

# Quality of end-of-life cancer care in Canada: a retrospective four-province study using administrative health care data

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## ABSTRACT

**Background** The quality of data comparing care at the end of life (EOL) in cancer patients across Canada is poor. This project used identical cohorts and definitions to evaluate quality indicators for EOL care in British Columbia, Alberta, Ontario, and Nova Scotia.

## Methods

This retrospective cohort study of cancer decedents during fiscal years 2004–2009 used administrative health care data to examine health service quality indicators commonly used and previously identified as important to quality EOL care: emergency department use, hospitalizations, intensive care unit admissions, chemotherapy, physician house calls, and home care visits near the EOL, as well as death in hospital. Crude and standardized rates were calculated. In each province, two separate multivariable logistic regression models examined factors associated with receiving aggressive or supportive care.

**Results** Overall, among the identified 200,285 cancer patients who died of their disease, 54% died in a hospital, with British Columbia having the lowest standardized rate of such deaths (50.2%). Emergency department use at EOL ranged from 30.7% in Nova Scotia to 47.9% in Ontario. Of all patients, 8.7% received aggressive care (similar across all provinces), and 46.3% received supportive care (range: 41.2% in Nova Scotia to 61.8% in British Columbia). Lower neighbourhood income was consistently associated with a decreased likelihood of supportive care receipt.

**Interpretation** We successfully used administrative health care data from four Canadian provinces to create identical cohorts with commonly defined indicators. This work is an important step toward maturing the field of EOL care in Canada. Future work in this arena would be facilitated by national-level data-sharing arrangements.

**Key Words** Palliative care, quality indicators, health services research

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## INTRODUCTION

Palliative care plays an important role on the cancer care continuum. In particular, it aims to enhance quality of life at the end of life (EOL)<sup>1</sup>. Without effective health care interventions, many cancer patients have uncontrolled symptoms, poor quality of life, and unnecessary suffering<sup>2–9</sup>. The literature suggests that, over time, cancer care is becoming more aggressive near the EOL<sup>10,11</sup>. The literature also suggests the presence of a discrepancy between what patients report as their preferred place of death (most often home) and their actual place of death<sup>12–20</sup>. Compared

with people receiving patient-centred palliative care services at home, those who die in institutions such as acute care facilities have unmet needs for symptom control, physician communication, emotional support, and respectful treatment<sup>21,22</sup>.

The use of administrative health care data to evaluate quality indicators of EOL care was originally developed in the United States through a combination of literature review, lay focus groups, and expert panels<sup>23</sup>. A similar panel of indicators has been developed for the Canadian setting<sup>24</sup>. An aggregate score of “aggressive care” has been described in both the United States and Canada<sup>10,11</sup>. Knowing which

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services patients receive before death offers insight into whether they are accessing resources meant to improve quality of death and dying<sup>25</sup>.

Since the early 2000s, the quality of EOL care in Canada has been highly criticized in a series of federal and provincial reports<sup>26–32</sup>. Those criticisms have included lack of expertise and of adequate home support services, lack of coordinated comprehensive programs, fragmentation of care, and inadequate caregiver support. Although EOL care has been studied in several provinces<sup>14,22,33–39</sup>, the quality of data for comparing EOL care in cancer patients across Canada is poor.

In 2010, the Canadian Cancer Society reported on EOL care as a special topic for their annual report. The authors concluded that comparisons between provinces are limited because of a lack of standard definitions and methods, and an inability to link data across provinces<sup>40</sup>. Ironically, more high-quality research has been published comparing EOL care in Ontario and the United States than between provinces in Canada<sup>11,41</sup>. The purpose of the present project was to evaluate EOL quality indicators in cancer patients from British Columbia, Alberta, Ontario, and Nova Scotia.

## METHODS

### Study Design

This retrospective cohort study considered patients with a confirmed cancer cause of death between 1 April 2004 and 31 March 2009 in four Canadian provinces: British Columbia, Alberta, Ontario, and Nova Scotia. Patients less than 19 years of age at the time of death and those with an invalid provincial health card number were excluded.

### Data Sources

Index cases of death from cancer were identified from the cancer registries of each participating province. All registries are population-based and capture at least 90% of all incident cancer cases<sup>42–45</sup>. Encoded unique health card numbers were used to link cases to administrative health databases within each province so as to obtain information about health services received at EOL. Data were not merged across provinces, but were analyzed independently.

The source databases included the Discharge Abstract Database maintained by the Canadian Institute for Health Information<sup>46,47</sup>, which contains diagnostic and procedure information about all acute care hospitalizations in Canada; the National Ambulatory Care Reporting System<sup>48</sup>, which, for Alberta and Ontario, contains information from hospital and community-based ambulatory care including day surgeries, outpatient clinics, and emergency departments (EDs); physician billing claims databases from provincial health insurance plans (the Medical Services Plan in British Columbia<sup>49</sup>, Medical Services Insurance in Nova Scotia, and the Ontario Health Insurance Plan in Ontario), which provide information on reimbursement claims made by physicians for services provided to patients; databases available from provincial organizations overseeing home care services (Home and Community Care in British Columbia<sup>50</sup>, Continuing Care in Nova Scotia, and the Ontario Association of Community Care Access Centres in Ontario); and the BC Cancer Agency's Systemic Therapy database for

chemotherapy treatment information. Physician claims and home care data were not available for Alberta, and chemotherapy data were not complete for Nova Scotia.

