,35</sup>. We hypothesized that TL patients with a better patient activation level report lower costs from both a healthcare and a societal perspective, compared to patients with lower levels of patient activation.

## PATIENTS AND METHODS

### Design and study population

All members of the Dutch Patients' Association for Laryngectomees were asked to participate in a cross-sectional study in November 2014. Patients willing to participate were asked to complete a survey comprising of validated questionnaires on healthcare utilization, productivity losses, patient activation, and HRQOL, and study-specific sociodemographic and clinical questions. Patients were included when they were treated with TL, were older than 18 years, and completed the survey. The study was performed in accordance with the Dutch Medical Research Involving Human Subjects Act. Ethical approval was not necessary, as patients were not subjected to procedures or required to follow rules of behavior.

## Measures

Direct medical healthcare utilization, direct non-medical service utilization and productivity losses in the previous three months were measured using the medical consumption questionnaire (iMCQ)<sup>36</sup> and productivity cost questionnaire (iPCQ)<sup>37</sup> of the Institute for Medical Technology Assessment of the Erasmus University Rotterdam, the Netherlands. The questionnaire was slightly adapted for usage in this population of TL patients. Direct medical costs in the previous three months were calculated by multiplying resource use by the integral cost price<sup>38</sup>. All prices were adjusted to 2014 prices using the consumer price index. Productivity losses from paid work were calculated by multiplying productivity losses by gender and age-specific costs<sup>38</sup> using the friction cost approach. Thus productivity losses were only included if start date of absence from work was less than the friction period of 160 days before completion of the questionnaire.

The patient activation measure (PAM) was used to measure patient activation. The PAM consists of 13 statements on self-reported knowledge, skills and confidence for self-management of one's health or chronic condition<sup>18</sup>. Patients can answer that they: 1. strongly disagree, 2. disagree, 3. agree, or 4. strongly agree with the statement, or can indicate that the statement is not applicable. A total score is calculated by summing scores of all applicable items and transforming it to a standardized activation score ranging of 0 (low patient activation) to 100 (high patient activation). In this study, a total score was calculated when at least 10 items were completed with a valid score. Patients' total score is categorized into four levels: PAM 1 (score  $\leq 47.0$ ), PAM 2 (score between 47.1 and 55.1), PAM 3 (score between 55.2 and 67.0) and PAM 4 (score  $> 67.0$ ).

In addition, HRQOL was measured using the EuroQol-5 dimensions (EQ-5D). The EQ-5D consists of five items measuring problems on five domains, namely mobility, self-care, usual activities, pain/discomfort and anxiety/depression. Patients are asked to report their level of problems on each of these domains: no problems, some problems or extreme problems<sup>39</sup>. The resulting profile of answers can be transformed to a value given by the Dutch general public using the EQ-5D index<sup>40</sup>. Also, sociodemographic and clinical characteristics were measured, namely age, sex, living situation, having children, education level, work situation, smoking, drinking, time since TL surgery, treatment with (chemo)radiation and current speech method.

### Statistical analyses

Statistical analyses were performed using the IBM Statistical Package for the Social Science (SPSS) version 22 (IBM Corp., Armonk, NY USA) and STATA version 12.1. Descriptive statistics were used to provide insight into sociodemographic characteristics, clinical characteristics and direct medical healthcare utilization, direct non-medical service utilization and productivity losses. Chi-squared tests, Fisher's Exact tests, independent samples T-tests and Mann-Whitney tests were used to compare sociodemographic and clinical characteristics among TL patients. A p-value < 0.05 was considered statistically significant.

To investigate the association between patient activation and total costs from a healthcare and societal perspective, mean costs of the four PAM groups were compared using both unadjusted and adjusted analyses. All analyses were performed using (multiple) regression analyses with dummy coding for PAM level. The analyses were performed twice, once with total costs from a healthcare perspective and once with total costs from a societal perspective (including direct medical, direct non-medical and productivity losses) as dependent variable. In the adjusted analyses, analyses were adjusted for variables that differed among the PAM groups (education level) and for variables found to have a major univariate influence (a change of  $\geq 20\%$ ) on incremental costs. Variables which were assessed for eligibility were age (continuous), sex (male/female), having children (yes/no), living alone (yes/no), employment status (employed vs. not employed or retired), smoking status (no vs. yes or quitted smoking), drinking status (no vs. yes or quitted drinking), time since total laryngectomy (continuous), additional treatment with (chemo)radiation (no additional treatment vs. (chemo)radiation) and having a voice prosthesis (yes/no).

