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The association between palliative care team consultation and hospital costs for patients with advanced cancer: An observational study in 12 Dutch hospitals

Arianne Brinkman-Stoppelenburg[1] | Suzanne Polinder[1] | Branko F. Olij[1] | Barbara van den Berg[2] | Nicolette Gunnink[3] | Mathijs P. Hendriks[4] | Yvette M. van der Linden[5] | Daan Nieboer[1] | Annemieke van der Padt-Pruijsten[6] | Liesbeth A. Peters[7] | Brenda Roggeveen[8] | Frederiek Terheggen[9] | Sylvia Verhage[10] | Maurice J. van der Vorst[11,12] | Ingrid Willemen[13] | Yvonne Vergouwe[1] | Agnes van der Heide[1]

[1]Department of Public Health, Erasmus MC, University Medical Center Rotterdam, Rotterdam, The Netherlands

[2]Department of Medical Oncology, Haga Hospital, The Hague, The Netherlands

[3]Department of Internal Medicine, Onze Lieve Vrouwe Gasthuis, Amsterdam, The Netherlands

[4]Department of Internal Medicine, Northwest Clinics, Alkmaar, The Netherlands

[5]Center of Expertise Palliative Care, Leiden University Medical Center, Leiden, The Netherlands

[6]Department of Medical Oncology, Maasstad Hospital, Rotterdam, The Netherlands

[7]Department of Pulmonary Diseases, Northwest Clinics, Den Helder, The Netherlands

[8]Department of Medical Oncology, Erasmus MC Cancer Institute, Rotterdam, The Netherlands

[9]Department of Internal Medicine, Bravis Hospital, Bergen op Zoom, The Netherlands

[10]Breast Center, Jeroen Bosch Hospital, 's-Hertogenbosch, The Netherlands

[11]Department of Medical Oncology, Cancer Center Amsterdam, VU University Medical Center, Amsterdam, The Netherlands

[12]Department of Internal Medicine, Rijnstate Hospital, Arnhem, The Netherlands

[13]Department of Internal Medicine,

Abstract

Background: Early palliative care team consultation has been shown to reduce costs of hospital care. The objective of this study was to investigate the association between palliative care team (PCT) consultation and the content and costs of hospital care in patients with advanced cancer.

Material and Methods: A prospective, observational study was conducted in 12 Dutch hospitals. Patients with advanced cancer and an estimated life expectancy of less than 1 year were included. We compared hospital care during 3 months of follow-up for patients with and without PCT involvement. Propensity score matching was used to estimate the effect of PCTs on costs of hospital care. Additionally, gamma regression models were estimated to assess predictors of hospital costs.

Results: We included 535 patients of whom 126 received PCT consultation. Patients with PCT had a worse life expectancy (life expectancy <3 months: 62% vs. 31%, $p < .01$) and performance status ($p < .01$, e.g., WHO status higher than 2:54% vs. 28%) and more often had no more options for anti-tumour therapy (57% vs. 30%, $p < .01$). Hospital length of stay, use of most diagnostic procedures, medication and other therapeutic interventions were similar. The total mean hospital costs were €8,393 for patients with and €8,631 for patients without PCT consultation. Analyses using propensity scores to control for observed confounding showed no significant difference in hospital costs.

Conclusions: PCT consultation for patients with cancer in Dutch hospitals often occurs late in the patients' disease trajectories, which might explain why we found no

Elisabeth-Tweesteden Hospital, Tilburg, The Netherlands

Correspondence
Arianne Brinkman-Stoppelenburg, Department of Public Health, Erasmus Medical Center, P.O. Box 2040, 3000 CA Rotterdam, The Netherlands.
Email: a.brinkman-stoppelenburg@erasmusmc.nl

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effect of PCT consultation on costs of hospital care. Earlier consultation could be beneficial to patients and reduce costs of care.