Sociodemographic information was obtained from the cancer registries of all provinces except Ontario and British Columbia, where public health insurance registration records were used<sup>51,52</sup>. The Statistics Canada 2006 census profile was used to obtain neighbourhood income and community size information. Additionally, as a measure of baseline comorbidity, a Charlson–Deyo modified score was calculated using hospitalizations in the 6 months before death<sup>53</sup>. The score is calculated by summing the points for a predefined list of conditions, with the points for cancer excluded.

### Health Service Quality Indicators

We examined health service quality indicators commonly used and previously identified as important to quality care at EOL<sup>23,24</sup>, where EOL is considered to be the time shortly before death. Indicators for which higher use is considered lower quality include ED use in both the last 2 weeks and the last 30 days of life, a new hospital admission in the last 30 days of life, intensive care unit (ICU) admission in the last 30 days of life, chemotherapy use in the last 2 weeks of life, and death in an acute care hospital. Indicators for which higher use is considered higher quality include physician house calls in the last 2 weeks of life, and nursing and personal support worker visits at home in the 6 months before death. Because the ICU admission date for one province was unknown, admissions to the ICU were counted only if the hospital admission date was within 30 days of death. Because patients considered palliative are eligible for increased home care services, we also examined a separate indicator for palliative home care, defined as receiving a nursing or personal support worker visit at home in the 6 months before death, with a specific flag or indicator of the palliative intent of the care.

Aggregate measures of aggressive and supportive care combining selected indicators were also developed:

- “Aggressive care” was defined as any one or a combination of ED visits (2 or more), a hospitalization, or an ICU admission in last 30 days of life<sup>10,11</sup>. Although the earlier literature included chemotherapy use in the aggressive care measures, variation in the sources of chemotherapy data between the provinces studied here would limit their comparability, and thus chemotherapy was excluded.
- “Supportive care” was defined as either or both of a physician house call in the 2 weeks before death and a palliative nursing or personal support worker visit at home (as already defined) in the 6 months before death. That aggregate measure was created specifically for the present study.

Table 1 details the indicator definitions and data sources.

### Statistical Analysis

Baseline characteristics of each provincial study population were compared using descriptive statistics. Crude

**TABLE 1** Indicator definitions and data sources from each province

Indicator	Data source			
	BC	AB	ON	NS
Death in acute care hospital or bed (overall) <i>Numerator:</i> Death in a hospital (discharge disposition) <i>Denominator:</i> Cohort of all deaths	Canadian Institute for Health Information			
Hospitalization within 30 days of death <i>Numerator:</i> Patients with a hospitalization in the last 30 days of life (only new admissions—that is, admission date within the 30-day window) <i>Denominator:</i> Cohort of all deaths, but excludes those in hospital for the last 30 days of life	Canadian Institute for Health Information			
With intensive care unit (ICU) admission <i>Numerator:</i> Patients who received ICU care (and a new hospitalization) within the last 30 days of life <i>Denominator:</i> Cohort of all deaths	Canadian Institute for Health Information			
Emergency department visit within 2 weeks (30 days) of death <i>Numerator:</i> Patients who visited the emergency department within 2 weeks (30 days) of death <i>Denominator:</i> Cohort of all deaths, but excludes those in hospital for the last 30 days of life	Canadian Institute for Health Information, National Ambulatory Care Reporting System (NACRS)			
Home visit within 6 months of death <i>Numerator:</i> Patients with any home care visit within 6 months of death <i>Denominator:</i> Cohort of all deaths	Home and Community Care database	—	Home Care database	Continuing Care database
By a registered nurse <i>Numerator:</i> Patients with home care nursing by a registered nurse within 6 months of death <i>Denominator:</i> Cohort of all deaths				
By a personal support worker <i>Numerator:</i> Patients receiving personal support at home by a personal support worker within 6 months of death <i>Denominator:</i> Cohort of all deaths				
For palliative care <i>Numerator:</i> Patients receiving palliative home care within 6 months of death <i>Denominator:</i> Cohort of all deaths				
Physician house call within 2 weeks of death <i>Numerator:</i> Patients receiving house calls within 2 weeks of death <i>Denominator:</i> Cohort of all deaths, but excludes those in hospital for the last 2 weeks of life	Claims (MSP)	—	Claims (OHIP)	Claims (MSI)
Chemotherapy within 2 weeks of death <i>Numerator:</i> Patients receiving chemotherapy within 2 weeks of death <i>Denominator:</i> Cohort of all deaths	Canadian Institute for Health Information, Discharge Abstract Database			
	—	NACRS	NACRS	—
	—	—	Claims (OHIP)	—
	—	—	—	OPIS
	BCCA Provincial Systemic Therapy Program	—	—	—

OHIP = Ontario Health Insurance Plan; MSI = Medical Services Insurance; MSP = Medical Services Plan; OPIS = Oncology Patient Information System; BCCA = British Columbia Cancer Agency.

and standardized rates for each indicator were compared between provinces for fiscal years 2004–2008 and overall. Crude rates were calculated as the proportion of patients who met the indicator definition. Standardized rates were calculated using the direct method and the combined fiscal year 2004/2005 study populations from each province as the standard population.

For each province, two separate multivariable logistic regression models were used to examine factors associated with receipt of aggressive and supportive care. Factors included in the adjusted models were age, sex, score on the Charlson-Deyo comorbidity index<sup>53</sup>, cancer type, neighbourhood income quintile, community size, health service region, and fiscal year of death. Age was included in the model as a continuous variable. The remaining variables were categorical. Each province was checked for collinearity between community size and region using the variance inflation factor. No collinearity was found, and so both variables were included in the model. Odds ratios (ors) are reported with 95% confidence intervals (cIs) and are considered statistically significant if the confidence interval does not include 1.00.

