Title: Community-based specialist palliative care teams reduce health system costs at end of life: A pooled-analysis of 11 teams

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Details of Funding and role of the study sponsors:
This study was funded by a grant from the Canadian Institutes of Health Research (Ref# 115112) and utilized databases maintained by the Institute for Clinical Evaluative Sciences (ICES), which receives funding by the Ontario Ministry of Health and Long-Term Care (MOHLTC) (Contract No. 2011-0006). The opinions, results and conclusions reported in this paper are those of the authors and are independent from the funding sources.

Details of contributors:
HS was responsible for study design and data acquisition. All authors were involved in the data analysis, interpretation of data and writing of the manuscript, and take responsibility for the integrity of the data and the accuracy of the data analysis.

Competing Interest Declaration:
Authors report having no potential conflicts of interest; all authors' spouses, partners, or children have no financial relationships that may be relevant to the submitted work; and all authors have no non-financial interests that may be relevant to the submitted work.

Transparency Declaration:
The senior author, Hsien Seow, affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; no important aspects of the study have been omitted; and any discrepancies from the study as planned have been explained.

Details of ethical approval:
The study was approved by McMaster University's research ethics board (11-403).

Data Sharing Statement:
No additional data available.

Word count: Abstract: 250 Text: 2835

ABSTRACT

BACKGROUND: Access to community-based specialist palliative care teams has been shown to improve patients' quality of life; however, the impact on health system expenditures is unclear. This study aims to determine whether exposure to these teams reduces health system costs compared to usual care.

METHODS: A pooled analysis of a retrospective cohort study in Ontario, Canada using linked administrative data. Decedents treated by one of 11 community-based specialist palliative care teams in 2009-2011 were propensity-score matched (comorbidity, extent of homecare, etc.) to similar decedents in usual care. The teams are comprised of a core group of specialized physicians, nurses, and other providers, with a role of managing symptoms around-the-clock, providing education, and coordinating care. Our primary outcome is the pooled difference in health system costs (among five health care sectors) between matched-pairs of exposed versus unexposed patients in the last 30 days of life.

RESULTS: The pooled cohort of decedents included 3,109 matched-pairs. Among matched-pairs, the mean health system cost difference was $512 (95% CIs [-$641, -$383]) lower in the last 30 days among exposed compared to usual care patients. Within the health sectors in the last 30 days, the mean homecare cost difference was $189 higher (95% CIs [-$161, -$217]) and the mean hospital cost difference was $733 lower (95% CIs [-$924, -$541]) among matched-pairs.

INTERPRETATION: Our study suggests that access to community-based specialist teams reduces health system costs compared to usual care alone. Savings were driven by decreased hospital costs, associated with the teams providing in-home support.

Introduction

Research has consistently demonstrated that access to specialist palliative care teams in the community improves the quality of life for end-of-life patients[1-3] and helps actualize their preference for a home death[4-6]. Although there is wide variation in the configuration of these teams that have been evaluated, they often consist of a core team of interdisciplinary providers with palliative care expertise including physicians, nurses, and personal support workers who deliver support to patients in their homes.[7] In addition, there is growing evidence that these specialist palliative care teams help reduce the use of health system resources.[8] Specialist teams provide enhanced symptom management, monitor the patient's condition and offer education to family caregivers, that may proactively avoid crises that would otherwise result in hospitalizations, that can be costly.[6 9, 10] However, the actual impact of these interventions in reducing health system costs is less clear. Systematic reviews of outcomes of community-based palliative care, including services in the home, have reported mixed evidence of lower costs and difficulty in drawing definitive conclusions due to heterogeneity in the components between interventions and different health systems.[4, 11-13]

The purpose of our study is to examine the impact of community-based specialist palliative care teams on health system costs compared to usual care, such as end-of-life homecare alone. In Ontario, Canada, several regions have independently created their own specialist palliative care teams that vary in team composition, caseload, and geography served. This forms a natural experiment to examine multiple diverse specialist palliative care teams within a single health care system. Specifically, this study investigates whether there are health system cost differences between propensity-score matched pairs of patients who received specialist palliative care teams versus usual care within the overall pooled cohort and individual teams.

