

Effect of Early Palliative Care on End-of-Life Health Care Costs: A Population-Based, Propensity Score–Matched Cohort Study

Hsien Seow, PhD¹; Lisa C. Barbera, MD²; Kimberlyn McGrail, PhD³; Fred Burge, MD⁴; Dawn M. Guthrie, PhD⁵; Beverley Lawson, MSc³; Kelvin K. W. Chan, MD⁶; Stuart J. Peacock, PhD⁷; and Rinku Sutradhar, PhD⁸

QUESTION ASKED: Among cancer decedents, were the end-of-life health care costs different for those who received early palliative care versus those who did not?

SUMMARY ANSWER: Receiving early palliative care reduced average health system costs in the last month of life, especially via avoided hospitalizations.

WHAT WE DID: We conducted a retrospective population-based cohort study of cancer decedents between 2004 and 2014 in Ontario, Canada. We identified those who received early palliative care (ie, palliative care services between 12 and 6 months before death) and used propensity score matching to define a control group of not-early palliative care. After matching, we included 79,648 cancer decedents (39,824 pairs) and examined differences in average per-person health system costs (including hospital, emergency department, physician, and home care costs) between groups in the last month of life.

WHAT WE FOUND: In the early–palliative care group, 56.3% used inpatient care in the last month compared

with 66.7% of control group ($P < .001$), which resulted in a statistically different average inpatient hospital costs: \$7,105 (\pm \$10,710) in the early group versus \$9,370 (\pm \$13,685) in the control group ($P < .001$). The average overall health system costs (\pm standard deviation) per patient in the early–palliative care group versus control group was \$12,753 (\pm \$10,868) versus \$14,147 (\pm \$14,288; $P < .001$) in the last month of life.

BIAS, CONFOUNDING FACTOR(S), REAL-LIFE IMPLICATIONS:

We used propensity score matching to compare those with a similar probability of receiving early palliative care, but this may not represent the entire population of cancer decedents. There are other confounders that we could not directly measure, such as patient or provider preferences, and informal caregiver support and private care. Many other studies have shown the patient benefits of palliative care; our study shows, in large, real-world populations, that integrating palliative care earlier into the disease care plan has high potential to save the health system money.

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ASSOCIATED CONTENT

Appendix

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abstract

PURPOSE This study aimed to investigate the impact of early versus not-early palliative care among cancer decedents on end-of-life health care costs.

METHODS Using linked administrative databases, we created a retrospective cohort of cancer decedents between 2004 and 2014 in Ontario, Canada. We identified those who received early palliative care (palliative care service used in the hospital or community 12 to 6 months before death [exposure]). We used propensity score matching to identify a control group of not-early palliative care, hard matched on age, sex, cancer type, and stage at diagnosis. We examined differences in average health system costs (including hospital, emergency department, physician, and home care costs) between groups in the last month of life.

RESULTS We identified 144,306 cancer decedents, of which 37% received early palliative care. After matching, we created 36,238 pairs of decedents who received early and not-early (control) palliative care; there were balanced distributions of age, sex, cancer type (24% lung cancer), and stage (25% stage III and IV). Overall, 56.3% of early group versus 66.7% of control group used inpatient care in the last month ($P < .001$). Considering inpatient hospital costs in the last month of life, the early group used an average (\pm standard deviation) of \$7,105 (\pm \$10,710) versus the control group of \$9,370 (\pm \$13,685; $P < .001$). Overall average costs (\pm standard deviation) in the last month of life for patients in the early versus control group was \$12,753 (\pm \$10,868) versus \$14,147 (\pm \$14,288; $P < .001$).

CONCLUSION Receiving early palliative care reduced average health system costs in the last month of life, especially via avoided hospitalizations.