Because nursing and personal support worker home visits and physician house call data were not available from Alberta, analyses of those indicators and of supportive care were not performed for that province. Statistical analyses were performed using the SAS (version 9.3: SAS Institute, Cary, NC, U.S.A.) and R (version 3.0.1: The R Foundation, Vienna, Austria) software applications and Microsoft Excel 2010 (Redmond, WA, U.S.A.).

The study was approved by the Hamilton Health Sciences Research Ethics Board and by the research ethics boards of each participating provincial organization: the Capital Health Research Ethics Board in Nova Scotia; the Alberta Health Services Research Ethics Board; and the University of British Columbia—BC Cancer Agency Research Ethics Board. In Ontario, the study was conducted in accordance with the strict confidentiality and privacy policies of the Institute for Clinical Evaluative Sciences.

## RESULTS

During the study period, 200,285 patients in the four provincial cancer registries who died from their cancer met the eligibility criteria for inclusion in the study (Table II). Overall, mean age at death was  $71.4 \pm 12.9$  years, and 47% were women. Demographics were similar across the provinces. Compared with the other provinces, British Columbia had a slightly lower proportion of cases with a score of at least 1 on the Charlson-Deyo comorbidity index, and the Nova Scotia study population lived in smaller-sized communities.

Table III shows the crude and standardized quality indicator rates by province, for all years combined. Overall, 54% of patients died in a hospital, with British Columbia having the lowest standardized rate of such deaths at 50.2%. Patients hospitalized within 30 days of death varied from 49.2% in Nova Scotia to 60.7% in Ontario. Rates of admission to the ICU were similar. Comparing ED visit data from the Discharge Abstract Database (ED visits captured from hospital admissions via the ED), Nova Scotia

also had the lowest use of ED within both 2 weeks and 30 days of death (22.2% and 30.7% respectively); Ontario had the highest use (35.7% and 47.9%). Rates estimated using the National Ambulatory Care Reporting System and physicians claim data in Alberta and Ontario were 4%–10% higher than the rates estimated using hospitalization data, but relative use across provinces was unchanged. In Nova Scotia, rates estimated using claims were lower. Intravenous chemotherapy treatment in the last 2 weeks of life ranged from 2.4% in Alberta to 4.8% in British Columbia; however, this particular comparison must be interpreted with caution because of the varying types of data sources used to gather the information. Nova Scotia chemotherapy data were incomplete.

With respect to the aggregate indicators, 8.7% of all patients received aggressive care, with rates being similar in all provinces. Supportive care was received by 46.3% of the study population. The highest rate of supportive care was observed in British Columbia (61.8%), and the lowest, in Nova Scotia (41.2%). Results across years were relatively stable.

In regression analyses, younger age, male sex, and residence in smaller-sized communities were all associated with an increased likelihood of receiving aggressive care (Table IV), an observation that was consistent for all provinces. In Ontario, living in a low-income neighbourhood or having a score of 1 or more on the Charlson-Deyo comorbidity index were also associated with receipt of aggressive care. Factors associated with an increased likelihood of supportive care receipt were younger age, female sex, no comorbidity, lung cancer, living in a higher-income neighbourhood and in a larger community, although some exceptions were observed (Table V). Notably, compared with people in the highest-income neighbourhoods, people living in the lowest-income neighbourhoods had a 0.73–0.87 likelihood of receiving supportive care.

## DISCUSSION

We successfully used administrative health care data to create identically defined cohorts with commonly defined indicators in four Canadian provinces that include about 65% of the Canadian population. Moderate differences in the indicators were observed between provinces, but overall, more than half the cancer patients died in hospital and 2 in 5 visited the ED near the EOL. Associations with explanatory covariates were similar in all the provinces, suggesting that observations from a single province are generalizable to others. One of the strongest associations observed was that patients living in poorer neighbourhoods were less likely to receive supportive care services.

The present work makes an important contribution to maturing the study of EOL cancer care in Canada. It addresses some of the gaps previously identified by the Canadian Cancer Society—specifically, comparing identically defined cohorts during the same years, with indicators defined as identically as the data allow. This work is in keeping with priorities outlined by the U.S. Institute of Medicine's recent report<sup>54</sup>, such as providing patients and families with EOL care that consistent with their values and developing a national quality reporting program.