KEYWORDS
cancer, consultation and referral, costs, hospital, observational study, palliative care, palliative medicine

1 | INTRODUCTION

In patients with incurable diseases for whom death is approaching, goals of care need to be realigned and typically include an emphasis on the relief of suffering and providing optimal quality of life (Sepulveda, Marlin, Yoshida, & Ullrich, 2002). However, burdensome medical interventions are sometimes prolonged at the end of life without any improvement in these outcomes (Bolt, Pasman, Willems, & Onwuteaka-Philipsen, 2016; Hales et al., 2014; McDermott et al., 2017; Teno et al., 1997; Veerbeek, van Zuylen, Swart, van der Maas, & van der Heide, 2007). Many hospitals have therefore started palliative care teams (PCTs) over the past decade (Brinkman-Stoppelenburg, Boddaert, Douma, & van der Heide, 2016; Davis, Strasser, & Cherny, 2015; Dumanovsky et al., 2016). PCTs constitute of professionals with expertise in palliative care and can be consulted by physicians or nurses working in the hospital. Several studies, mainly performed in the United States, have shown that consultation of PCTs in hospitals is associated with better patient quality of life, lower symptom burden and increased patient satisfaction with care (Gaertner et al., 2017; Kavalieratos et al., 2016; Temel et al., 2010; Zimmermann et al., 2014). Studies, mostly performed in the United States, have reported that the involvement of hospital PCTs was found to reduce the length of stay in hospital (Ciemins, Blum, Nunley, Lasher, & Newman, 2007; May et al., 2017) and to improve communication about goals of care, resulting in less diagnostic tests, less use of intensive care (Morrison et al., 2008; Penrod et al., 2006) and less aggressive care during the last weeks of life (Temel et al., 2010). Recently, a meta-analysis showed that involvement of a PCT within 3 days after hospital admission was associated with significant cost savings (May, Normand, et al., 2018).

In the Netherlands, health care is characterised by a strong emphasis on home-based care, which is provided by general practitioners and community nurses (Kroneman et al., 2016). However, 77% of cancer patients of 65 years and older in the Netherlands were found to be admitted to the hospital at least once in the last 6 months of life (Bekelman et al., 2016). The Dutch Federation of Oncological Societies has stated that every hospital providing oncology care should have a PCT by January 2017. As a result, many Dutch hospitals have now established PCTs (Brinkman-Stoppelenburg et al., 2016).

We studied the association between PCT consultation and use of hospital care for patients with advanced cancer. We also estimated the costs of hospital care for patients with and without PCT consultation, while taking into account baseline differences between both patient groups.

2 | MATERIAL AND METHODS

2.1 | Study design

We performed a prospective observational study in inpatient wards of 12 hospitals, including general, teaching and university hospitals. Nine hospitals had a PCT facility. Patients with PCT consultation came from these nine hospitals. Patients without PCT consultation came from all twelve hospitals. Diagnostic and therapeutic interventions and hospital length of stay were compared for patients for whom a PCT was consulted during their stay in the hospital and control patients for whom no PCT was consulted. An extensive description of the study protocol has been published elsewhere (Brinkman-Stoppelenburg, Polinder, Vergouwe, & van der Heide, 2015).

2.2 | Study population and setting

Patients who were admitted to the hospital with incurable cancer, who were 18 years or over, for whom the physician answered "no" to the surprise question "Would you be surprised if this patient would die within the next year?" (Moss et al., 2010) and who were expected to stay in hospital for at least 3 days were eligible for this study. No sample size was calculated a priori as this was a secondary analysis of data from a study that had the primary aim to assess the effect of PCT consultation on patients' quality of life. Patients were included sequentially (Brinkman-Stoppelenburg et al., 2015). All patients were followed during 3 months after their initial hospitalisation.

2.3 | Intervention

PCTs typically assess patients' symptoms and physical, emotional, social and spiritual problems prioritize these and provide an advice to the attending healthcare professionals on how to address them. They also frequently advise on the coordination of care. Most PCTs consist of clinicians from different specialties, such as medical oncologists, neurologists, anesthesiologists, and nurses, nurse practitioners and psychosocial or spiritual caregivers (Brinkman-Stoppelenburg et al., 2016). Since 2014, the Dutch Federation of Oncological Societies (SONCOS) has stated criteria for PCTs in their "Multidisciplinary standards for oncological care in the Netherlands" (Dutch Federation of Oncological Societies, 2017). Criteria are for instance that PCTs should include at least two medical specialist and a nurse, and meet weekly. Members of the PCT should also have the possibility of consultation of other disciplines, all with expertise in palliative care, in so far as not already part of the PCT. However, it is known from other studies that PCTs in Dutch hospitals vary in the frequency of consultations, number of disciplines that are represented in the team and the procedures for consultations (Brinkman-Stoppelenburg et al., 2016).