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INTRODUCTION

Palliative care is an approach to care that focuses on improving quality of life and controlling physical and psychological symptoms for patients with life-threatening illnesses and their families.¹ Unfortunately, data show palliative care is often applied very late in the disease trajectory or not at all. In the United States, palliative care is used in 45% of all deaths for a median of 17 days before death.² Research from several cancer randomized trials has shown that the provision of early palliative care improves patient outcomes, such as reduced anxiety and depression.³⁻⁵ The integration of palliative care with standard oncologic care earlier in the cancer trajectory has even been endorsed by ASCO.⁶ A systematic review of 28 *early* palliative care trials showed, besides patient benefits, that it reduced both

aggressive care, such as hospitalizations and emergency department (ED) visits in the last weeks of life, and hospital deaths.⁷ However, the review found mixed evidence that costs were different from usual care. Thus, although there was strong evidence of reduced hospital deaths and utilization at end of life, it was unclear whether early palliative care led to cost savings at a health system level.

There are a few studies that concluded that early palliative care led to cost savings in the last month of life, mostly through lower hospital costs.⁸⁻¹¹ A large systematic review specifically examined the cost-effectiveness of home-based palliative care programs but found that compared with usual care, cost-effectiveness was inconclusive.¹² Similar to the aforementioned review,⁷ and other systematic reviews,¹³ the

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methodologic challenges comparing multiple trials were small sample sizes, selection bias during recruitment, and most importantly varied definitions of the timing of early, differing elements of the palliative care intervention, and different or unclear contexts of usual care.

The health administrative data in Ontario, Canada, present a unique opportunity to address these limitations. Specifically because Ontario has a universal health system, including cancer care, we are able to standardize definitions for early palliative care, usual care, and the palliative care intervention in a large retrospective cohort including all cancers. Previously, we conducted a large propensity score–matched cohort study to examine the effect of early palliative care on late-life health services utilization.¹⁴ We used propensity score matching to address the selection bias that can occur when using observational data. Thus, although prior evidence from randomized trials provides high internal validity within controlled settings, our study design provides high external validity in real-world settings. In this study, we sought to investigate the overall mean health system costs per individual among a group who received early palliative care (at least 6 months before death) versus a matched group who did not receive early palliative care (ie, not-early group, a.k.a. control group).

METHODS

Study Design and Data Sources

Using linked administrative health databases, we performed population-based, retrospective cohort study of all cancer decedents in Ontario, Canada, from 2004 to 2014. We used propensity score matching to match decedents having received palliative care early (ie, between 12 months and 6 months before death)—referred to as the early group—to those not having received palliative care early (which includes both those who had palliative care initiated late and not initiated at all)—referred to as the control group.

To be included in the study, decedents needed to have a cancer diagnosis in the Ontario Cancer Registry before the death and a death caused by cancer as per the provincial Vital Statistics Registry (where 2014 was the most recent data available during data analysis). Other databases linked were the Discharge Abstract Database (hospitalizations), National Ambulatory Care Reporting System (ED use), Continuing Care Reporting System (complex continuing care use), Home Care Database, physician billings, Statistics Canada (sociodemographic data such as income and rurality), and the Resident Assessment Instrument–Home Care (RAI-HC) assessment database. Home care assessments used in Ontario, Canada, are validated and standardized and developed by interRAI (akin to the Minimum Data Set assessment tools used in US nursing homes and other settings).¹⁵⁻¹⁸ These data sets were linked using unique encoded identifiers and analyzed at ICES (formerly known as the Institute for Clinical Evaluative Sciences).

Exposure

Access to early palliative care was defined as having received home care with an end-of-life intent, an outpatient or home-visit physician billing for palliative care, or a hospitalization with a palliative care service code between 12 months and 6 months before death (the exposure period). These methods to determine palliative care service use within administrative data were validated previously.¹⁹ Generally, these services are independent of one another and uncoordinated.²⁰ This contrasts the community-based, multidisciplinary team approach in the United States via home hospice care or in the United Kingdom via Macmillan Cancer Support program. Although a minority of patients might have access to a home-visiting, multidisciplinary, specialist palliative care team or a residential hospice, especially if they lived in a major city, this is haphazard and typically accessed in the last weeks of life.²¹

Outcome

The main outcome was the overall average health care costs per individual in their last month of life (CDN\$). Health care costs were derived using validated costing macros²² and included the following sector costs: inpatient hospital, ED visit, physician billing, home care, and complex continuing care (ie, inpatient subacute or palliative care unit). We examined the outcome within the entire early–palliative care group compared with the matched control group, as per previous research.²³ As a secondary outcome, we examined the average sector-specific costs per individual in the last month of life, comparing the early group with the control group.