**TABLE II** Socio-demographics of study populations overall, by province, 2004–2008

Characteristic	British Columbia		Alberta		Ontario		Nova Scotia		Overall	
	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)
Study population	40,175		27,763		119,543		12,804		200,285	
Age group										
19–29 Years	125	0.3	136	0.5	446	0.4	44	0.3	751	0.4
30–39 Years	357	0.9	369	1.3	1,300	1.1	96	0.8	2,122	1.1
40–49 Years	1,645	4.1	1,465	5.3	5,480	4.6	507	4.0	9,097	4.5
50–59 Years	5,068	12.6	3,886	14.0	14,859	12.4	1,381	10.8	25,194	12.6
60–69 Years	8,453	21.0	5,940	21.4	25,176	21.1	2,692	21.0	42,261	21.1
70–79 Years	12,045	30.0	8,244	29.7	36,836	30.8	3,748	29.3	60,873	30.4
80–89 Years	10,285	25.6	6,330	22.8	29,663	24.8	3,351	26.2	49,629	24.8
90+ Years	2,197	5.5	1,393	5.0	5,783	4.8	985	7.7	10,358	5.2
Mean age (years)	71.8±12.8		70.5±13.3		71.3±12.9		72.7±12.9			
Sex										
Female	18,729	46.6	13,011	46.9	56,859	47.6	5,861	45.8	94,460	47.2
Male	21,446	53.4	14,752	53.1	62,684	52.4	6,943	54.2	105,825	52.8
Income quintile <sup>a</sup>										
1 (lowest)	9,405	23.4	6,415	23.1	25,947	21.7	2,714	21.2	44,481	22.4
2	8,332	20.7	6,229	22.4	25,815	21.6	2,594	20.3	42,970	21.7
3	7,583	18.9	5,583	20.1	23,118	19.3	2,530	19.8	38,814	19.6
4	7,240	18.0	4,869	17.5	22,226	18.6	2,280	17.8	36,615	18.5
5 (highest)	6,972	17.4	4,449	16.0	21,944	18.4	2,198	17.2	35,563	17.9
Community size <sup>a</sup>										
>1,500,000	17,237	42.9	0	0.0	39,776	33.3	0	0.0	57,013	28.5
500,000–1,499,999	0	0.0	16,682	60.1	15,602	13.1	0	0.0	32,284	16.1
100,000–499,999	7,350	18.3	0	0.0	32,485	27.2	5,965	46.6	45,800	22.9
10,000–99,999	9,420	23.5	3,923	14.1	13,570	11.4	1,527	11.9	28,440	14.2
<10,000	6,083	15.1	7,045	25.4	18,110	15.2	5,269	41.2	36,507	18.2
Cancer type										
Brain	1,016	2.5	835	3.0	2,945	2.5	290	2.3	5,086	2.5
Breast	2,859	7.1	1,905	6.9	9,921	8.3	917	7.2	15,602	7.8
Colorectal	4,947	12.3	3,182	11.5	16,264	13.6	1,756	13.7	26,149	13.1
Gynecologic	1,555	3.9	1,126	4.1	5,628	4.7	442	3.5	8,751	4.4
Hematologic	3,562	8.9	2,312	8.3	11,380	9.5	1,080	8.4	18,334	9.2
Head and neck	1,006	2.5	646	2.3	3,466	2.9	290	2.3	5,408	2.7
Lung	10,564	26.3	6,917	24.9	29,809	24.9	3,523	27.5	50,813	25.4
Other gastrointestinal	4,366	10.9	3,012	10.8	11,763	9.8	1,228	9.6	20,369	10.2
Other genitourinary	1,961	4.9	1,415	5.1	6,484	5.4	724	5.7	10,584	5.3
Prostate	2,612	6.5	1,600	5.8	7,476	6.3	839	6.6	12,527	6.3
Other	5,727	14.3	4,813	17.3	14,407	12.1	1,715	13.4	26,662	13.3

TABLE II Continued

Characteristic	British Columbia		Alberta		Ontario		Nova Scotia		Overall	
	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)
Score on the Charlson comorbidity index										
0	14,801	36.8	6,862	24.7	50,524	42.3	5,497	42.9	77,684	38.8
1+	7,220	18.0	5,953	21.4	26,342	22.0	2,742	21.4	42,257	21.1
Missing	18,154	45.2	14,948	53.8	42,677	35.7	4,565	35.7	80,344	40.1
Healthcare service area <sup>a</sup>										
Health Authority (BC)										
Interior	8,404	20.9								
Fraser	12,131	30.2								
Vancouver Coastal	8,561	21.3								
Vancouver Island	8,672	21.6								
Northern	2,296	5.7								
Health Zone (AB)										
South			2,599	9.4						
Calgary			8,726	31.4						
Central			4,271	15.4						
Edmonton			9,072	32.7						
North			3,050	11.0						
Local Health Integration Network (ON)										
Erie St. Clair					7,124	6.0				
South West					10,165	8.5				
Waterloo Wellington					6,142	5.1				
Hamilton Niagara Haldimand Brant					15,951	13.3				
Central West					4,498	3.8				
Mississauga Halton					7,536	6.3				
Toronto Central					10,065	8.4				
Central					11,683	9.8				
Central East					13,746	11.5				
South East					6,084	5.1				
Champlain					11,527	9.6				
North Simcoe Muskoka					4,895	4.1				
North East					7,474	6.3				
North West					2,601	2.2				
District Health Authority (NS)										
South Shore							926	7.2		
South West							951	7.4		
Annapolis Valley							1,197	9.4		
Colchester East- Hants							955	7.5		



TABLE II Continued

Characteristic	British Columbia		Alberta		Ontario		Nova Scotia		Overall	
	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)
District Health Authority (NS)										
Cumberland							629	4.9		
Pictou							740	5.8		
Guysborough–Antigonish Strait							721	5.6		
Cape Breton							2,233	17.4		
Capital							4,400	34.4		
Fiscal year of death										
2004–2005	7,899	19.7	5,369	19.3	23,349	19.5	2,518	19.7	39,135	19.5
2005–2006	7,880	19.6	5,487	19.8	23,615	19.8	2,490	19.5	39,472	19.7
2006–2007	7,933	19.8	5,501	19.8	23,768	19.9	2,722	21.3	39,924	19.9
2007–2008	8,436	21.0	5,631	20.3	24,068	20.1	2,513	19.6	40,648	20.3
2008–2009	8,027	20.0	5,775	20.8	24,743	20.7	2,561	20.0	41,106	20.5

<sup>a</sup> Missing observations for income quintile ( $n=1842$ ), community size ( $n=241$ ), and health service area ( $n=260$ ) are excluded.