Methods

Study design

This is a retrospective cohort study of deceased palliative care patients in Ontario, Canada, during fiscal years 2009-2011. We examined health system costs in the last 30 days of life for patients who received services from one of 11 interdisciplinary palliative care teams (exposed) and used propensity score matching to create an equivalent comparison group of patients who received usual care (unexposed). The demographic and service use characteristics of the cohort were identified by linking health care administrative datasets using encrypted unique patient identifiers. The cost differences between matched pairs was determined for each of the teams separately and collectively to determine an overall pooled cohort effect.

Study setting

In Ontario, the majority of community-based palliative care is delivered by homecare providers (e.g., nurses and personal support workers)[14] referred to in this study as the unexposed "usual care" group. In usual care, there is no involvement from community-based specialist palliative care teams. Patients are eligible for homecare if they require nursing care, personal support care or therapy, and are eligible for "end-of-life" homecare if they also have a life limiting or life threatening health condition with a prognosis of less than 6 months to live and they have pain and symptom issues related to the end of life. The end-of-life designation entitles

patients to more homecare hours and sometimes providers with more end-of-life care experience.[15] Population-based data in the province show that about a third of deceased patients receive homecare in the last year of life and 19% receive end-of-life homecare.[16] Over half (56%) of deaths occur in hospital and 20% occur at home.[14, 17] Access to homecare or other palliative care services such as residential hospices (i.e., free-standing, home-like facilities in the community) and hospital palliative care units are very limited.[18] End-of-life homecare may be provided by one or more service provider organizations, with little coordination between them. Furthermore, care provided by these organizations vary in palliative care training of the homecare workers and extent of after-hours coverage. Moreover, most family physicians provide care independently of homecare and rarely make home visits.[19] In contrast, care from a specialist palliative care team, referred to in this study as the exposed group, provides care that is accessible around-the-clock, coordinated, and provided by specially trained providers.

Specialist palliative care teams

In Ontario, regions have independently developed their own community-based, specialist, palliative care teams to improve palliative care access and delivery over time.[20] These teams vary in geography served, patient admissions (range 90-830 patient deaths over 2 years), and team size (3 to 18 Full Time Equivalent [FTE]) (Table 1). The mean time from admission to a specialist palliative care team to death was 73 days. However, they all consist of a core group of interdisciplinary providers including community physicians and nurses with specialized palliative care expertise. Some teams also involve allied health professionals, such as social workers and psychosocial-spiritual counselors. The common roles of the community-based specialist palliative care teams include ongoing comfort care, symptom management 24/7, education, care coordination. Patients are usually referred to the teams during the last months of life based on clinical factors, functional decline, and expected prognosis of less than six months. The specialist team visits the patient in-home to assess needs and develop a care plan. These teams work in conjunction with homecare services, including nurses and personal support workers, to provide integrated palliative care in patients' homes, similar to visiting hospice services by MacMillan nurses in the United Kingdom. The structure and development of these teams have been previously described in detail.[20, 21]

Cohort selection

Exposed group: Eleven teams were identified that met the above criteria as well as the following: (1) had little or no change in staffing or structure during the cohort timeframe (2009 to 2011); (2) did not limit admission criteria to one disease, e.g., cancer; and (3) served more than 50 patients a year. Within each team, patients were included if they died by April 1 2011, were at least 18 years of age, and had a valid provincial health insurance number.

Unexposed group: Two a priori approaches were taken to identify appropriate control groups depending on how long the team had been established. One, for teams that were established after 2009 (teams 1 to 6), a pool of decedents was matched within the same health regions during fiscal years 2007-2009 (two years before the team was established). The research team confirmed that no major policy or organizational changes occurred in these study regions between 2007 and 2011, with the exception of the introduction of the teams.[6] Two, for teams that started before 2009 (teams 7 to 11), a pool of decedents was matched from similarly resourced regions (i.e., similar in size, geography, access to homecare services, but did not have access to

community-based specialist palliative care teams) during the same study period of 2009-2011. This second approach was taken because: i) many of these teams were established a decade or more ago, where a pre-team cohort would not be reasonably comparable to 2009-2011; and ii) because a major health policy that regionalized homecare occurred in 2006, making comparisons prior to this time problematic.[22]