Propensity Score Matching Analytic Plan

To reduce selection bias for decedents who were exposed to early palliative care in our cohort, we used propensity score matching to create a similar comparison group of unexposed decedents (not-early). The propensity score is an individual's probability of receiving early palliative care, given the values of the individual's baseline covariates measured either during or before the exposure period. Matching on the propensity score aids in balancing the distributions of measured characteristics between intervention and control groups, which helps to minimize confounding bias when estimating the effect of the intervention on an outcome.^{24,25}

We estimated the propensity score using a logistic regression model with exposure to early palliative care as the dependent variable. The covariates in the propensity score regression included income quintile, rurality, health region, prior hospital utilization in months 24 to 12 before death, Deyo-modified Charlson comorbidity score (in the months 24 to 12 before death),²⁶ year of death, and having had radiation or cancer surgery before death (from diagnosis to 6 months before death). In the end, all pairs were hard matched on age at death, sex (male or female), cancer type, and cancer stage at diagnosis (where available) and also matched on the logit of the propensity score (calipers of

width equal to 0.2 of the standard deviation of the logit of the propensity score).^{27,28}

Subgroup Analysis

A priori we examined separately the group who received a home care assessment in the exposure period; thus, among all those who used home care in the exposure period, individuals who also received early palliative care services were propensity score–matched with an individual who did not. The rationale was because of the concern of selection bias on unmeasured covariates within retrospective observational cohort studies. Specifically, palliative care may have been offered to those who were seemingly sicker, were more symptomatic, or had a worse physical decline and function—all reasons why someone might start home care services earlier, and thus, these act as unmeasured confounders in the matching process. To address this concern, the RAI-HC home care assessment has several unique variables that are associated with patient need for palliative care (eg, high pain, depression, and poor functional status)—and in this subgroup, we could further match on these. In other words, we identified individuals with similar levels of pain, depression, and functional status while using home care during the exposure period, although the exposed also received palliative care services, whereas the controls did not.

Therefore, we have two mutually exclusive groups of matched pairs, each pair has an exposed and unexposed decedent. The first group is the main analysis (which had no home care assessments); the other group is the subanalysis (which had home care assessments in the exposure period). So in addition to the variables in the main analysis, in the subanalysis, pairs were hard matched on their score on a prognostic physical function scale, ie, the validated CHESS scale, which measures changes in activities of daily living (ADL) status, cognition, shortness of breath, and life expectancy of < 6 months.^{29,30} Moreover, other covariates available in the home care assessment that were included in the propensity score regression for the subanalysis were as follows: (1) functional performance, using the validated ADL self-performance hierarchy scale, which examines the help required to eat, toilet, complete personal hygiene, etc to determine dependency³¹; (2) depressive symptoms, using a validated scale to measure signs and symptoms of depression³²⁻³⁴; (3) cognitive performance, using a validated scale to measure cognitive impairment (no impairment to severe impairment)³⁵; (4) pain, using a validated scale of intensity of pain (ranging from no pain to severe daily pain)³⁶; (5) having a caregiver present at home (yes or no); and (6) the number of RAI-HC assessments in the exposure period.