Besides abovementioned analyses, an additional multiple regression analysis was performed in which we adjusted for HRQOL (in addition to the other variables included in the second analysis). We adjusted for HRQOL in a separate analysis since patient activation and HRQOL are likely to be strongly associated<sup>41</sup>, and both may be associated with total costs.

Since cost data is usually characterized by its non-normal distribution and high variance, studies are seldom powered to detect significant differences in costs among groups. Therefore, as accepted in current state of economic evaluations, a probabilistic approach was used rather than reliance upon significance levels to investigate the association between PAM level and total costs<sup>42</sup>. The probability that groups with a higher PAM level (level 2, 3 and 4) had lower costs compared to the group with the lowest PAM level (level 1) was assessed by replicating the regression analyses using bias-corrected accelerated bootstrapping with 5,000 replications.

## RESULTS

In total 288 of the 914 (32%) approached patients actually participated. In this study only those patients (n = 248) were included for whom PAM data and data on direct medical healthcare utilization, direct non-medical service utilization and productivity losses were available. There were some significant differences between the included (n = 248) and the excluded patients (n = 40) (Table 1). Included patients were significantly younger (mean = 70 years, standard deviation (SD) = 9 versus mean = 73 years, SD = 10; p = 0.043) and had a significantly shorter time since TL (median = 6 years, range 0 - 34 versus median = 11 years, range 0 - 37; p = 0.025).

Of the 248 patients, the mean PAM score was 59 (SD = 17). Most patients (n = 104) had a PAM score between 55.2 and 67.0 (PAM level 3), 56 patients had a low PAM score (PAM level 1), 43 patients had a somewhat higher PAM score (PAM level 2) and 45 patients were in the group with the highest PAM score (PAM level 4). There were no significant differences between these four groups regarding socio-demographic and clinical characteristics, except for education level (p = 0.041) and HRQOL (p = 0.004) (Table 1). The group with the highest PAM level had on average the highest percentage of higher educated patients as well as the highest HRQOL, while the group with the lowest PAM level had the lowest.

### Direct medical healthcare utilization, direct non-medical service utilization, and productivity losses

Results of direct medical healthcare utilization, direct non-medical service utilization and productivity losses in the previous three months among TL patients are presented in Table 2. In general, more than half of all TL patients visited their general practitioner in the past 3 months (54%). In addition, 55% of patients reported that they visited a specialist in an academic center, while 42% visited a specialist in a general practice. A quarter of all TL patients received care from a physiotherapist, 18% received care from a speech pathologist, 17% from an oral hygienist and 14% from a dietitian. Only 3% received care from a social worker, 2% received psychologic or psychiatric help in a private practice and 1% received psychologic or psychiatric help in a mental healthcare center. About one out of 10 TL patients (11%) were admitted to a hospital in the previous three months, while 26% received day treatment. Several TL patients received personal care (6%), nursing care (6%), or home care (8%) by a professional. Also, 15% of the TL patients reported to receive informal care. Two percent of all TL patients reported to have productivity losses, which is 18% of the employed TL patients.

Table 1. Patient characteristics

	Included patients n = 248	Not included patients n = 40	PAM 1 n = 56	PAM 2 n = 43	PAM 3 n = 104	PAM 4 n = 45	Significance level included patients	Significance level PAM groups
<b>Mean [SD] age<sup>1</sup></b>	70 [9]	73 [10]	70 [9]	70 [9]	68 [9]	72 [9]	0.043	0.206
<b>Sex<sup>2</sup></b>							0.183	0.067
- men	85%	77%	75%	84%	89%	91%		
- women	15%	23%	25%	16%	11%	9%		
<b>Having children<sup>3,4</sup></b>							0.526	0.982
- no	15%	11%	16%	16%	15%	14%		
- yes	85%	89%	84%	84%	85%	86%		
<b>Living arrangements<sup>3</sup></b>							0.920	0.459
- living alone	21%	22%	29%	19%	19%	18%		
- living together (with partner, children or in an institution)	79%	78%	71%	81%	81%	82%		
<b>Education level<sup>5</sup></b>							0.784	0.041
- elementary	10%	8%	7%	14%	12%	7%		
- lower	47%	55%	64%	49%	43%	30%		
- secondary	25%	23%	18%	26%	24%	36%		
- higher	18%	15%	11%	12%	22%	27%		
<b>Employment status</b>							0.164	0.650
- employed in paid work	11%	13%	7%	14%	11%	16%		
- not employed/not able to work	17%	5%	14%	21%	18%	11%		
- retired	72%	83%	79%	65%	71%	73%		
<b>Smoking status<sup>5</sup></b>							0.486	0.750
- is not a smoker	67%	73%	66%	60%	69%	70%		
- current smoker or quitted smoking	33%	28%	34%	40%	31%	30%		