2.4 | Questionnaires and main outcomes

The attending medical oncologist was asked to fill in a questionnaire about the patient's diagnosis, WHO performance status, co-morbidity, treatment status and life expectancy. Life expectancy was assessed using (modified versions) of the Surprise Question: "Would you be surprised if this patients died within 12/6/3/1 month(s)?" (Moss et al., 2010) Information about hospital length of stay, diagnostic procedures, in-hospital treatments such as chemotherapy, invasive procedures, medication and intensive care days was extracted from the patients' medical file over a 3 month period using a standardised checklist.

2.5 | Costs

The economic evaluation was focused on hospital care. Costs of hospital care were calculated by multiplying volumes with the corresponding unit prices (see Attachment 1). We calculated costs of inpatient days in the hospital, costs of diagnostic procedures, costs of therapeutic interventions, including chemotherapy, medication and other types of treatment, and total hospital costs (May & Normand, 2016). Unit costs for medication were determined with information from the National Dutch Formulary (National Health Care Institute, 2016a, 2016b). The average costs per day for expensive and other medications were calculated, based on a random sample of 43 patients with and 43 patients without PCT consultation. Costs for inpatient days in hospitals were estimated as real, basic costs per day using detailed hospital administrative information. We distinguished costs in general and university hospitals.

2.6 | Data analysis

Propensity score matching was used to adjust for possible confounders of the association of PCT consultation and costs of hospital care (Austin, 2011). Within propensity score matching, patients who received and did not receive PCT consultation are matched based on the propensity score, which is the estimated probability that patients received PCT consultation based on their characteristics. Characteristics that were included in the propensity score model were age, gender, prognosis, WHO performance status, planned or unplanned hospital admission, treatment status, diagnosis, number of co-morbidities, type of hospital, time since primary diagnosis and number of hospital admissions. A 1:1 matching was performed using the nearest-neighbour algorithm with a caliper width of 0.1. The matching was performed using the MatchIT package in R. To assess the impact of the caliper width on the final results, we performed sensitivity analyses where we varied the caliper width.

We fitted multivariable gamma regression models to investigate which determinants had a significant impact on hospital costs. A gamma regression model was used due to the expected skewed distribution of costs (Barber & Thompson, 2004). The exponentiated regression coefficients from this model can be interpreted as the relative difference of average costs between patients.

Patient characteristics (age, gender, diagnosis and co-morbidity) and prognostic factors such as WHO performance status, treatment status, type of hospitalisation, time since primary diagnosis and number of hospitalisations were selected as potential determinants. A p-value < .05 was considered statistically significant.

Gamma regression models were estimated for total hospital costs, costs of inpatient hospital stay, costs of diagnostic procedures and costs of therapeutic interventions. Each cost model used the same variables.

Previous studies have found that the time between hospital admission and PCT consultation is an important factor in assessing the association between PCT consultation and hospital costs. We therefore also performed an analysis in which we restricted the consultation group to patients for whom consultations took place within 3 days of hospital admission.

2.7 | Ethical considerations

In three hospitals, data were collected anonymously. In nine other hospitals, the study included an assessment of patients' quality of life, for which patients provided written informed consent. The results of this study are reported elsewhere. The research protocol was submitted to the Medical Ethical Research Committee of the Erasmus Medical Centre (MEC-2012–259). The committee stated that there were no objections to perform this study.