Analysis Plan

We calculated the average overall health care costs within the early–palliative care group and the control group. This was done separately for the main analysis and the

subanalysis. Differences in mean costs (standardized to 2016) between exposed and control groups were compared using standardized differences and *P* values obtained from two-sample *t* tests. Furthermore, as a sensitivity analysis, we divided the control group (ie, not-early palliative care) into late palliative care (ie, only received palliative care in the last six months of life) and never received palliative care. We then compared our outcomes among our groups of matched pairs by early (exposed) versus late and early versus never separately. The purpose of the sensitivity analysis was to address unmeasured patient preferences. Comparing the late users paired to their early user matches specifically was an attempt to separate out those patients who might have refused palliative care as per their preference. Analysis was performed using SAS, version 9.4 (SAS Institute, Cary, NC). The study was approved by the Hamilton Integrated Research Ethics Board (#3039).

RESULTS

Demographics of the Groups Before and After Matching

In the overall cohort, there were 144,306 cancer decedents in Ontario between 2004 and 2014, of which 37.4% received early palliative care in the exposure period (12 months to 6 months before death).

In the main analysis (comprising 89% of overall cohort, *n* = 128,548), we matched 83% of patients who received early palliative care for a total of 36,238 matched pairs. Before matching, those who received palliative care early, compared with those who did not, were more likely to have lung cancer (24.2% *v* 19.3%), stage IV cancer (20.1% *v* 8.1%), moderate to severe health instability (1.2% *v* 0.1%), symptoms of depression (3.3% *v* 0.9%), and moderate to severe pain (2.7% *v* 0.7%). After matching, the groups had nearly identical distributions with respect to the measured covariates: age at death was 69 years, 23.5% had lung cancer, 14.2% had stage IV disease, 34% had a comorbidity, and 44% had ever had cancer surgery (Table 1).

In the subanalysis, where individuals also had a home care assessment in the exposure period (comprising mutually exclusive 11% of overall cohort, *n* = 16,055), we matched 60% of patients who received home care in the exposure period for a total of 3,586 matched pairs. After matching, the groups had nearly identical distributions with respect to the measured covariates: age at death was 76 years, 15.3% had lung cancer, 9.2% had stage IV disease, 40% had a comorbidity, and 48% had ever had cancer surgery. In addition, using the RAI-HC variables, 11.8% had a CHESS score of 3 or higher, 7% were fully dependent on their ADLs, 10%-13% had signs or symptoms of minor-major depression, 10% had moderate-severe cognitive impairment, 11% had moderate-severe pain, and 63% had a caregiver living at home.

Use of Health Care Services in Last Month of Life

In the main analysis, the early group compared with the control group had a lower proportion who used inpatient

