

A population-level comparison of cancer-related and non-cancer-related health care costs using publicly available provincial administrative data

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ABSTRACT

Introduction Costs associated with cancer care are increasing. Cancer costs in the context of other common non-cancer diagnoses have not been extensively studied at the population level. Knowledge from such analyses can inform health care resource allocation and highlight strategies to reduce overall costs.

Methods Using cross-sectional data from publicly available population-level administrative data sources (health insurance claims, physician billing, and hospital discharge abstracts), we calculated incidence-adjusted health care costs (in 2014 Canadian dollars) for cancers and common non-cancer diagnoses in the adult population in a large Canadian province. Subgroup analyses were also performed for various provincial health administrative regions.

Results Total costs related to cancer care amounted to \$495 million for the province, of which at least \$67 million (14%) was attributable to radiation and chemotherapy. Of the various cancer subtypes, hematologic malignancies were most costly at \$70 million, accounting for 14% of the total cancer budget. Colon cancer followed at \$51 million (10%), and lung cancer, at \$44 million (9%). Cancer costs (with and without costs for radiation and chemotherapy) exceeded those for cardiovascular disease, diabetes mellitus, mental health, and trauma ($p < 0.001$). In addition, the costs of specific cancer subtypes varied by region, but hematologic and lung cancers were typically the most costly no matter the health region.

Conclusions Using provincial administrative data to establish cost trends can help to inform health care allocation and budget decisions, and can facilitate comparisons between provinces.

Key Words Cancer costs, health care costs, administrative databases, health economics

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INTRODUCTION

Costs associated with cancer care in Canada are increasing¹. A recent review of case-based administrative data from Ontario revealed a substantial increase in total cancer costs to \$7.5 billion in 2012 from \$2.9 billion in 2005². Cancer costs in the context of other common non-cancer diagnoses have not been extensively studied, particularly in Alberta. The Alberta Health Services (AHS) Secondary Use Data Project^{3,4} recently released publicly available

population data to expand the access and use of such information for research. The relevant datasets have been only infrequently analyzed for population-level outcomes.

As of 2014, Alberta had a growing population of 4.1 million, with 1.5 million and 1.3 million residing in the two largest AHS zones (Calgary and Edmonton respectively). The province has 2 academic centres, 4 regional cancer centres, and 11 community oncology sites. An understanding of the costs associated with cancers compared with the costs for other common non-cancer diagnoses can inform

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health care resource allocation and highlight strategies to reduce overall system costs. Specifically, we aimed to determine whether the cost per patient for cancer was greater than the cost per patient for other common non-cancer diagnoses managed in the primary care setting, and to characterize the distribution of costs by cancer subtype in a representative Canadian province.

METHODS

The publicly available province-wide administrative data from the AHS Secondary Use Data Project comprise summative information from health insurance claims, physician claims, hospital clinics, hospital discharge abstracts, and AHS financial records spanning 3 years of visits (April 2013 to April 2016) by diagnosis and 1 year of costs (April 2014 to April 2015) by diagnosis. In the case of physician claims data, costs were assigned based on physician billing records. For hospital clinic, emergency, and inpatient visits, the costs were assigned based on individual visit “intensity.” Furthermore, the relevant data were made available already age- and sex-standardized to allow for better comparisons by geographic region. Patients with a specific disease who had at least 1 encounter with the health care system during the 3-year period contributed to the prevalence (denominator) for a specific disease. If patients had multiple diseases and related health care visits, they were counted in the disease prevalence for each condition.

Our aim was to evaluate costs related to cancer and common non-cancer comorbidities. We calculated incidence-adjusted health care system costs (disease-specific cost per patient per year in 2014 Canadian dollars) for common non-cancer diagnoses in the adult population of Alberta. For example, the annual cost per patient with lung cancer was determined using 1 year of health care costs divided by 1 year of lung cancer prevalence data.

Disease groups included all cancers (subdivided into solid tumours, hematologic cancers, and radiation or chemotherapy), cardiovascular disease, diabetes mellitus, musculoskeletal conditions, mental health conditions, and trauma (supplemental Table 1). Total and average incidence-adjusted costs by health administrative region were also calculated. Data for AHS zones outside of Calgary and Edmonton (specifically the Central, North, and South zones) were pooled as an “Other” category. Province-wide averages were calculated from regional incidence-adjusted costs. Single-factor analysis of variance was used to compare the province-wide average costs for all cancers with those for other common non-cancer diagnoses, and to compare average costs between the cancer subtypes. Incidence rates and costs for which the health region was unknown (for example, chemotherapy and radiation) were excluded from the regional comparisons.

RESULTS

Total provincial costs related to cancer care between April 2014 and April 2015 amounted to \$495.8 million. Solid tumours cost \$357.5 million (72.1% of the total); hematologic cancers, \$70.3 million (14.2%); and radiation and chemotherapy, \$67.9 million (13.7%). Among the solid

tumour subtypes, colon cancer represented \$50.8 million of the total (14.2%); lung cancer, \$44.7 million (12.5%); breast cancer, \$27.8 million (7.8%); and prostate cancer, \$18.5 million (5.2%).