Data sources

The teams provided their patient lists during fiscal years 2009-2011 that were linked to multiple administrative data bases using the patients' provincial health insurance numbers. The provincial vital statistics database was used to confirm date of death. The Discharge Abstract Database was used to determine hospital and palliative care unit admissions, as well as comorbidity score weight, presence of cancer condition and hospital death. We used the National Ambulatory Care Reporting System to determine emergency department visits. The Continuing Care Reporting System was used to calculate cost in chronic or complex in-patient beds. The Home Care Database provided dates of publicly funded homecare service use and service type. The Ontario Health Insurance Plan database and the physician billing codes were used to determine physician visits. We used Statistics Canada census data on postal codes to determine region and rurality. These linked datasets were also used to determine the pool of unexposed patients.

Propensity score matching

We used propensity score matching to match on propensity to have received the community-based specialist palliative care team and create equivalent comparison groups in usual care for each intervention team. Matching on the propensity score can estimate the effect of the intervention, which is unbiased by differences in measured pre-intervention covariates.[23] We matched on variables prior to exposure to the intervention: age at death, sex, cancer or non-cancer, homecare service type (palliative, supportive, maintenance, rehabilitation) and time in homecare, Aggregated Diagnosis Group (comorbidity weighting that determines clinically cogent groups from 6 to 18 months before death),[24] hospital and emergency department use before death (during the period from 6 to 18 months before death).[6] Eleven cohorts were created, consisting of pairs of exposed patients and unexposed subjects who were selected from the appropriate control population (see cohort selection).

Outcomes

The primary outcome is the paired-difference in total health system costs between the matched-pairs of exposed versus unexposed groups in the last 30 days of life across the overall aggregated pooled cohort. We also calculated the paired-difference in health system costs for each individual team. Health system costs consisted of the five health care sectors: 1) physician visits, 2) sub-acute care,[25] 3) homecare, 4) inpatient hospitalization, and 5) emergency department. The secondary outcome is the paired-difference in health care sector-specific costs respectively, in the last 30 days of life for the overall pooled cohort. Costing macros that have been validated in Ontario data were applied to calculate costs for the above services.[26] All physician costs beyond palliative home visits were included, regardless of specialty or care setting.

Statistical Analysis

Descriptive statistics were used to examine patient characteristics and health system costs. We used paired t-tests (among propensity score matched patient pairs) to determine if health system costs in the last 30 days of life were statistically different between the exposed and unexposed matched pairs across the overall pooled cohort. The pooled cohort was comprised of the matched-pairs, considered independently, pooled into an aggregate total cohort, akin to a meta-analysis of 11 separate studies. We also used paired t-tests to determine significance among paired-differences in health system costs in the last 30 days of life for each of the 11 teams respectively, summarized in a forest-plot. Additionally, we report the paired-difference in cost for each health care sector for the overall pooled cohort. Analysis was completed using SAS v9 statistical software. All tests were two-sided and a p-value of 0.05 or less was considered statistically significant.

Ethics Approval

The study was approved by Hamilton Health Sciences/McMaster University research ethics review board, Ontario, Canada (11-403).

Results

In total, the specialist teams (exposed) served 3,912 patients, whereas the control regions had 41,113 deaths (Table 2). The characteristics between the initial exposed and unexposed groups differed greatly before propensity score matching, for instance, 79% had a cancer diagnosis and 78% received end-of-life homecare services in the exposed group, compared to only 35% and 15% in the unexposed group ($p<0.001$), respectively. Propensity score matching created similar groups across a number of patient characteristics, generating 3,109 paired decedents. In both groups after matching, 79% had cancer diagnosis and 78% received end-of-life homecare services. The main difference between the two groups is their exposure to a community-based specialist palliative care team.