TABLE 1. Demographics of Early Versus Not-Early Palliative Care

Characteristic	After Propensity Score Matching					
	No-RAI			Yes-RAI		
	Not-Early Palliative Care (n = 36,238), No. (%)	Early Palliative Care (n = 36,238), No. (%)	SD	Not-Early Palliative Care (n = 3,586), No. (%)	Early Palliative Care (n = 3,568), No. (%)	SD
Variables that were hard matched						
Mean age ± SD	69.43 ± 12.84	69.36 ± 12.87	0.01	76.63 ± 11.25	76.46 ± 11.19	0.01
Female	17,702 (48.8)	17,702 (48.8)	0.00	1,826 (50.9)	1,826 (50.9)	0.00
Cancer type at diagnosis						
Breast	4,126 (11.4)	4,126 (11.4)	0.00	433 (12.1)	433 (12.1)	0.00
Colorectal	5,266 (14.5)	5,266 (14.5)	0.00	722 (20.1)	722 (20.1)	0.00
Lung	8,530 (23.5)	8,530 (23.5)	0.00	548 (15.3)	548 (15.3)	0.00
Prostate	3,053 (8.4)	3,053 (8.4)	0.00	486 (13.6)	486 (13.6)	0.00
Stage at diagnosis						
III	3,726 (10.3)	3,726 (10.3)	0.00	275 (7.7)	275 (7.7)	0.00
IV	5,151 (14.2)	5,151 (14.2)	0.00	329 (9.2)	329 (9.2)	0.00
Unavailable	24,631 (68.0)	24,631 (68.0)	0.00	2,749 (76.7)	2,749 (76.7)	0.00
CHESS score (when RAI-HC completed)						
Low health instability	—	—	—	2,242 (62.5)	2,242 (62.5)	0.00
Moderate health instability	—	—	—	380 (10.6)	380 (10.6)	0.00
Severe health instability	—	—	—	43 (1.2)	43 (1.2)	0.00
Variables within the propensity score						
Lowest income quintile	7,058 (19.5)	7,146 (19.7)	0.01	776 (21.6)	790 (22.0)	0.01
Lives in rural community	5,206 (14.4)	5,236 (14.4)	0.00	579 (16.1)	568 (15.8)	0.01
Charlson comorbidity score (≥ 1)	12,026 (33.2)	12,540 (34.6)	0.03	1,483 (41.4)	1,426 (39.8)	0.08
Had radiation since diagnosis	22,337 (61.6)	21,982 (60.7)	0.02	1,894 (52.8)	1,950 (54.4)	0.03
Had cancer surgery since diagnosis	16,339 (45.1)	15,701 (43.3)	0.04	1,780 (49.6)	1,716 (47.9)	0.04
Disease duration, years						
0-5	28,084 (77.5)	29,115 (80.3)	0.07	2,347 (65.4)	2,515 (70.1)	0.10
6-11	4,918 (13.6)	4,581 (12.6)	0.03	656 (18.3)	636 (17.7)	0.01
> 12	3,236 (9.0)	2,542 (7.0)	0.05	583 (16.2)	435 (12.1)	0.08
InterRAI scales (when RAI-HC completed)						
Dependent on activities of daily living	—	—	—	241 (6.7)	247 (6.9)	0.01
Minor-major depression	—	—	—	496 (13.8)	429 (10.0)	0.06

(continued on following page)

TABLE 1. Demographics of Early Versus Not-Early Palliative Care (continued)

Characteristic	After Propensity Score Matching					
	No-RAI			Yes-RAI		
	Not-Early Palliative Care (n = 36,238), No. (%)	Early Palliative Care (n = 36,238), No. (%)	SD	Not-Early Palliative Care (n = 3,586), No. (%)	Early Palliative Care (n = 3,568), No. (%)	SD
Moderate-severe cognitive impairment	—	—	—	373 (10.4)	363 (10.1)	0.01
Moderate-severe pain	—	—	—	391 (10.9)	398 (11.1)	0.01
Caregiver present at home	—	—	—	2,279 (63.6)	2,264 (63.1)	0.01

Abbreviations: RAI-HC, Resident Assessment Instrument-Home Care; SD, standard deviation.

hospitalizations (56.3% v 66.7%; $P < .001$) and ED visits (42.2% v 51.9%; $P < .001$) and a higher proportion who used home care (75.5% v 63.3%; $P < .001$) in the last month of life (Fig 1). There were no major differences in the use of physician services (98.0%) or use of complex continuing care (15.5%-18.2%) in both groups.

In the subanalysis, similar results emerged. In the last month of life, the early group compared with the control group had a lower proportion who used inpatient hospitalizations (53.3% v 66.6%; $P < .001$) and ED visits (40.0% v 50.1%; $P < .001$) and a higher proportion who used home care (72.8% v 61.2%; $P < .001$). There were no major differences in the use of physician services (98.0%) or use of complex continuing care (19.5%) in both groups.

Mean Total and Sector-Specific Health Care Costs in the Last Month of Life

In the main analysis, the overall combined total health care costs was \$462,131,424 for the entire early group and \$512,643,233 for the entire control group in the last month of life. This equates to an average individual cost of \$12,753 (\pm \$10,868) in the early group versus \$14,147 (\pm \$14,288) in the control group ($P < .001$; Table 2). Examining sector-specific costs, the biggest differences were in home care and inpatient costs. The early group had higher average home care costs per person (\$2,203 \pm \$2,928) in the last month of life compared with the control (\$1,426 \pm \$2,277; $P < .001$). However, the early group had lower average inpatient costs per person (\$7,105 \pm \$10,710) compared with the control group (\$9,307 \pm \$13,685; $P < .001$). Trends were the same when the median was examined. With respect to the other sectors, the early group also had slightly higher complex continuing care costs but slightly lower ED costs and physician billing costs compared with the control group.