TABLE 1 Baseline characteristics of patients with and without palliative care team consultation

	Patients with PCT consultation *n* = 126	Patients without PCT consultation *n* = 409	
	Mean (*SD*)	Mean (*SD*)	*p*-Value
Age	66.4 (12.5)	64.9 (11.6)	.20[a]
Number of hospital admissions due to current disease (median, IQR)	2 (1–3)	2 (1–4)	.16[b]
Time since diagnosis (year, median, IQR)	2 (0–9)	1 (0–8)	.29[b]
	N (%)	*N* (%)	
Female gender	73 (59)	215 (53)	.22[c]
Type of hospital			<.01[c]
General hospital	109 (86)	297 (73)	
Academic hospital	17 (14)	112 (27)	
Type of cancer			.49[c]
Gastrointestinal cancer	52 (42)	172 (43)	
Urogenital cancer	27 (22)	65 (16)	
Breast cancer	17 (14)	48 (12)	
Lung cancer	7 (6)	30 (8)	
Other	21 (17)	87 (22)	
Co-morbidities			.97[c]
No co-morbidities	48 (38)	152 (37)	
1 co-morbidity	45 (36)	151 (37)	
> 1 co-morbidities	33 (26)	106 (26)	
Estimated life expectancy			<.01[c]
< 1 month	34 (27)	51 (13)	
1–3 months	44 (35)	73 (18)	
3–6 months	27 (21)	135 (33)	
6–12 months	21 (17)	150 (37)	
WHO performance status			<.01[c]
0 - Asymptomatic	9 (7)	67 (16)	
1-Symptomatic but completely ambulatory	25 (20)	123 (30)	
2-Symptomatic, <50% in bed during the day	24 (19)	102 (25)	
3-Symptomatic, >50% in bed, but not bedbound	45 (36)	87 (21)	
4-Bedbound	22 (18)	29 (7)	
Hospital admission was:			
Planned	14 (12)	101 (26)	<0.01[c]
Unplanned	107 (88)	293 (74)	
Treatment status at time of admission:			<0.01[c]
Patient received anti-tumour therapy	33 (26)	226 (56)	
No further options for anti-tumour therapy	72 (57)	119 (30)	
Other	21 (17)	58 (14)	

[a]*t* Test.
[b]Mann–Whitney test.
[c]Chi-square test.

TABLE 2 Discharge destination and survival of patients without and with palliative care team consultation

	Patients with PCT consultation *N* = 126	Patients without PCT consultation *N* = 409	
	N (%)	*N* (%)	*p*-Value
Discharge destination			<.01[a]
Home	78 (62)	318 (80)	
Hospice	13 (10)	15 (4)	
Other	16 (13)	42 (11)	
Deceased during hospital admission	18 (14)	25 (6)	
Survival			
Deceased within 3 months after inclusion	91 (72)	160 (39)	<.01[a]

[a]Chi-square test.

3 | RESULTS

3.1 | Baseline characteristics

Between January 2013 and February 2015, 535 patients were included in the study. PCTs were consulted for 126 of these patients. Median time between hospital admission and PCT consultation was 4 days. At the time of their admission to the hospital, 62% of patients with PCT consultation had an estimated life expectancy of <3 months, compared to 31% of patients without PCT consultation ($p < .01$; Table 1). Hospitalisation was more often unplanned in patients with PCT consultation (88%) than in patients without PCT consultation (74%; $p < .01$). Baseline WHO performance status was also worse for patients with PCT consultation: 54% were only capable of limited self-care or completely disabled, compared to 28% of patients without PCT consultation ($p < .01$). Furthermore, at admission, patients with PCT consultation were less often receiving systemic antitumour treatment than patients without PCT consultation (26% vs. 56%, $p < .01$).

3.2 | Discharge destination and survival

Patients with PCT consultation were less often discharged to go home than patients without PCT consultation (62% vs. 80%, $p < .01$). There was a substantial difference in survival between the two groups (Table 2): 72% of patients with PCT consultation did not survive 3 months of follow-up, compared to 39% of patients without PCT consultation.