Overall pooled cohort and individual team health system costs

In the overall pooled cohort, the median health system costs in the last 30 days of life were $8,299 per decedent in the exposed group compared to $9,383 per decedent in the unexposed group. This results in a median paired difference in health system costs per patient of $512 (95% Confidence Interval [CI] [-$641, -$383]) lower at 30 days (all $p<0.0001$) among exposed versus unexposed patients. (Figure 1, Supplemental Table 3)

Looking at regional teams individually in the last 30 days of life, we found 7 of the 11 teams were associated with significant mean paired cost reductions. The 7 teams with significant mean paired differences in costs range from $1,285 to $307 lower among the exposed than the unexposed group. The four teams that did not have significant paired cost reductions at 60 days ranged from $397 to -$31 cost differences between exposed versus unexposed.

Costs by health care sector

Mean paired differences in health care costs in the last 30 days before death differed by sector as well (Figure 2). The greatest cost differences are observed in homecare and hospital sectors. At 30 days, the paired-differences show that the exposed group has higher mean homecare costs by $189 (95% CIs [-$161, -$217]) than the unexposed, but has lower hospital costs by $733 (95% CIs [-$924, -$541]). Though statistically significant, there were not

clinically significant differences in costs among matched pairs in emergency department use, sub-acute care or physician services.

Interpretation

Our pooled analysis of 11 community-based specialist palliative care teams suggests that exposure to these teams compared to usual homecare is associated with a reduction in health system costs at the end of life. Our data suggest that access to community-based specialist palliative care teams, in addition to usual care (which was primarily end-of-life homecare services), helps to reduce end-of-life hospital cost. These findings were consistent even though the teams differed in geography, team size, and team organization.

Generally, teams seemed to keep patients in the home and avoid or reduce hospitalizations. Because the teams aim to expertly manage, constantly monitor, and rapidly respond to complex symptoms and changes in the patient's condition in the home 24/7, they can help patients to stay at home, where they might otherwise go to hospital. Indeed in most teams comparing exposed to unexposed, we found a reduction in hospital costs with more than offset the higher homecare costs. The homecare service (including the cost of delivering community-based specialist palliative care teams) cost a fraction of that of a hospital bed, which typically ranges from $1000-2000 per day for non-critical care,[9, 27-29] which can lead to overall health system savings. Furthermore, support and education from the specialist palliative care teams may prompt patients and families to choose comfort care measures rather than aggressive treatments in hospital.

Nonetheless, among the 11 community-based specialist palliative care teams, four teams (team 2, 5, 6 and 10) did not individually show significant cost savings. This may be due to a few factors: they tended to be very small teams, serving no more than 40-100 decedents per year in large rural or suburban geographies. As well, two of the teams only had a half FTE palliative care physician.

Comparison to other studies

Two systematic reviews examined the cost benefits of home-based palliative care interventions, identifying over a dozen randomized trials that included cancer and non-cancer populations.[4, 8] These reviews concluded that the evidence for cost-benefit was inconclusive, since the community-based team interventions were very heterogeneous: the interventions differed (e.g. some were telephone-based, education only, nurse-led only, did not include afterhours coverage, etc.); the countries and health systems differed; and the cost outcome definitions differed. Our study is unique because it includes independent teams, where the core components of the team-based intervention were the same, occurring in the same health system, with standardized outcome definitions. However, our study population did mainly (80%) serve cancer patients.

Limitations

We could not match on data that are unavailable in administrative data, such as availability of existing caregiver support, patient preferences for hospital use, marital status, and education level. We did not adjust for covariates using a regression since there were no significant differences after propensity score matching, though income quintiles were not balanced. Furthermore, not all potential costs are accounted for, such as drugs, costs of private

homecare services, or other indirect costs incurred by informal caregivers. Our study period of 2009-2011 was due to lags in administrative data linkage, but remains relevant in that there have been no major policy changes within the homecare sector and there has been little decrease in the proportion of deaths in hospital since then.[17] In addition, for the five older teams matched to decedents from a comparable region, there may have been regional differences leading to confounding. Finally, we did not differentiate multiple visits within hospital costs; nonetheless, even among cancer patients who die in hospital in Ontario, the majority (77%) only have a single visit in the last month.[30] A strength of the study is that we propensity-score matched the exposed and unexposed groups based on cancer/non-cancer diagnosis, end-of-life homecare use, length of time in homecare, and comorbidity, controlling for major factors affecting access to a specialist palliative care team.