In the subanalysis, nearly identical trends were found. Average individual total health care cost in the last month of life was \$12,143 \pm \$10,140 for the early group and \$14,257 \pm \$14,288 for the control group ($P < .001$). Sector-specific trends were similar where the early group had higher average home care costs and lower average

inpatient hospital costs than the control group. Finally, in the sensitivity analyses looking at early versus late paired groups, it showed the same statistically significant trends as the main and subanalysis (Appendix Table A1, online only). However, in the early versus never paired groups, the never users had lower overall costs, although this was not statistically significant. Note, total standardized costs per person increased by approximately \$1,000 from 2004 to 2014, which was consistent in either exposure group.

DISCUSSION

In our large population-based cohort study of cancer decedents, those who received early palliative care had lower overall health care costs than those who did not, in the last month of life. The main differences in costs were the early-palliative care group used more home care services and less inpatient acute care services. This suggests that cost savings is driven by increased home care services use, which serves to prevent late-life hospitalizations.

Although our main findings were consistent with other studies examining palliative care and costs, our study's methods uniquely contribute to the evidence base. We addressed limitations noted in previous meta-analyses by using consistent exposure, intervention, and outcome definitions over an 11-year period of time. Our palliative care definition included a broad array of palliative care services from multiple settings, not just within inpatient hospital admissions.³⁷⁻³⁹ As well, although there are other observational cohort studies comparing early versus late palliative care, we used propensity score matching to reduce selection bias.¹¹ Moreover, our home care subanalysis allowed us to control uniquely for additional prognostic covariates (eg, high pain or poor health instability) that are known to be associated with referrals to palliative care but are typically unmeasured confounders in other studies.⁴⁰ A major strength of our study is the use of a population-based cohort of all cancers, which creates a sample size considerably greater than previous randomized trials examining this topic⁸ and contributes to the external validity and real-world evidence that outside controlled settings, palliative care can reduce

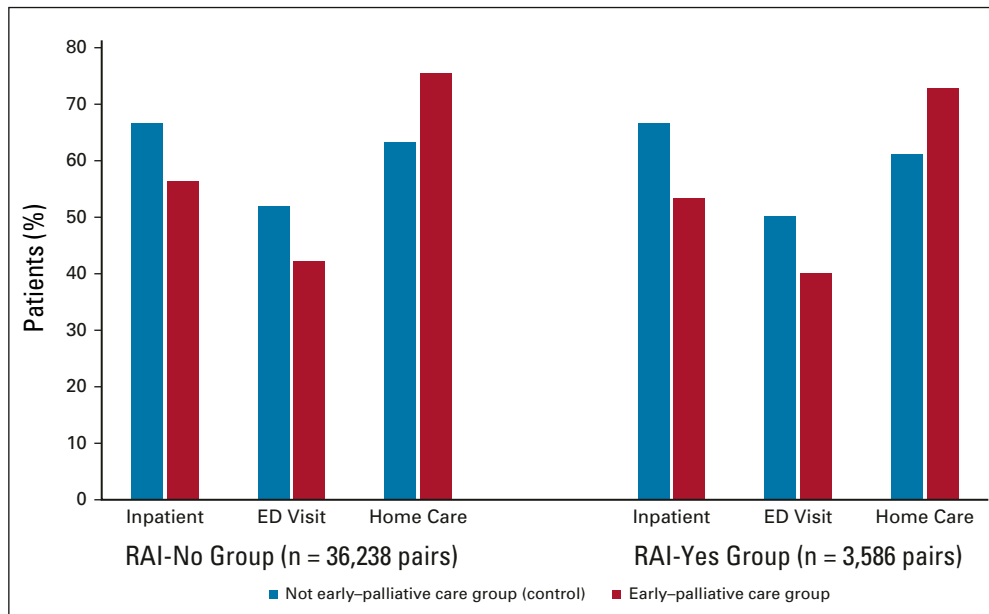


FIG 1. Percent of patients who used a health care sector in last month of life. ED, emergency department; RAI, Resident Assessment Instrument.