### Strengths and Limitations

Our study has several strengths. Its population-based cohorts of cancer decedents were identified using a common method, and it examines care provided in the inpatient, ambulatory, and community settings. Earlier work was conducted primarily within single provinces<sup>14,33–39</sup>. The provincial populations included in the present study account for more than half the Canadian population. Tremendous effort was taken to ensure that the indicators represent fair comparisons, despite the variety of data sources.

The Canadian Partnership Against Cancer is monitoring location of death across the country, but that variable is reported as an unadjusted value<sup>55</sup>. Interpretation is further limited because location of death is identified from the death certificate, and there are differences in death certificate reporting. The Canadian Institute for Health Information has released a national-level report on EOL care, but its study included only patients who died in hospital and was able to examine only care delivered in an inpatient setting, thus excluding care delivered in the community<sup>56</sup>.

There are limitations to the present study. All of the methodology choices made prioritized assurance of an “apples to apples” comparison. In some cases, options were limited. For example, ED visits were not available for all provinces from either the National Ambulatory Care Reporting System (a data source that specifically captures ED visits) or physician claims data. For that reason, inpatient hospitalization data were used to identify patients admitted to hospital via the ED. As a result, ED visits that did not lead to hospitalization were not counted. In other cases, the data required to evaluate an indicator could not be obtained. For example, the custodians of home care data in Alberta did not release it for inclusion in the study. Although cause-of-death data are available for more recent years from some provinces, the availability of such

data lags by 1–2 years in Ontario, such that all the cohorts included data only up to March 2009. Finally, the indicators themselves have limitations. For example, death in hospital might not reflect the location in which a patient spent most of his or her time at EOL.

### Comparison with Other Studies

The indicator values and associations reported here are in keeping with earlier Canadian results<sup>24,33</sup>. Notably, in all provinces studied, patients living in lower-income neighbourhoods were less likely to receive supportive care and, in Ontario, were more likely to receive aggressive care. In all provinces, people residing in smaller communities were more likely to receive aggressive care and less likely to receive supportive care. In contrast to earlier work using data from the early 2000s, an increase in aggressive care over time was not evident<sup>11</sup>. That discrepancy might be a result of our inability to include chemotherapy in the aggregate indicator of aggressive care, although the earlier work indicated that all types of aggressive care increased over time. Alternatively, aggressive EOL care might be beginning to stabilize. Other countries have reported similar data. For example, Canadian in-hospital death rates seem to be higher than those in the United States, but similar to those in Taiwan<sup>41,57,58</sup>.

### CONCLUSIONS

We successfully used administrative health care data to create identically defined cohorts with commonly defined indicators for four Canadian provinces. National reporting of quality of care improves the contextual understanding of variations in care. It facilitates a richer consideration of differences in the structures and processes of care that might contribute to the variations. The time and effort

TABLE III Quality indicator rates<sup>a</sup> by province, 2004–2008

Indicator	British Columbia			Alberta <sup>b</sup>			Ontario			Nova Scotia			Overall		
	(n)	(%)	Std <sup>c</sup>	(n)	(%)	Std <sup>c</sup>	(n)	(%)	Std <sup>c</sup>	(n)	(%)	Std <sup>c</sup>	(n)	(%)	Std <sup>c</sup>
Population	40,175			27,763			119,543			12,804			200,285		
Death in acute care hospital or bed (overall)	20,100	50.0	50.2	16,458	59.3	58.0	63,389	53.0	53.8	7,500	58.6	57.9	53.6		
Hospitalization within 30 days of death															
≥1 New admission	19,879	56.2	56.5	11,975	55.1	54.0	65,241	60.0	60.7	6,380	57.5	49.2	58.5		
With intensive care unit admission	1,055	3.0	2.9	550	2.5	2.5	3,752	3.5	3.5	445	4.0	3.5	3.3		
Denominator	35,358			21,726			108,721			11,100					
Emergency department visit within 2 weeks of death															
Source: CIHI Discharge Abstract Database	10,368	32.5	32.3	5,331	29.2	28.6	32,887	35.1	35.7	2,991	30.6	22.2	33.6		
Source: NACRS	—	—	—	6,658	36.5	35.6	37,821	40.4	41.2	—	—	—	—		
Source: Physicians claims data	—	—	—	—	—	—	34,855	37.2	37.8	2,172	22.2	18.1	—		
Denominator	31,940			18,261			93,639			9,790					
Emergency department visit within 30 days of death															
Source: CIHI Discharge Abstract Database	14,870	42.1	41.8	8,547	39.3	38.6	51,658	47.5	47.9	4,084	36.8	30.7	44.7		
Source: NACRS (unplanned), ≥1 visit	—	—	—	10,686	49.2	48.1	58,721	54.0	54.6	—	—	—	—		
Source: Physicians claims data, ≥1 visit	—	—	—	—	—	—	55,856	51.4	51.8	3,197	28.8	26.9	—		
Denominator	35,358			21,726			108,721			11,100					
Chemotherapy within 2 weeks of death															
Source: CIHI Discharge Abstract Database (inpatient only)	204	0.5	0.5	—	—	—	525	0.4	0.4	—	—	—	—		
Source: NACRS	—	—	—	—	—	—	3,136	2.6	2.6	—	—	—	—		
Source: Claims-based, intravenous only	—	—	—	695	2.5	2.4	4,054	3.4	3.4	—	—	—	—		
Source: Dispensing record, intravenous and oral	2,852	7.1	7.4	—	—	—	—	—	—	—	—	—	—		
Source: Dispensing record, intravenous only	1,875	4.7	4.8	—	—	—	—	—	—	—	—	—	—		
Source: Other (registry data) <sup>d</sup>	—	—	—	—	—	—	—	—	—	68	0.5	0.7	—		