Conclusion

Although the teams vary in composition and geography, the core team interventions contain common components, such as expert symptom management, patient education, coordination of care, 24/7 telephone access, and on-going conversations about care preferences. Our findings demonstrate that specialist palliative care teams that feature these qualities are associated with reduced use of costly hospital care, which contributed to health system cost savings. Involvement from a community-based specialist palliative care team is one method for reducing the high cost of end-of-life care. Future research should examine which aspects of the specialist palliative care teams are most attributable to reduced health system costs using multi-level regression models and the impact of these teams on informal caregiver costs.

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Table 1: Team characteristics prior to matching

Team	Date established	Geography	No. decedents FY2009-11	Median time on service (days)	Palliative care physicians FTE (Funding source)		Nurses FTE	Other team members FTE
1	2009	Urban	830	40	1	(FFS)	8	2
2	2009	Suburban	221	53	3	(FFS)	3.5	5
3	2009	Suburban	144	38	1	(FFS)	1	0.6
4	2009	Suburban	125	40	1	(FFS)	2	1
5	2009	Suburban	105	36	0.5	(FFS)	1	0.2
6	2009	Rural	90	63	2	(APP)	2	1.2
7	1986	Urban	676	45	11.5	(APP)	1	5.9
8	2007	Suburban	497	49	2	(FFS & APP)	2	1
9	1998	Urban	775	38	1.3	(FFS)	3	1.7
10	2004	Rural	268	23	0.6	(APP)	1	2.5
11	1979	Rural	181	32	6	(FFS)	2	4.7

FTE=full time equivalent
FFS=Fee-For-Service, i.e., physician bills for each aspect of care and service they provide according to a set price mechanism
APP = Alternative Payment Plan, i.e., physician reimbursement is a combination of FFS and salary

Table 2: Comparison of patient characteristics before and after propensity score matching