<b>Drinking status<sup>5</sup></b>							0.302	0.269
- does not drink	29%	38%	39%	26%	28%	23%		
- drinks or quit drinking	71%	62%	61%	74%	72%	77%		
<b>Median [range] years since total laryngectomy<sup>6</sup></b>	6 [0 - 34]	11 [0 - 37]	6 [0 - 34]	4 [0 - 27]	5 [0 - 28]	10 [0 - 33]	0.025	0.094
<b>Received other treatments<sup>7</sup></b>							0.557	0.259
- no	19%	15%	11%	23%	20%	25%		
- yes, (chemo) radiation	81%	85%	89%	77%	80%	75%		
<b>Current speech method<sup>4,7</sup></b>								
- voice prosthesis	84%	78%	87%	84%	83%	84%	0.285	0.917
- injection method	17%	25%	13%	19%	18%	16%	0.194	0.830
- electrolarynx	5%	10%	2%	7%	5%	5%	0.242	NS
- other (e.g., cannot speak)	2%	8%	4%	2%	2%	0%	0.089	NS
<b>Median [range] health-related quality of life<sup>8</sup></b> (EQ-5D utility score)	0.89 [0.07-1.00]	1.00 [0.24-1.00]	0.83 [0.07-1.00]	0.86 [0.65-1.00]	0.90 [0.19-1.00]	1.00 [0.32-1.00]	0.297	0.004

Abbreviations: PAM, patient activation measure; SD, standard deviation; EQ-5D, EuroQol-5 dimensions; NS, non-significant

<sup>1</sup> Age is missing in 2 patients.

<sup>2</sup> Sex is missing in 4 patients.

<sup>3</sup> Having children and living situation are missing in 7 patients.

<sup>4</sup> Multiple answers possible.

<sup>5</sup> Education level, smoking status and drinking status are missing in 3 patients.

<sup>6</sup> Time since total laryngectomy is missing in 14 patients.

<sup>7</sup> Information on other received treatments and current speech method is missing in 6 patients.

<sup>8</sup> Health-related quality of life is missing in 9 patients.

**Table 2: Description of direct medical healthcare utilization, direct non-medical service utilization and productivity losses among patients after total laryngectomy with different levels of patient activation**

	<b>All patients</b> n = 248		<b>PAM 1</b> n = 56	
	% patients using service	Mean (SD) number of contacts/ hours or days <sup>1</sup>	% patients using service	Mean (SD) number of contacts/ hours or days <sup>1</sup>
<b>Direct medical</b>				
General practitioner (phone)	38%	1.9 (1.3)	41%	1.7 (0.6)
General practitioner (home visit)	13%	1.9 (1.1)	14%	1.9 (0.8)
General practitioner (practice)	54%	1.8 (1.3)	64%	2.0 (1.4)
Company doctor	5%	1.3 (0.5)	2%	1.0 (-)
Social worker	3%	1.6 (0.9)	5%	1.3 (0.5)
Physiotherapist	25%	11.9 (8.9)	29%	13.6 (10.2)
Ergotherapist	1%	2.5 (2.1)	0%	-
Dietitian	14%	1.6 (0.9)	14%	1.9 (1.5)
Speech pathologist	18%	4.3 (5.5)	21%	6.8 (8.8)
Oral hygienist	17%	1.3 (0.9)	16%	1.7 (1.3)
Psychologic or psychiatric help (private practice)	2%	2.8 (2.2)	2%	6.0 (-)
Psychologic or psychiatric help (mental healthcare center)	1%	2.0 (1.0)	2%	1.0 (-)
Specialist (general practice)	42%	1.9 (1.4)	41%	2.0 (1.1)
Specialist (academic center)	55%	2.2 (2.2)	63%	1.9 (1.9)
Spiritual counsellor	1%	1.3 (0.6)	2%	1.0 (-)
Alternative medicine	1%	2.0 (1.4)	0%	-
Emergency care visit	12%	2.0 (2.6)	16%	1.4 (0.5)
Personal care by a nurse	6%	78.5 (46.7)	11%	71.3 (54.4)
Nursing care by a nurse	6%	54.8 (42.8)	9%	87.1 (35.1)
Admission medical center (day treatment)	26%	4.6 (7.7)	32%	3.1 (3.3)
Admission medical center (multiple days)	11%	6.7 (6.0)	14%	4.3 (2.6)
Medication	84%	NA	84%	NA
<b>Direct non-medical</b>				
Home care	8%	37.6 (16.3)	16%	37.2 (11.7)
Support groups	2%	24.9 (36.6)	4%	2.0 (1.4)
Informal care	15%	83.7 (151.8)	25%	59.7 (42.2)
<b>Productivity losses (presenteism and absenteeism)</b>	2%	NA	2%	NA