3.3 | Hospital care

In Table 3, hospital care for patients with and without PCT consultation is presented. Patients with PCT consultation had a median length of stay in the hospital of 11 days (Interquartile range (IQR) 8–18), compared to 9 days (IQR 5–17) for patients without PCT consultation. The most common diagnostic procedures in both groups were blood tests (used in 94% of patients in both groups), X-rays (used in 52% of patients with and 50% of patients without PCT consultation), CT-scans (used in 54% and 39%, respectively) and urine tests (used in 42% and 28% respectively). Invasive therapeutic procedures were used in 14% and 19%, respectively, and chemotherapy in 4% and 20% respectively. Other therapeutic interventions were rare in both groups.

3.4 | Costs of hospital care

The total mean costs of hospital care during 3 months of follow-up were €8,393 for patients with PCT consultation and €8,631 for patients without PCT consultation (Table 3). The majority of these costs consisted of costs of inpatients days in the hospital.

Whereas the proportion of patients who survived the 3 month follow-up period was lower among patients with PCT consultation, we also calculated the average costs per in-hospital day. The average daily costs for diagnostic procedures were €54 in both groups. The average daily costs for therapeutic procedures were €83 and €201 for patients with and without PCT consultation, respectively, for chemotherapy they were €6 and €131, and the average total daily hospital costs were €607 and €757.

Analyses using propensity scores to control for observed confounding showed that PCT consultation had no effect on costs of hospital stay, costs of diagnostic procedures, costs of therapeutic interventions or total hospital costs. Varying the caliper width did not impact the results in a meaningful way.

3.5 | Predictors of costs of hospital care

Gamma regression models showed that the predictors varied between different types of costs (Table 4). The total costs of hospital care were predicted by patients' prognosis: a prognosis of <1 month was associated with lower costs; and type of hospitalisation: unplanned admission was associated with lower costs. The total hospital care costs nor the costs per inpatient day were significantly associated with PCT consultation.

TABLE 3 Hospital care and costs during 3 months of follow-up in patients with and without PCT consultation

	Patients with PCT consultation *N* = 126	Patients without PCT consultation *N* = 409
Length of hospital stay (days; median, IQR)	11 (8–18)	9 (5–17)
Number of hospital admissions (median, IQR)	1 (1–1)	1 (1–2)
	***N* (%)**	***N* (%)**
Diagnostic procedures		
Ultrasound	27 (21)	90 (22)
MRI	19 (15)	43 (11)
CT-scan	68 (54)	161 (39)
Endoscopy	7 (6)	41 (10)
X-ray	66 (52)	204 (50)
ECG	17 (14)	44 (11)
Gastroscopy	3 (2)	21 (5)
Blood test	119 (94)	384 (94)
Urine test	53 (42)	113 (28)
Therapeutic interventions		
Chemotherapy	5 (4)	80 (20)
Invasive procedures	18 (14)	79 (19)
Admission to ICU	0 (0)	11 (3)
Tube feeding	5 (4)	16 (4)
Artificial respiration	0 (0)	1 (0)
	Costs (€)	**Costs (€)**
Costs of hospital stay		
Mean (*SD*)	6,505 (4,546)	6,261 (6,263)
Median (IQ)	5,136 (3,544–8,417)	4,494 (2,568–7,974)
Diagnostic costs		
Mean (*SD*)	648 (656)	559 (726)
Median (IQR)	455 (252–878)	374 (106–719)
Costs for therapeutic interventions[a]		
Mean (*SD*)	1,240 (2,351)	1812 (3,831)
Median (IQR)	487 (414–726)	235 (103–2,529)
Costs for chemotherapy		
Mean (*SD*)	119 (621)	856 (2,368)
Median (IQR)	0 (0–0)	0 (0–0)
Total hospital costs[b]		
Mean (*SD*)	8,393 (6,358)	8,631 (8,572)
Median (IQR)	6,296 (4,444–10,483)	5,647 (3,445–10,826)

[a]Costs for therapeutic interventions include medication costs, costs for other/medical procedure and costs of PCT consultation.

[b]Costs of therapeutic interventions include costs of PCT consultation, costs of therapeutic procedures and medication costs. The average medication costs per day were estimated based on a random sample of 43 patients in both groups to be €15 per day for regular medication and €143 per day for expensive medication. We did not find a difference in costs between patients with and without PCT consultation.