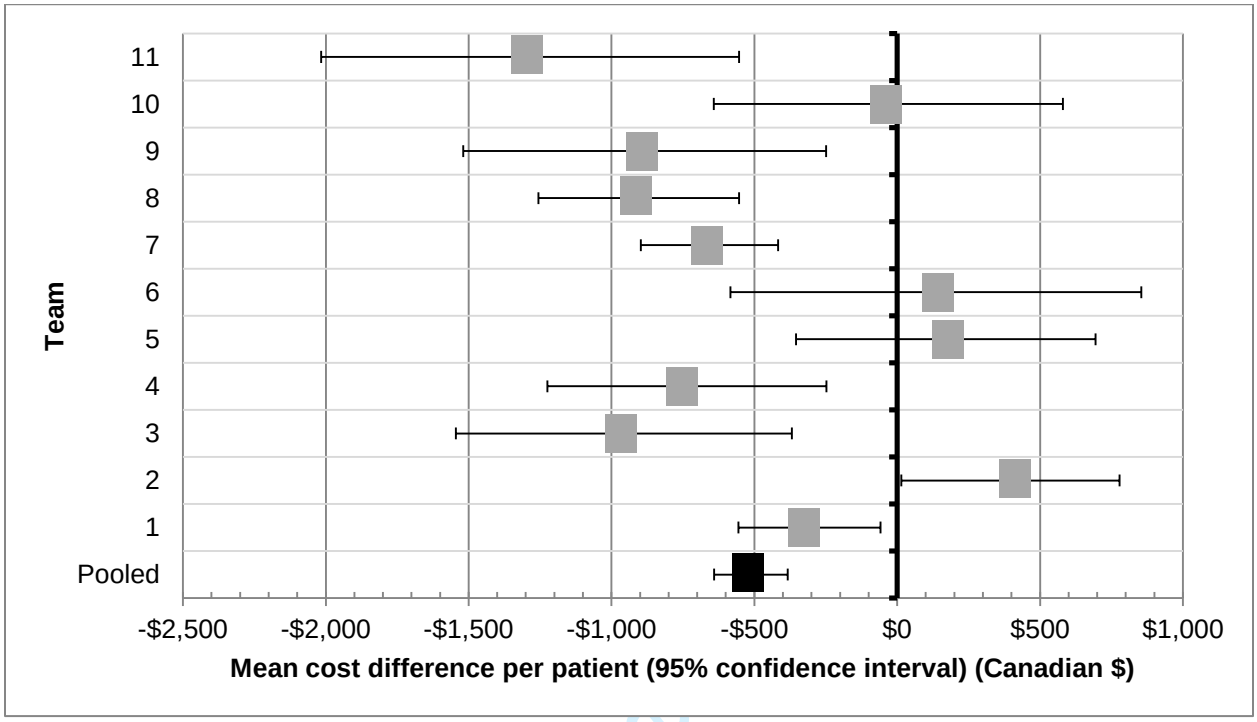
	Before propensity score matching		After propensity score matching		
Characteristics	**Unexposed**	**Exposed**	**Unexposed**	**Exposed**	**p-value**
No of patients (pooled across the teams)	41,133	3,912	3,109	3,109	
Median (IQR) age at death (range years)	80 (69 to 87)	75 (64 to 84)	74 (63-83)	75 (64-84)	p>0.05
Cancer diagnosis, n (%)	14,443 (35.1)	3,073 (78.6)	2,481 (79.8)	2,469 (79.4)	p>0.05
Female, n (%)	20,895 (50.8)	2,032 (51.9)	1,609 (51.8)	1,600 (51.5)	p>0.05
Mean (SD) Adjusted Clinical Group comorbidity weighting	5.12 (4.09)	6.30 (4.04)	6.21 (3.93)	6.20 (3.98)	p>0.05
Home care service type, n (%):					
End of life	6,208 (15.1)	3,041 (77.7)	2,409 (77.5)	2,409 (77.5)	p>0.05
Long term supportive	3,408 (8.3)	210 (5.4)	145 (4.7)	145 (4.7)	p>0.05
Maintenance	7,692 (18.7)	328 (8.4)	278 (8.9)	278 (8.9)	p>0.05
Rehab/acute care	6,478 (15.7)	157 (4.0)	106 (3.4)	106 (3.4)	p>0.05
None	17,347 (42.2)	176 (4.5)	171 (5.5)	171 (5.5)	p>0.05
Mean (SD) time from first receipt of most severe home care service type:					
End of life	15.47 (56.48)	86.18 (107.29)	79.23 (102.02)	79.32 (102.05)	p>0.05
Long term supportive	23.92 (81.17)	31.00 (87.25)	37.96 (95.92)	27.84 (83.51)	p>0.05
Maintenance	63.68 (124.80)	82.02 (131.69)	81.64 (131.06)	83.55 (132.16)	p>0.05
Rehab/acute care	69.70 (113.27)	76.05 (113.98)	79.29 (112.60)	80.12 (114.96)	p>0.05
Mean (SD) No of prior emergency department visits	1.16 (2.10)	1.43 (2.11)	1.40 (1.95)	1.36 (1.96)	p>0.05
Mean (SD) prior hospital length of stay (days)	7.18 (22.23)	7.53 (17.09)	6.84 (14.17)	6.73 (14.85)	p>0.05
Mean (SD) No of prior hospital visits	0.56 (1.04)	0.75 (1.14)	0.76 (1.15)	0.70 (1.07)	p>0.05
Income quintile, n (%):					
1 (lowest)	10,288 (25.0)	668 (17.1)	772 (24.8)	536 (17.2)	p<0.01
2	9,053 (22.0)	746 (19.1)	703 (22.6)	605 (19.5)	p<0.01
3	7,565 (18.4)	720 (18.4)	604 (19.4)	550 (17.7)	p>0.05
4	7,460 (18.1)	872 (22.3)	585 (18.8)	675 (21.7)	p<0.01
5 (highest)	6,555 (15.9)	906 (23.2)	437 (14.1)	743 (23.9)	p<0.01

Table 3 supplemental: Mean healthcare cost differences by team and overall, between matched pairs of unexposed and exposed patients in the last 30 days of life (n= 3,109)