Abbreviations: PAM, patient activation measure; SD, standard deviation.

<sup>1</sup>Of all patients who used the service or had productivity losses. Most direct medical costs and support groups were measured per contact. Personal care, nursing care, home care, informal care and productivity losses were measured per hour. Admission to a medical center was measured in days.

<b>PAM 2</b> n = 43		<b>PAM 3</b> n = 104		<b>PAM 4</b> n = 45	
% patients using service	Mean (SD) number of contacts/ hours or days <sup>1</sup>	% patients using service	Mean (SD) number of contacts/ hours or days <sup>1</sup>	% patients using service	Mean (SD) number of contacts/ hours or days <sup>1</sup>
44%	1.9 (2.1)	38%	2.0 (1.3)	31%	2.1 (1.2)
19%	1.3 (0.5)	11%	2.6 (1.5)	13%	1.7 (0.8)
44%	1.9 (1.3)	59%	1.7 (1.1)	38%	2.0 (1.5)
2%	2.0 (-)	8%	1.3 (0.5)	7%	1.3 (0.6)
2%	3.0 (-)	3%	1.7 (1.2)	0%	-
35%	12.3 (9.1)	22%	11.7 (8.8)	18%	8.8 (5.7)
0%	-	0%	-	4%	2.5 (2.1)
12%	2.0 (0.7)	16%	1.5 (0.6)	11%	1.4 (0.9)
16%	4.0 (3.9)	17%	3.7 (3.9)	16%	2.0 (1.8)
21%	1.1 (0.3)	19%	1.3 (0.9)	9%	1.0 (0.0)
2%	1.0 (-)	3%	3.0 (2.0)	2%	1.0 (-)
0%	-	1%	3.0 (-)	2%	2.0 (-)
42%	1.9 (1.2)	48%	1.9 (1.6)	31%	1.4 (0.6)
47%	2.5 (3.2)	61%	2.2 (1.8)	40%	2.3 (2.8)
0%	-	1%	2.0 (-)	2%	1.0 (-)
0%	-	2%	2.0 (1.4)	0%	-
9%	1.5 (0.6)	13%	1.5 (1.1)	7%	6.0 (7.8)
7%	83.3 (64.3)	5%	71.2 (26.1)	2%	143 (-)
7%	15.3 (7.6)	5%	43.0 (31.4)	4%	62.5 (77.1)
28%	5.3 (11.0)	22%	4.5 (6.7)	24%	6.4 (10.6)
7%	11.7 (12.7)	13%	8.3 (5.3)	7%	1.3 (0.6)
88%	NA	84%	NA	82%	NA
9%	34.3 (16.0)	4%	47.3 (24.8)	9%	32.1 (18.6)
5%	12.3 (16.6)	0%	-	4%	60.5 (50.2)
19%	62.6 (54.7)	12%	54.1 (35.1)	9%	287.5 (434.6)
2%	NA	3%	NA	0%	NA

**Table 3: Association between patient activation level and direct medical costs and total costs from a societal perspective (n = 248)**