3.6 | Early PCT consultation

A total of 63 patients received PCT consultation within the first 3 days of their hospital admission. The total mean costs of hospital care during 3 months of follow-up of these patients were €6,543. Costs for inpatient days were €5,059, and costs for therapeutic interventions were €1,009. In the multivariable analyses, that included 51 patients with and 357 patients without PCT consultation and adjusted for baseline differences, we found a non-significant trend of lower costs for

TABLE 4 Determinants of costs of hospital care: generalised linear model

	Costs of hospital stay			Costs of diagnostic procedures			Costs of therapeutic interventions[a]			Costs of chemotherapy			Total hospital care costs		
	Exp (B)	95% CI	*p*-Value	Exp (B)	95% CI	*p*-Value	Exp (B)	95% CI	*p*-Value	Exp (B)	95% CI	*p*-Value	Exp (B)	95% CI	*p*-Value
PCT consultation			.34			.21			.89			.67			.48
Yes	1.09	0.92–1.29		1.18	0.91–1.52		0.98	0.72–1.33		0.85	0.41–1.78		1.06	0.90–1.26	
No	1.00			1.00			1.00			1.00			1.00		
Gender			.58			.26			<.01			<.01			.12
Female	1.04	0.90–1.21		0.88	0.70–1.10		1.65	1.25–2.18		1.51	1.20–1.90		1.12	0.97–1.31	
Male	1.00			1.00			1.00			1.00			1.00		
Estimated prognosis according to the physician			.18			.08			<0.01			.69			.02
<1 month	0.79	0.62–1.02		0.63	0.43–0.91		0.35	0.22–0.56		0.74	0.43–1.26		0.68	0.53–0.87	
3–1 months	1.03	0.84–1.26		0.91	0.67–1.23		0.49	0.33–0.72		0.83	0.49–1.40		0.92	0.75–1.12	
6–3 months	1.00	0.84–1.19		0.97	0.75–1.25		0.60	0.43–0.84		0.93	0.69–1.23		0.95	0.80–1.13	
6–12 months	1.00			1.00			1.00			1.00			1		
WHO Performance Status			.08			.37			.06			.34			.24
4-Bedbound	1.47	1.04–2.07		0.72	0.42–1.21		1.50	0.82–2.76		2.01	0.85–4.71		1.38	0.98–1.94	
3-Symptomatic. >50% in bed. but not bedbound	1.41	1.09–1.81		0.77	0.54–1.11		1.34	0.82–2.18		1.22	0.75–1.96		1.25	0.97–1.61	
2-Symptomatic. <50% in bed during the day	1.34	1.05–1.69		0.82	0.57–1.16		0.83	0.52–1.32		1.45	0.95–2.21		1.13	0.89–1.44	
1-Symptomatic but completely ambulatory	1.20	0.96–1.51		0.71	0.51–0.99		0.86	0.56–1.33		1.34	0.93–1.93		1.04	0.83–1.30	
0-Asymptomatic	1.00			1.00			1.00			1.00			1		
Hospital admission was			.54			.77			<.00			<.01			.02
Unplanned	1.06	0.88–1.27		1.04	0.80–1.36		0.32	0.23–0.46		0.64	0.47–0.88		0.81	0.67–0.97	
Planned	1.00			1.00			1.00			1.00			1.00		
Treatment status at time the time of admission:			.04			.02			.03			.93			.02
Other	1.18	0.96–1.44		1.52	1.12–2.06		1.03	0.71–1.51		1.10	0.40–2.99		1.18	0.97–1.45	
No further options for anti-tumour therapy	0.89	0.74–1.06		1.28	0.97–1.67		0.67	0.48–0.93		1.17	0.52–2.60		0.86	0.72–1.03	
Patient received anti-tumour therapy	1.00			1.00			1.00			1.00			1.00		

(Continues)

TABLE 4 (Continued)