Team	N of pairs (each arm)	Median Cost Unexposed	Median Cost Exposed	Mean paired difference	Lower 95CL	Upper 95CL	Pr > |t|*
Pooled	3,109	$9,383	$8,299	-$512	-$641	-$383	**<0.0001**
1	828	$9,553	$9,503	-$307	-$556	-$57	**0.016**
2	197	$6,314	$7,905	$396	$14	$778	0.042
3	124	$9,216	$6,738	-$957	-$1,545	-$369	**0.001**
4	117	$7,469	$5,126	-$736	-$1,224	-$249	**0.003**
5	99	$7,067	$6,965	$170	-$354	$694	0.52
6	76	$9,238	$8,940	$135	-$584	$854	0.71
7	663	$10,698	$8,524	-$657	-$897	-$418	**<0.0001**
8	448	$9,856	$6,498	-$905	-$1,256	-$554	**<0.0001**
9	275	$8,308	$7,300	-$884	-$1,519	-$249	**0.006**
10	167	$8,399	$10,103	-$31	-$642	$580	0.92
11	115	$12,928	$10,782	-$1,285	-$2,016	-$555	**<0.0001**

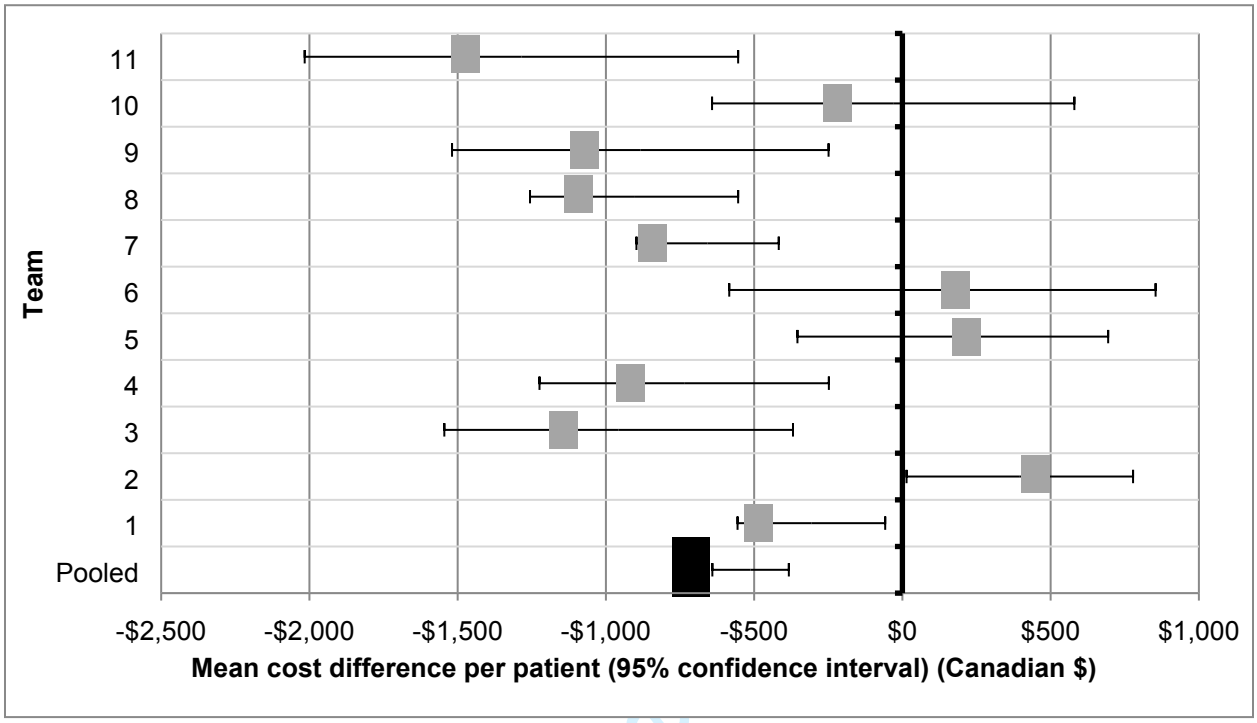
*Bold indicates significant cost savings of exposed arm, p<0.05

Figure 1: Mean healthcare cost differences by team and overall, between matched pairs of unexposed and exposed patients in the last 30 days of life (n= 3,109)