health system costs. In other words, the large population-based sample strengthens the credibility that the results were not because of any particular cancer center,¹¹ any specific palliative care program,²³ or cancer type.⁸

Our data seem to support the common hypothesis of a causal pathway: those who are receiving earlier palliative care seem to access palliative home care services earlier and more often which, while increasing home care costs, seems to help some patients avoid end-of-life hospitalizations and ED visits altogether. Physician costs were similar between both groups.

Ultimately, given there are statistically significant average savings at an individual level between those exposed early or not-early, the savings at a health system level across a population would seem to be sizeable. Across our early group of 36,236 individuals, there was a \$50 million dollar savings than the control group. Our study, combined with the growing evidence base, underscores the need to invest in hospital and home-community palliative care programs as a strategy to not only save the health system money but also address hospital bed overcrowding.

TABLE 2. Mean Costs in Last Month of Life by Sector

Main Analysis	Not-Early Palliative Care (n = 36,238)	Early Palliative Care (n = 36,238)	Standardized Difference	P
Inpatient hospital costs	9,370.20 ± 13,684.87	7,105.33 ± 10,709.54	0.18	< .001
Complex continuing care costs	1,322.60 ± 3,880.92	1,741.86 ± 4,488.33	0.10	< .001
Home care costs	1,425.90 ± 2,276.59	2,202.63 ± 2,928.14	0.30	< .001
ED costs	406.56 ± 495.96	310.42 ± 449.13	0.20	< .001
Physician billing costs	1,621.31 ± 1,638.43	1,392.44 ± 1,249.04	0.16	< .001
Total cost	14,146.57 ± 14,287.99	12,752.67 ± 10,867.69	0.11	< .001

Subanalysis	Not-Early Palliative Care (n = 3,586)	Early Palliative Care (n = 3,586)	Standardized Difference	P
Inpatient hospital costs	9,396.55 ± 11,874.56	6,453.18 ± 9,804.94	0.27	< .001
Complex continuing care costs	1,926.72 ± 4,772.13	1,963.51 ± 4,794.01	0.01	.745
Home care costs	1,095.38 ± 1,814.51	2,250.43 ± 3,238.40	0.44	< .001
ED costs	390.20 ± 478.99	291.28 ± 436.15	0.22	< .001
Physician billing costs	1,448.41 ± 1,467.51	1,184.26 ± 1,046.05	0.21	< .001
Total cost	14,257.26 ± 12,426.30	12,142.67 ± 10,139.89	0.19	< .001

NOTE. Bold indicates the higher cost of the two groups.

Abbreviation: ED, emergency department.

This study has several limitations. Although we used propensity score matching to compare between those with a similar probability of receiving early palliative care, this may not represent the entire population of cancer decedents. We also matched on individual characteristics but did not examine physician propensity to provide palliative care. In addition, administrative data are limited in that providers may have been providing palliative approaches to care that are not captured in billing codes. There are other confounders that we could not directly measure, such as patient or provider preferences, and caregiver availability or private care, which may support

patients to remain at home. Last, our cost analysis does not capture out-of-pocket costs or informal caregiving contributions of the patient or family. Future research could examine impacts of early palliative care on patient and caregiver well-being and quality of life, optimal timing for palliative care benefits, and physician propensity for providing palliative care.

In conclusion, in our large population-based cancer cohort study, we found strong evidence that receiving early palliative care reduced the average health system costs in the last month of life, in particular via avoided hospitalizations.