	Costs of hospital stay			Costs of diagnostic procedures			Costs of therapeutic interventions[a]			Costs of chemotherapy			Total hospital care costs		
	Exp (B)	95% CI	*p*-Value	Exp (B)	95% CI	*p*-Value	Exp (B)	95% CI	*p*-Value	Exp (B)	95% CI	*p*-Value	Exp (B)	95% CI	*p*-Value
Diagnosis			.15			.54			.92			.11			.66
Other cancer	1.28	1.06–1.55		1.10	0.83–1.48		0.93	0.65–1.31		0.61	0.40–0.93		1.14	0.95–1.38	
Lung cancer	1.07	0.81–1.41		1.06	0.70–1.60		0.93	0.56–1.56		1.05	0.69–1.61		0.97	0.74–1.28	
Breast cancer	1.10	0.87–1.41		1.36	0.94–1.96		0.81	0.51–1.27		0.68	0.32–1.42		0.98	0.77–1.25	
Urogenital cancer	1.08	0.88–1.32		1.02	0.74–1.41		0.96	0.66–1.40		0.97	0.70–1.34		1.02	0.83–1.25	
Gastrointestinal cancer	1.00			1.00			1.00			1.00					
Co-morbidity			.69			.14			.83			.10			.66
>1 co-morbidity	1.04	0.87–1.25		1.07	0.82–1.40		0.96	0.68–1.34		1.37	0.99–1.88		1.05	0.88–1.26	
1 co-morbidity	1.07	0.91–1.26		1.27	1.00–1.61		0.91	0.68–1.23		0.97	0.76–1.24		1.07	0.92–1.26	
No co-morbidity	1.00			1.00			1.00			1.00			1.00		
Type of hospital			.22			.22			.99			.02			.57
Academic hospital	1.12	0.94–1.34		0.85	0.65–1.10		1.00	0.70–1.41		1.41	1.05–1.89		1.05	0.88–1.26	
General hospital	1.00			1.00			1.00			1.00			1.00		
Age	0.99	0.99–1.00	.09	1.00	0.99–1.01	.88	1.01	0.99-1.02	.35	0.99	0.98–1.00	.17	0.99	0.99–1.00	.13
Number of hospital admissions due to current disease	1.01	0.99 -1.03	.39	1.00	0.97–1.03	.91	1.02	0.98–1.06	.30	1.01	0.96–1.05	.75	1.01	0.99–1.03	.37
Time since primary diagnosis	1.00	0.99–1.01	.91	0.99	0.97–1.01	.30	1.02	1.00–1.05	.09	1.00	0.97–1.03	.91	1.00	0.99–1.01	.88

[a]Costs of therapeutic interventions include costs of PCT consultation, costs of therapeutic procedures and medication costs. The average medication costs per day were estimated based on a random sample of 43 patients in both groups to be €15 per day for regular medication and €143 per day for expensive medication. We did not find a difference in costs between patients with and without PCT consultation.

inpatient hospital days (β = 0.84, p = .17), diagnostics (β = 0.85, p = .35), therapeutic interventions (β = 0.80, p = .33) and total hospital costs (β = 0.84, p = .15) for patients who received early PCT consultation.

4 | DISCUSSION

This is the first observational study to assess the association between PCT consultation and hospital care in Dutch hospitals. At baseline, patients with PCT consultation had a significantly worse prognosis and performance status. They also more often had an unplanned hospitalisation, which probably explains why they more often received CT-scans and urine tests. Patients with PCT consultation also more often had no more options for anti-tumour therapy at admission, which explains why chemotherapy during follow-up was less common in this group. We found no significant differences in hospital length of stay, medication use, ICU admission, tube feeding or artificial respiration between patients who did and who did not receive PCT consultation. When controlling for baseline differences, we did not find a statistically significant association between PCT consultation and hospital costs. When restricted to patients who received PCT within 3 days of hospital admission, we also found a non-significant trend towards lower hospital costs for patients who received PCT consultation.