	Total costs from a healthcare perspective	Difference in costs from a healthcare perspective € [95% CI]		
		Mean (SD)	Unadjusted	Adjusted <sup>1</sup> Adjusted including health-related quality of life
PAM level 1	€2,282 (3,798)	Reference	Reference	Reference
PAM level 2	€1,908 (3,314)	€-375 [€-1,748 to €1,026]	€-204 [€-1,496 to €1,114]	€264 [€-875 to €1,670]
PAM level 3	€1,781 (2,978)	€-501 [€-1,779 to €537]	€-624 [€-1,731 to €324]	€-19 [€-932 to €881]
PAM level 4	€1,346 (2,597)	€-936 [€-2,282 to €288]	€-770 [€-1,954 to €397]	€-263 [€-1,278 to €823]

Abbreviations: PAM, patient activation measure; SD, standard deviation; CI, confidence interval

<sup>1</sup> Adjusted for time since TL, sex, and education level.

#### Patient activation in relation to total costs from a healthcare and societal perspective

Total costs from a healthcare perspective in the previous 3 months ranged from €1,346 (SD = 2,597) in the group with the highest PAM level to €2,282 (SD = 3,798) in the group with the lowest PAM level (Table 3). Total costs from a societal perspective ranged from €1,909 (SD = 3,855) in the group with the highest PAM level to €2,627 (SD = 4,147) in the group with the lowest PAM level. In the unadjusted analysis, patients in the group with the highest PAM level had a 93% probability that total costs from a healthcare perspective were lower than costs in the group with the lowest PAM level (Table 3 and 4). This probability was 82% for total costs from a societal perspective. For the other two groups, probabilities of respectively 80% and 87% (PAM 3 vs. PAM 1) and 70% and 73% (PAM 2 vs. PAM 1) were found. After adjusting for potential confounders (time since TL, sex, and education level), these probabilities changed to respectively 91% and 79% (PAM 4 vs. PAM 1), 88% and 92% (PAM 3 vs. PAM 1), and 62% and 63% (PAM 2 vs. PAM 1). After adjusting for potential confounders and HRQOL, the probabilities were reduced to respectively 71% and 45% (PAM 4 vs. PAM 1), 52% and 48% (PAM 3 vs. PAM 1), and 35% and 31% (PAM 2 vs. PAM 1). No statistically significant differences were found.

Total costs from a societal perspective	Difference in costs from a societal perspective € [95% CI]		
	Mean (SD)	Unadjusted	Adjusted <sup>1</sup>
€2,627 (4,147)	Reference	Reference	Reference
€2,159 (3,431)	€-468 [€-1,970 to €998]	€-251 [€-1,659 to €1,156]	€344 [€-891 to €1,782]
€1,933 (3,104)	€-694 [€-2,045 to €427]	€-801 [€-2,039 to €240]	€35 [€-999 to €1,059]
€1,909 (3,855)	€-719 [€-2,282 to €921]	€-541 [€-1,898 to €955]	€146 [€-1,060 to €1,583]

**Table 4: Probability<sup>1</sup> that costs are lower compared to the group with the lowest PAM score**

		Total costs from a healthcare perspective	Total costs from a societal perspective
<b>Unadjusted</b>	PAM 2 vs PAM 1	70%	73%
	PAM 3 vs PAM 1	80%	87%
	PAM 4 vs PAM 1	93%	82%
<b>Adjusted<sup>2</sup></b>	PAM 2 vs PAM 1	62%	63%
	PAM 3 vs PAM 1	88%	92%
	PAM 4 vs PAM 1	91%	79%
<b>Adjusted including EQ-5D</b>	PAM 2 vs PAM 1	35%	31%
	PAM 3 vs PAM 1	52%	48%
	PAM 4 vs PAM 1	71%	45%

Abbreviations: PAM, patient activation measure

<sup>1</sup> The probability that total costs were lower in a certain PAM group compared to the first PAM group was investigated by replicating the regression analyses using bias-corrected accelerated bootstrapping with 5,000 replications. The percentage described in this Table presents the percentage of the 5,000 bootstrap replications that showed lower total costs.

<sup>2</sup> Adjusted for time since TL, sex, and education level.