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DISCLAIMER

The opinions, results, and conclusions reported in this article are those of the authors and are independent from the funding and data-providing sources.

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DATA SHARING STATEMENT

Data may be obtained from a third party and are not publicly available. A data request can be sent to ICES (formerly the Institute for Clinical Evaluative Sciences): <https://www.ices.on.ca/About-ICES/ICES-Contacts-and-Locations/contact-form>.

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Open Payments is a public database containing information reported by companies about payments made to US-licensed physicians ([Open Payments](#)).

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APPENDIX

TABLE A1. Sensitivity Analysis

Main Analysis	Late Palliative Care (n = 28,285), Mean ± SD	Early Palliative Care (n = 28,285), Mean ± SD	Standardized Difference	P
Inpatient hospital costs	8,773.84 ± 11,646.46	7,136.99 ± 10,738.68	0.15	< .001
Complex continuing care costs	1,430.87 ± 3,984.78	1,704.21 ± 4,450.63	0.06	< .001
Home care costs	1,702.44 ± 2,443.40	2,218.21 ± 2,931.62	0.19	< .001
ED costs	391.13 ± 491.00	312.92 ± 449.16	0.17	< .001
Physician billing costs	1,585.60 ± 1,372.11	1,412.37 ± 1,258.10	0.13	< .001
Total cost	13,883.88 ± 11,893.62	12,784.70 ± 10,898.52	0.1	< .001

Main Analysis	Never Palliative Care (n = 7,953)	Early Palliative Care (n = 7,953)	Standardized Difference	P
Inpatient hospital costs	11,491.17 ± 19,110.07	6,992.75 ± 10,605.13	0.29	< .001
Complex continuing care costs	937.54 ± 3,459.46	1,875.75 ± 4,617.71	0.23	< .001
Home care costs	442.37 ± 1,069.45	2,147.24 ± 2,915.26	0.78	< .001
ED costs	461.45 ± 509.44	301.50 ± 448.93	0.33	< .001
Physician billing costs	1,748.30 ± 2,348.59	1,321.53 ± 1,213.69	0.23	< .001
Total cost	15,080.82 ± 20,640.41	12,638.76 ± 10,757.23	0.15	< .001

Subanalysis	Late Palliative Care (n = 2,323)	Early Palliative Care (n = 2,323)	Standardized Difference	P
Inpatient hospital costs	10,127.11 ± 11,849.26	6,449.62 ± 9,813.44	0.34	< .001
Complex continuing care costs	2,262.22 ± 5,038.23	1,921.84 ± 4,735.53	0.07	.018
Home care costs	1,346.36 ± 2,071.72	2,308.10 ± 3,271.11	0.35	< .001
ED costs	371.89 ± 473.93	297.61 ± 438.32	0.16	< .001
Physician billing costs	1,547.95 ± 1,365.24	1,199.44 ± 1,060.16	0.29	< .001
Total cost	15,655.52 ± 11,806.85	12,176.60 ± 10,141.94	0.32	< .001

Subanalysis	Never Palliative Care (n = 1,263)	Early Palliative Care (n = 1,263)	Standardized Difference	P
Inpatient hospital costs	8,052.84 ± 11,808.13	6,459.75 ± 9,793.16	0.15	< .001
Complex continuing care costs	1,309.62 ± 4,171.30	2,040.17 ± 4,900.72	0.16	< .001
Home care costs	633.77 ± 1,061.47	2,144.37 ± 3,175.91	0.64	< .001
ED costs	423.89 ± 486.55	279.62 ± 432.07	0.31	< .001
Physician billing costs	1,265.35 ± 1,623.74	1,156.33 ± 1,019.41	0.08	.043
Total cost	11,685.47 ± 13,112.47	12,080.25 ± 10,139.83	0.03	.397

NOTE. Bold indicates the higher cost of the two groups.

Abbreviations: ED, emergency department; SD, standard deviation.