TABLE III Continued

Indicator	British Columbia			Alberta <sup>b</sup>			Ontario			Nova Scotia			Overall		
	(n)	(%)	Std <sup>c</sup>	(n)	(%)	Std <sup>c</sup>	(n)	(%)	Std <sup>c</sup>	(n)	(%)	Std <sup>c</sup>	(n)	(%)	Std <sup>c</sup>
Home visit within 6 months of death <sup>e</sup>															
By a registered nurse	19,878	66.9	66.9	—	—	—	73,214	61.7	62.0	5,393	53.9	43.3		62.2	
By a personal support worker	3,820	12.9	12.9	—	—	—	46,019	38.8	38.6	2,943	29.4	22.9		33.3	
For palliative care	17,715	59.6	59.6	—	—	—	36,086	43.0	43.0	4,717	47.1	38.2		47.3	
Denominator	29,719						118,684			10,007					
Denominator (for Ontario palliative care)							83,887								
Physician house call within 2 weeks of death	6,348	21.4	19.4	—	—	—	22,658	24.2	23.9	2,338	23.9	18.7		23.2	
Denominator	31,940						93,639			9,790					
Aggressive care <sup>f</sup>	3,057	8.7	8.6	1,779	8.2	7.6	9,487	8.7	8.9	1,065	9.6	8.2		8.7	
Denominator	35,358			21,726			108,721			11,100					
Supportive care <sup>c,g</sup>	18,361	61.8	61.8	—	—	—	39,207	46.7	46.7	5,126	51.2	41.2		46.4	
Denominator	29,719			95,481			10,007								

<sup>a</sup> Roman typeface indicates best data; italic typeface indicates values from other data sources. Denominators include the entire cohort unless otherwise specified.

<sup>b</sup> Home care and physicians claims data are not available for Alberta.

<sup>c</sup> Based on the combined population from each province for the first year of the study (fiscal year 2004–2005).

<sup>d</sup> Based on data from only two District Health Authorities in Nova Scotia (Capital and Cape Breton).

<sup>e</sup> Denominator for British Columbia excludes patients living in regions in which home visit data were unavailable in 2005 and later. Palliative care data in Ontario between 1 April 2004 and 30 September 2005 are not available, and thus deaths during that period are excluded from the denominator. Home visit data for Nova Scotia in 2004–2005 were not available.

<sup>f</sup> Defined as having any of 2 or more emergency department visits, a hospitalization, or an intensive care unit admission during the last 30 days of life (data source for aggressive-care emergency department visits is CIHI's Discharge Abstract Database).

<sup>g</sup> Defined as either a physician house call during the last 2 weeks of life or a palliative nursing or personal support worker visit at home during the last 6 months of life.

Std = standard; CIHI = Canadian Institute for Health Information; NACRS = National Ambulatory Care Reporting System.

**TABLE IV** Multivariable logistic regression model for aggressive care<sup>a</sup>

Factor	British Columbia			Alberta			Ontario			Nova Scotia		
	OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI	
		Lower	Upper		Lower	Upper		Lower	Upper		Lower	Upper
Age (years)	<b>0.98</b>	<b>0.98</b>	<b>0.98</b>	<b>0.97</b>	<b>0.97</b>	<b>0.98</b>	<b>0.98</b>	<b>0.98</b>	<b>0.98</b>	<b>0.98</b>	<b>0.98</b>	<b>0.99</b>
Sex												
Male	<b>1.23</b>	<b>1.14</b>	<b>1.34</b>	<b>1.25</b>	<b>1.12</b>	<b>1.39</b>	<b>1.29</b>	<b>1.23</b>	<b>1.35</b>	<b>1.55</b>	<b>1.34</b>	<b>1.79</b>
Female	1.00	—	—	1.00	—	—	1.00	—	—	1.00	—	—
Score on the Charlson comorbidity index												
1+	1.04	0.93	1.15	1.11	0.98	1.27	<b>1.18</b>	<b>1.12</b>	<b>1.24</b>	1.10	0.93	1.29
0 or missing	1.00	—	—	1.00	—	—	1.00	—	—	1.00	—	—
Cancer type												
Breast	0.92	0.78	1.10	0.96	0.75	1.21	<b>0.83</b>	<b>0.76</b>	<b>0.91</b>	1.05	0.77	1.42
Colorectal	1.08	0.95	1.23	1.18	0.98	1.41	<b>0.88</b>	<b>0.82</b>	<b>0.95</b>	1.06	0.86	1.32
Prostate	<b>1.11</b>	<b>1.01</b>	<b>1.21</b>	0.86	0.66	1.12	<b>0.73</b>	<b>0.66</b>	<b>0.81</b>	0.86	0.64	1.16
Other	0.88	0.73	1.05	<b>1.35</b>	<b>1.19</b>	<b>1.53</b>	1.00	0.95	1.05	1.04	0.89	1.22
Lung	1.00	—	—	1.00	—	—	1.00	—	—	1.00	—	—
Neighbourhood income quintile												
1 (lowest)	0.98	0.87	1.11	1.16	0.99	1.37	<b>1.10</b>	<b>1.03</b>	<b>1.18</b>	1.22	0.99	1.51
2	0.99	0.88	1.12	1.08	0.91	1.27	<b>1.09</b>	<b>1.01</b>	<b>1.16</b>	1.14	0.92	1.42
3	1.03	0.91	1.17	1.12	0.95	1.32	<b>1.09</b>	<b>1.02</b>	<b>1.17</b>	1.07	0.86	1.33
4	1.02	0.90	1.15	1.05	0.89	1.25	1.06	0.98	1.13	1.25	1.00	1.55
5 (highest)	1.00	—	—	1.00	—	—	1.00	—	—	1.00	—	—
Community size												
<10,000	<b>1.73</b>	<b>1.53</b>	<b>1.95</b>	<b>2.73</b>	<b>2.18</b>	<b>3.42</b>	<b>1.47</b>	<b>1.37</b>	<b>1.57</b>	<b>1.59</b>	<b>1.06</b>	<b>2.39</b>
10,000–99,999	<b>1.52</b>	<b>1.36</b>	<b>1.70</b>	<b>2.04</b>	<b>1.56</b>	<b>2.65</b>	<b>1.32</b>	<b>1.22</b>	<b>1.42</b>	1.31	0.98	1.76
≥100,000	1.00	—	—	1.00	—	—	1.00	—	—	1.00	—	—
Healthcare service area												
Health Authority (BC)												
Fraser	1.00	—	—									
Interior	0.88	0.78	1.01									
Northern	1.03	0.86	1.23									
Vancouver Coastal	<b>1.21</b>	<b>1.08</b>	<b>1.34</b>									
Vancouver Island	0.95	0.84	1.07									
Health Zone (AB)												
South				1.00	—	—						
Calgary				1.08	0.83	1.40						
Central				1.16	0.95	1.41						
Edmonton				<b>1.67</b>	<b>1.25</b>	<b>2.25</b>						
North				<b>1.40</b>	<b>1.14</b>	<b>1.72</b>						