## DISCUSSION

This study aimed to investigate the associations between patient activation and total costs from a healthcare and societal perspective in cancer patients. To answer this research question, TL cancer patients were studied. We found that TL patients with a better patient activation reported less costs from a healthcare and societal perspective compared to patients with lower patient activation (probability of 70% to 93%). This finding remained present when adjusting for sociodemographic and clinical characteristics (probability of 62% to 92%).

Our findings on total costs from a healthcare perspective are in line with previous cross-sectional analyses of Hibbard et al.<sup>27</sup> and Greene et al.<sup>19</sup> conducted in primary care patients. Hibbard et al.<sup>27</sup> reported that the predicted total healthcare costs were 8% higher in the group with the lowest patient activation compared to the group with the highest patient activation, even when adjusted for several sociodemographic characteristics and a risk score for future costs. In the study of Greene et al.<sup>19</sup> predicted total healthcare costs were 8% higher in the lowest patient activation group and 12% higher in the second lowest group, compared to the highest patient activation group.

Besides healthcare costs, our study also included other important costs from a societal point of view, such as informal care costs and productivity losses. It was previously estimated that about 60% of the economic burden of cancer in the European Union is caused by productivity losses (including mortality and morbidity) and informal care costs<sup>43</sup>, emphasizing the importance of conducting analyses from a societal perspective. In our study, we found that 15% of all TL patients received informal care, 8% received home care, 2% made use of support groups, and 2% (or 18% of all employed TL patients) had productivity losses. Of these cost categories, especially informal care usage seemed to decrease with better patient activation (PAM 1 = 25%, PAM 2 = 19%, PAM 3 = 12%, and PAM 4 = 9%). However, no clear influence of the inclusion of these costs on the association between patient activation and total costs was found; the adjusted probability to be less costly was 62% - 91% from a healthcare perspective compared to 63% - 92% from a societal perspective. Further research should look at the association between patient activation and different cost categories (e.g., healthcare costs, informal care costs and productivity losses) in more detail.

As an additional analysis, we investigated the potential confounding role of HRQOL on the association between patient activation and total costs from a healthcare and societal perspective. We found that after adjustment for HRQOL no association seemed to be present anymore (probability to be less costly was 31% - 71%). Due to the cross-sectional design of the study, no conclusions can be drawn regarding causality of the association between HRQOL, patient activation and total costs. However, based on the conceptual framework of Howell et al.<sup>7</sup>, it can be hypothesized that self-management interventions may improve patient activation, which in turn may improve patient health outcomes, such as HRQOL, and costs. So far, however, only a few randomized controlled trials have investigated the effectiveness of self-management interventions on patient activation, including one study in cancer patients<sup>44</sup>, which showed inconclusive results<sup>44-47</sup>. Also, none of these studies investigated cost-effectiveness or cost-utility. One previous (non-randomized) prospective study in primary care patients, nevertheless, reported that primary care patients with a positive change in patient activation (e.g., from level 3 to 4) had lower total healthcare costs compared to patients who remained at PAM level 3<sup>19</sup>. Further research should investigate whether patient activation can be improved in cancer patients, and whether this affects HRQOL and total costs. A currently ongoing Dutch randomized controlled trial on the (cost-)effectiveness of a guided self-help program in TL cancer patients may provide further information regarding this association<sup>10</sup>.

This study provides novel insights into the associations between patient activation and total costs, as no such study has previously been performed in cancer patients. Also, this is the first study that investigated the association between patient activation in relation to costs from a societal perspective. Some potential limitations, however, need also to be kept in mind. First, information on healthcare utilization, service utilization and productivity losses were obtained using self-report, which may have resulted in recall bias. Besides, missing data was not entirely missing at random; patients in the final study sample were significantly younger and had a significantly shorter time period since TL, which might influence representativeness of findings for the entire TL population. Also, the relative low response of 32% and the selection of patients via the Dutch Patients' Association for Laryngectomees may have influenced the representativeness of findings. In conclusion, patient activation is likely to be associated with total costs from both a healthcare and societal perspective in TL patients. TL patients with better patient activation reported less costs compared to patients with lower patient activation, even after adjusting for sociodemographic and clinical characteristics. However, after adjusting

for HRQOL, no such association seemed to be present anymore. More research on the causality of the association between patient activation, HRQOL and total costs from both a healthcare and a societal perspective in cancer patients is warranted.



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