The cost per cancer patient per year for all cancers throughout the province amounted to \$6,486 with the cost of radiation and chemotherapy included and to \$5,597 without radiation and chemotherapy (Figure 1). When averaged for the Calgary, Edmonton, and Other zones, the cost of cancer per cancer patient exceeded the respective mean costs per patient for cardiovascular disease, diabetes mellitus, musculoskeletal conditions, mental health, and trauma-related diagnoses ($p < 0.001$, Table 1).

Cost per patient for each cancer subtype (excluding the costs of radiation and chemotherapy) varied by provincial administrative region (Figure 2). Per-patient costs specific to the cancer subtypes were greatest in the Edmonton zone, with hematologic cancers amounting to \$24,786 and solid tumours amounting to \$13,151. Among the solid tumour subtypes, the cost reached up to \$22,410 per lung cancer patient and up to \$20,858 per colon cancer patient, both within the Edmonton zone. Province-wide, costs were \$22,305 per lung cancer patient, \$19,723 per hematologic cancer patient, and \$19,100 per colon cancer patient. When averaged across provincial zones, cancer subtype costs were significantly different ($p < 0.001$, Table 1).

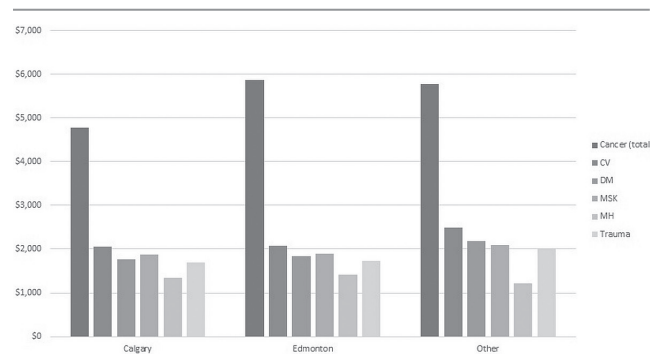


FIGURE 1 Cancer diagnosis-specific and selected non-cancer diagnosis-specific costs by Alberta Health Services zone (2014 Canadian dollars). Costs of radiation and chemotherapy are excluded from the total cancer costs. CV = cardiovascular; DM = diabetes mellitus; MSK = musculoskeletal; MH = mental health.

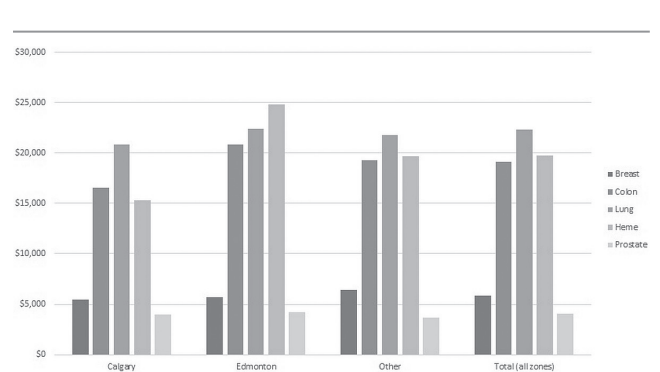


FIGURE 2 Cancer subtype-specific costs by Alberta Health Services zone (2014 Canadian dollars).

TABLE 1 Comparison of mean annual patient-specific costs for all cancers and common non-cancer diagnoses and for cancer subtypes in Alberta

Disease group	Mean cost (2014 CA\$)	Single-factor ANOVA <i>p</i> value
All cancer and non-cancer diagnoses		<0.001
Cancer		
With R&C costs	6,409±777	
Without R&C costs	5,472±606	
Cardiovascular	2,225±206	
Diabetes mellitus	1,935±182	
Musculoskeletal	1,968±108	
Mental health	1,344±89	
Trauma	1,840±159	
Cancer subtypes		0.0004
Breast	5,852±466	
Colon	18,884±2,199	
Lung	21,674±783	
Prostate	3,965±261	
Hematologic	19,914±4,740	

ANOVA = analysis of variance; R&C = radiation and chemotherapy.

DISCUSSION

This descriptive analysis used publicly available administrative data for cancer and common non-cancer disease prevalence over 3 years and costs over 1 year in Alberta. When the data were pooled for the purpose of comparison, we observed that incidence-adjusted cancer costs, with and without consideration of the costs of radiation and chemotherapy, exceeded those of other common non-cancer diagnoses frequently managed in the primary care setting. In addition, we also noted regional differences in the costs pertaining to specific cancer subtypes.