TABLE IV Continued

Factor	British Columbia			Alberta			Ontario			Nova Scotia		
	OR	95% CL		OR	95% CL		OR	95% CL		OR	95% CL	
		Lower	Upper		Lower	Upper		Lower	Upper		Lower	Upper
Local Health Integration Network (ON)												
Erie St. Clair							1.08	0.96	1.21			
South West							1.08	0.97	1.21			
Waterloo Wellington							1.08	0.96	1.22			
Hamilton Niagara Haldimand Brant							1.00	0.90	1.10			
Central West							1.17	1.02	1.33			
Mississauga Halton							1.16	1.04	1.31			
Toronto Central							1.00	—	—			
Central							1.12	1.01	1.24			
Central East							1.03	0.93	1.14			
South East							0.91	0.80	1.04			
Champlain							0.86	0.77	0.96			
North Simcoe Muskoka							1.20	1.05	1.37			
North East							1.15	1.02	1.29			
North West							0.86	0.72	1.02			
District Health Authority (NS)												
South Shore										1.01	0.69	1.47
South West										0.90	0.61	1.32
Annapolis Valley										1.04	0.72	1.50
Colchester East-Hants										0.92	0.61	1.39
Cumberland										1.10	0.73	1.66
Pictou										1.39	0.90	2.14
Guysborough–Antigonish Strait										1.18	0.80	1.74
Cape Breton										1.25	1.03	1.53
Capital										1.00	—	—
Year of death												
2004–2005	0.97	0.86	1.09	1.11	0.95	1.30	1.03	0.96	1.10	1.27	1.03	1.57
2005–2006	0.92	0.81	1.03	1.10	0.94	1.28	1.00	0.94	1.07	1.16	0.94	1.44
2006–2007	1.02	0.90	1.14	1.00	0.85	1.17	0.99	0.93	1.06	1.31	1.06	1.61
2007–2008	0.95	0.84	1.07	0.99	0.84	1.16	1.01	0.95	1.08	1.18	0.95	1.46
2008–2009	1.00	—	—	1.00	—	—	1.00	—	—	1.00	—	—

<sup>a</sup> Boldface type indicates significant values.  
OR = odds ratio; CL = confidence limits.