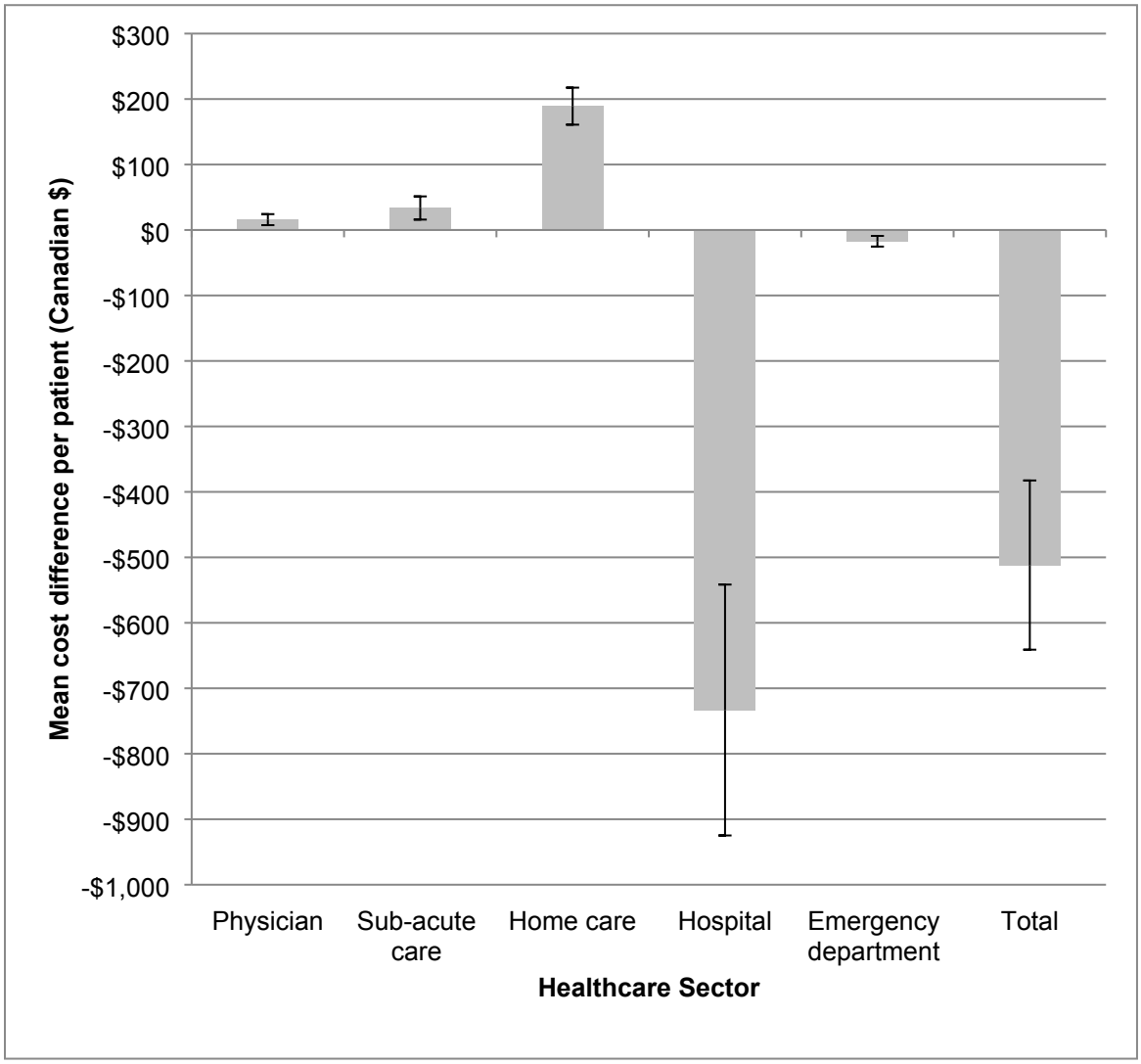
Error bars indicate 95% confidence intervals

Figure 1: Mean healthcare cost differences by team and overall, between matched pairs of unexposed and exposed patients in the last 30 days of life (n= 3,109)



Error bars indicate 95% confidence intervals

Figure 2: Mean sectorial cost differences between matched pairs of unexposed and exposed patients in the last 30 days of life (n= 3,109)



95% confidence intervals shown