Growing fiscal constraints in Canada make the use of administrative data for cost evaluations increasingly important⁵. Although some prior population-based reports have characterized cancer costs in Canada^{1,6}, they might have underestimated the financial impact of cancer because of the lack of comprehensive cost data—for example, radiation and chemotherapy costs being excluded². Furthermore, most existing cancer cost studies^{7–10} were conducted in health care settings different from that in Canada, where patients might incur significant out-of-pocket costs or where most of the costs were likely to have been covered by private insurers¹¹.

With the steady introduction of novel anticancer drugs, all of which are increasingly expensive, a contemporary and systematic reassessment of cancer costs is both timely and relevant. Our study findings add to the literature by demonstrating at the population level that cancer-related costs in a universal health care system are substantial. Further, they roughly quantify the degree of difference in costs between cancer and common non-cancer diagnoses.

Our calculation of patient-specific costs showed that costs for cancer diagnoses tended to be greater than the costs for other non-cancer diagnoses for patients in the province of Alberta overall. In contrast, prior population-level studies have described overall system costs or total budget impact, for which cardiovascular disease is often ranked highest^{1,6}. Our analysis provides a different population-based perspective of cancer costs. However, to clearly establish differences in cost, a cohort of cancer patients would have to be compared with a cohort of non-cancer patients, with the two cohorts being matched in other characteristics. Such an analysis was beyond the scope of the present study.

Interestingly, cost per patient for specific cancer subtypes varied across the province. The differences between the major zones (Calgary and Edmonton) and the “Other” zone could be related to disparities in cancer care between urban and rural locales. Inequities in access to cancer care based on geographic region are an issue that is increasingly being recognized in Canada¹². Variations between the major centres could be related to institutional differences in management or differences in population demographics and other risk factors that affect cancer incidence. Further research with administrative data is needed to help elucidate some of the reasons for the discordances.

The fact that per-patient costs for a cancer diagnosis were greater than the costs for most other non-cancer diagnoses, even when radiation and chemotherapy were excluded from the calculations, suggests that other areas of cancer care are also becoming more expensive. For example, patients who, because of frailty, did not receive chemotherapy or radiation might be more likely to use acute-care services such as the emergency department and to experience extended inpatient hospital stays, which have a significant cost impact on the health care system².

In a prior study in Alberta that examined the cost of lung cancer care¹³, the average total cost per case during 2 years of follow-up amounted to \$18,243 ± \$13,647 in 2007 Canadian dollars (\$20,473 ± \$15,314 in 2014 Canadian dollars). The annual cost per lung cancer patient reported in the present analysis is higher. A potential reason for the discrepancy is that patients diagnosed in recent years are more likely to have been exposed to additional lines of therapy as the number of therapeutic options continued to grow. For instance, where only 2 lines of treatment for metastatic non-small-cell lung cancer were available a decade ago, up to 4 lines of therapy are now currently available¹⁴. Furthermore, the newer agents often come at a much higher cost.

The use of publicly available administrative data has limitations¹⁵. For example, late-stage cancers have been shown to incur higher costs¹⁰. However, our data did not include staging information. Further, prior studies of cancer costs have frequently used costs from a small number of pharmacies and hospitals rather than from the provincial health care system overall^{13,15,16}. The latter costs could differ from those used in our study based on how they were derived. Although our administrative dataset is useful for assessing actual costs from the perspective of the health care system, our analysis did not account for indirect costs such as lost productivity attributable to illness. Wage losses attributable to new cancer diagnoses during 2009 in Canada

have been estimated at up to \$3.18 billion¹⁷. In addition, Oliveira *et al.*² found that a substantial component of cancer costs in Ontario were related to hospital-based care. Our analysis was unable to differentiate inpatient from outpatient costs or other specific expense drivers. Furthermore, cancer screening and community-based pharmacy costs were not captured in the dataset. The absence of those data sources therefore results in an underestimation of disease costs and might select for higher cancer-related costs, given that many prescriptions might have been provided in hospital-associated centres. It is anticipated that future phases of the AHS Secondary Use Data Project will offer more granular data to help determine the specific drivers of cancer costs in Alberta.

Nonetheless, the present analysis illustrates an efficient method of using readily available datasets to compare the costs of care for cancer and for other non-cancer diagnoses at the population level. Further research is needed to determine trends in such costs in Alberta. As advances in cancer diagnosis and management continue to develop and as survival in many cancers continues to improve, future studies might show an increase in the lifetime costs of cancer care that could exceed the costs for other chronic diseases. Such information could be useful in health care budget planning.

Further defining the cost of cancer care in Alberta will also allow for comparisons with other provinces. Cancer-related costs were recently shown to vary between British Columbia and Ontario¹⁶. Cost comparisons between centres could help to refine cancer management options and to improve cost-effectiveness¹⁵.

CONCLUSIONS

Administrative datasets represent a simple and accessible means to establish cost trends that could help to inform health care allocation and budget decision-making provincially and nationally. Analyses of publicly available data will also facilitate repeated interprovincial comparisons at regular intervals and allow for iterative assessments over time to detect cost trends. Other jurisdictions are strongly encouraged to provide similar data for cost research.

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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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