**TABLE V** Multivariable logistic regression model for supportive care<sup>a</sup>

Factor	British Columbia			Ontario			Nova Scotia		
	OR	95% CI		OR	95% CI		OR	95% CI	
		Lower	Upper		Lower	Upper		Lower	Upper
Age (years)	<b>0.97</b>	<b>0.97</b>	<b>0.97</b>	<b>0.98</b>	<b>0.98</b>	<b>0.98</b>	<b>0.98</b>	<b>0.97</b>	<b>0.98</b>
Sex									
Male	0.96	0.91	1.01	<b>0.96</b>	<b>0.93</b>	<b>0.99</b>	<b>0.90</b>	<b>0.83</b>	<b>0.99</b>
Female	1.00	—	—	1.00	—	—	1.00	—	—
Score on the Charlson comorbidity index									
1+	<b>0.91</b>	<b>0.85</b>	<b>0.97</b>	<b>0.67</b>	<b>0.65</b>	<b>0.69</b>	<b>0.69</b>	<b>0.62</b>	<b>0.76</b>
0 or missing	1.00	—	—	1.00	—	—	1.00	—	—
Cancer type									
Breast	<b>0.78</b>	<b>0.70</b>	<b>0.87</b>	0.97	0.92	1.03	<b>0.72</b>	<b>0.60</b>	<b>0.86</b>
Colorectal	<b>0.87</b>	<b>0.80</b>	<b>0.95</b>	1.01	0.96	1.06	0.97	0.85	1.12
Prostate	<b>0.77</b>	<b>0.72</b>	<b>0.82</b>	0.94	0.88	1.00	<b>0.78</b>	<b>0.65</b>	<b>0.93</b>
Other	<b>0.84</b>	<b>0.76</b>	<b>0.94</b>	<b>0.81</b>	<b>0.78</b>	<b>0.84</b>	<b>0.82</b>	<b>0.74</b>	<b>0.91</b>
Lung	1.00	—	—	1.00	—	—	1.00	—	—
Neighbourhood income quintile									
1 (lowest)	<b>0.74</b>	<b>0.69</b>	<b>0.80</b>	<b>0.73</b>	<b>0.70</b>	<b>0.77</b>	0.87	0.77	1.00
2	<b>0.87</b>	<b>0.80</b>	<b>0.94</b>	<b>0.84</b>	<b>0.80</b>	<b>0.88</b>	0.89	0.78	1.01
3	<b>0.87</b>	<b>0.80</b>	<b>0.94</b>	<b>0.86</b>	<b>0.82</b>	<b>0.90</b>	0.99	0.86	1.13
4	<b>0.90</b>	<b>0.83</b>	<b>0.97</b>	<b>0.92</b>	<b>0.88</b>	<b>0.96</b>	1.00	0.88	1.15
5 (highest)	1.00	—	—	1.00	—	—	1.00	—	—
Community size									
<10,000	<b>0.91</b>	<b>0.83</b>	<b>0.99</b>	<b>0.93</b>	<b>0.89</b>	<b>0.97</b>	<b>0.55</b>	<b>0.42</b>	<b>0.72</b>
10,000–99,999	1.02	0.95	1.10	0.96	0.92	1.01	<b>0.60</b>	<b>0.49</b>	<b>0.72</b>
≥100,000	1.00	—	—	1.00	—	—	1.00	—	—
Healthcare service area									
Health Authority (BC)									
Fraser	1.00	—	—						
Interior	1.20	1.06	1.37						
Northern	<b>0.84</b>	<b>0.75</b>	<b>0.95</b>						
Vancouver Coastal	<b>1.10</b>	<b>1.03</b>	<b>1.17</b>						
Vancouver Island	<b>1.64</b>	<b>1.53</b>	<b>1.76</b>						
Local Health Integration Network (ON)									
Erie St. Clair				<b>1.13</b>	<b>1.05</b>	<b>1.22</b>			
South West				<b>0.78</b>	<b>0.73</b>	<b>0.84</b>			
Waterloo Wellington				<b>1.55</b>	<b>1.43</b>	<b>1.67</b>			
Hamilton Niagara Haldimand Brant				<b>1.24</b>	<b>1.17</b>	<b>1.32</b>			
Central West				<b>0.72</b>	<b>0.66</b>	<b>0.78</b>			
Mississauga Halton				0.94	0.87	1.01			
Toronto Central				1.00	—	—			

TABLE V Continued

Factor	British Columbia			Ontario			Nova Scotia		
	OR	95% CL		OR	95% CL		OR	95% CL	
		Lower	Upper		Lower	Upper		Lower	Upper
Local Health Integration Network (ON)									
Central				1.01	0.95	1.08			
Central East				1.04	0.98	1.11			
South East				1.01	0.93	1.09			
Champlain				<b>1.42</b>	<b>1.33</b>	<b>1.52</b>			
North Simcoe Muskoka				<b>1.10</b>	<b>1.01</b>	<b>1.20</b>			
North East				<b>0.81</b>	<b>0.75</b>	<b>0.88</b>			
North West				<b>0.63</b>	<b>0.56</b>	<b>0.70</b>			
District Health Authority (NS)									
South Shore							<b>1.53</b>	<b>1.20</b>	<b>1.96</b>
South West							<b>1.71</b>	<b>1.34</b>	<b>2.18</b>
Annapolis Valley							<b>1.51</b>	<b>1.19</b>	<b>1.93</b>
Colchester East Hants							<b>1.75</b>	<b>1.33</b>	<b>2.30</b>
Cumberland							0.89	0.68	1.16
Pictou							<b>2.23</b>	<b>1.65</b>	<b>3.01</b>
Guysborough–Antigonish Strait							1.08	0.84	1.40
Year of death									
2004–2005	1.06	0.97	1.15	NA	NA	NA	NA	NA	NA
2005–2006	<b>1.10</b>	<b>1.01</b>	<b>1.19</b>	0.98	0.93	1.02	<b>0.82</b>	<b>0.73</b>	<b>0.92</b>
2006–2007	<b>1.13</b>	<b>1.04</b>	<b>1.23</b>	0.98	0.95	1.02	0.92	0.82	1.03
2007–2008	<b>1.10</b>	<b>1.01</b>	<b>1.20</b>	1.00	0.96	1.04	0.95	0.85	1.07
2008–2009	1.00	—	—	1.00	—	—	1.00	—	—

<sup>a</sup> Home care and physician claims data from Alberta are not available to enable calculation of supportive care. Boldface type indicates significant values.

NA = not available.

required to produce these results was, however, tremendous and raises feasibility issues with respect to ongoing surveillance in the absence of a more integrated national data platform. Future work in this arena would be facilitated by data-sharing arrangements at the national level.

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#### CONFLICT OF INTEREST DISCLOSURES

We have read and understood *Current Oncology's* policy on disclosing conflicts of interest and we declare that we have none.

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