Other studies have reported that PCT involvement had a significant impact on (costs of) hospital treatment of cancer patients (May, Normand, et al., 2018; May, Normand, & Morrison, 2014). Most authors relate the impact of PCTs on medical treatment found in these studies to the core activities of PCTs. These include adequate controlling of symptoms, initiating patient and family-centred discussions on goals of care, discussing pros and cons of available treatment alternatives, and planning hospital discharge (Singer, Martin, & Kelner, 1999; Steinhauser et al., 2001). PCT involvement thus may account for a better match between patients' needs and the treatment provided, and thus involves a shift in the course of treatment, resulting in less (aggressive) hospital treatment (Morrison et al., 2008). Consequently, costs are saved. In a meta-review May et al. identified 10 studies until 2013, all performed in the United States that assessed costs and cost-effectiveness of specialist inpatient palliative care consultation in acute care hospitals. The review showed "a clear pattern of cost savings" from inpatient palliative care teams, with savings ranging from 9% to 25% (May et al., 2014). Further, a cost analysis of early palliative care in 151 patients with metastatic lung cancer showed a non-significant trend towards lower total costs of hospital care per day and significantly lower expenses for chemotherapy (Greer et al., 2016). Recently, a meta-analysis was performed to estimate the association of PCT consultation within 3 days of hospital admission with total direct hospital costs (May, Normand, et al., 2018). It was found that PCT consultation was associated with significant costs savings (on average €4,151 per hospital admission) for patients with cancer. Savings were higher for patients with more co-morbidities (May, Normand, et al., 2018) and were mainly due to a reduced length of stay, less ICU admissions, and less medication and laboratory costs (May et al., 2015; May, Garrido, et al., 2018; Morrison et al., 2008; Penrod et al., 2010).

There may be several reasons why we did not find a significant effect of PCT consultation on costs of hospital care. First, there is an open culture towards death and end-of-life care and relatively strong and long-standing emphasis on home-based care in the Netherlands as compared with other countries (Kroneman et al., 2016; Leget, 2017). Bekelman et al. found hospital costs in the last 180 days of life of patients with cancer to be much higher in the United States than in the Netherlands, where fewer patients are admitted to an ICU and fewer patients receive chemotherapy in the last phase of life (Bekelman et al., 2016). Second, it has been suggested that cost analyses should incorporate the timing of the intervention (May & Normand, 2016). An earlier intervention may involve larger cost savings (May & Normand, 2016). This finding seems to be confirmed by our study, as total costs were lower for patients with (early) PCT consultation, although our findings were not statistically significant. Third, we included patients' prognosis as a potential confounder, because many studies have shown that PCT consultation often concerns patients with a limited life expectancy which may in itself affect the use of hospital care. This is, however, not commonly done in other studies (May, Normand, et al., 2018).

Our study has several limitations. First, we only studied hospital care. A health care or societal perspective would have given a more comprehensive insight in the potential impact of PCT consultation (May et al., 2014). Second, although we corrected for known possible confounders, there may have been additional unmeasured confounding factors, such as the presence of other activities to improve hospital palliative care, or the experience and knowledge about palliative care of general caregivers. Furthermore, no sample size calculation was made a priori, which may account for non-significant results as the sample, especially in the analysis of early versus later consultation, is small for this kind of study.

5 | CONCLUSION

When taking confounding by indication into account, involvement of a PCT was not significantly associated with a reduction in costs of hospital care. We found that PCT consultation in Dutch hospitals often occurs late in patients' disease trajectories. This might explain why we found no effect of PCT consultation on costs of hospital care. When PCT consultations occurred early during admission, costs of hospital care are lower for patients with than patients without PCT consultation. Earlier consultation could be beneficial to patients and reduce costs of care.

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CONFLICT OF INTEREST

All authors declare that they have no conflict of interest. The study was conducted independent from the funders. All authors have full access to all the data (including statistical reports and tables) in the study and take responsibility for the integrity of the data and the accuracy of the analysis. AvdH, AB, DN, YV, SP and BO designed the study and analysed the data. BvdB, NG, MH, YvdL, AvdP, LP, BR, FT, SV, MvdV and IW were involved in collecting the data. AB drafted the paper. All authors made a substantial contribution to the interpretation of the data and revised the paper critically for important intellectual content.

ORCID

Arianne Brinkman-Stoppelenburg https://orcid.org/0000-0001-6377-1599
Mathijs P. Hendriks https://orcid.org/0000-0001-6687-5393
Agnes van der Heide https://orcid.org/0000-0001-5584-4305

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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