

A first look at relative survival by stage for colorectal and lung cancers in Canada

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ABSTRACT

Monitoring and reporting on cancer survival provides a mechanism for understanding the effectiveness of Canada's cancer care system. Although 5-year relative survival for colorectal cancer and lung cancer has been previously reported, only recently has pan-Canadian relative survival by stage been analyzed using comprehensive registry data. This article presents a first look at 2-year relative survival by stage for colorectal and lung cancer across 9 provinces.

As expected, 2-year age-standardized relative survival ratios (ARSRS) for colorectal cancer and lung cancer were higher when the cancer was diagnosed at an earlier stage. The ARSRS for stage I colorectal cancer ranged from 92.2% in Nova Scotia [95% confidence interval (CI): 88.6% to 95.1%] to 98.4% in British Columbia (95% CI: 96.2% to 99.3%); for stage IV, they ranged from 24.3% in Prince Edward Island (95% CI: 15.2% to 34.4%) to 38.8% in New Brunswick (95% CI: 33.3% to 44.2%). The ARSRS for stage I lung cancer ranged from 66.5% in Prince Edward Island (95% CI: 54.5% to 76.5%) to 84.8% in Ontario (95% CI: 83.5% to 86.0%). By contrast, ARSRS for stage IV lung cancer ranged from 7.6% in Manitoba (95% CI: 5.8% to 9.7%) to 13.2% in British Columbia (95% CI: 11.8% to 14.6%).

The available stage data are too recent to allow for meaningful comparisons between provinces, but over time, analyzing relative survival by stage can provide further insight into the known differences in 5-year relative survival. As the data mature, they will enable an assessment of the extent to which interprovincial differences in relative survival are influenced by differences in stage distribution or treatment effectiveness (or both), permitting targeted measures to improve population health outcomes to be implemented.

Key Words Lung cancer, colorectal cancer, relative survival by stage

Curr Oncol. 2016 Apr;23(2):119-124

www.current-oncology.com

INTRODUCTION

Colorectal cancer and lung cancer are two of the most common cancers affecting Canadians. In 2015, an estimated 25,100 people were diagnosed with colorectal cancer and 26,600 were diagnosed with lung cancer, with 5-year relative survival ratios of 65% and 18% respectively^{1,2}.

To date, pan-Canadian reporting of cancer outcomes, undertaken in collaboration with provincial and territorial partners, has focused on 5-year relative survival, which is important for monitoring the success of cancer control initiatives³. However, those estimates fail to distinguish the degree to which differences in relative survival can be explained by early or late diagnosis rather than by variation in treatment practices.

Relative survival for both colorectal and lung cancer varies across the country² and merits further exploration with respect to the underlying factors causing the differences. Through the National Cancer Staging Initiative led by

the Canadian Partnership Against Cancer, population-level staging data for colorectal cancer and lung cancer became available in 9 provinces starting in 2010⁴. The availability of staging data made a collaborative project to analyze relative survival by stage possible for the first time. Because of the timing of staging data availability, the analysis of relative survival could include only the 2-year ratios.

This article presents a first look at 2-year relative survival by stage for colorectal cancer and lung cancer and at how data of this kind can be used to provide important insight into the burden of cancer in Canada. As the data mature, future work will focus on determining whether and to what extent there is clear interprovincial variation in relative survival by stage.

METHODS

Analysts in each province used their provincial cancer registry to perform relative survival analyses for all

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colorectal and lung cancer patients for whom staging data were available. All used common case selection procedures and data quality protocols, together with a standardized macro adapted from a publicly available algorithm⁵ for the SAS software application (SAS Institute, Cary, NC, U.S.A.). The analysis method was developed by the authors (RD, LS, DN, JN, GL). Results were compiled centrally for presentation.

Using the complete analysis method, relative survival was estimated as the ratio of the observed survival for people diagnosed with cancer to the survival expected for the general population of the same sex, age, province at time of diagnosis and time period. The Ederer II approach⁶ was used to derive expected survival proportions from sex- and period-specific complete provincial life tables⁷. Estimates were age-standardized using the International Cancer Survival Standard weights⁸. Where numbers were too small to allow for age standardization, crude relative survival ratios are presented.

Because stage data were available only from 2010, colorectal and lung cancers were analyzed for the combined years 2010–2012, and relative survival was calculated up to 2 years for all provinces except Prince Edward Island. Relative survival estimates for Prince Edward Island were based on 5 diagnosis years (2008–2012) because the additional years increased the sample size sufficiently to enable reporting and because staging data were available for all 5 years.

RESULTS

Colorectal Cancer

The stage distribution for colorectal cancer was similar across provinces, with the disease most commonly diagnosed at stages II and III (Table 1). Designations of “unknown stage” were notably high in British Columbia and Ontario compared with the other provinces (14.6% and 15.9% respectively, compared with a low of 2.8% in Newfoundland and Labrador).

The 2-year age-standardized relative survival ratios (ARSRS) ranged from 71.9% in Prince Edward Island [95% confidence interval (CI): 66.7% to 76.4%] to 77.9% in New Brunswick (95% CI: 75.4% to 80.1%; Table 1, Figure 1). As expected, the 2-year ARSRS were higher in all provinces at the early and intermediate stages than at stage IV. The ARSRS for stage I colorectal cancer ranged from 92.2% in Nova Scotia (95% CI: 88.6% to 95.1%) to 98.4% in British Columbia (95% CI: 96.2% to 99.3%). The ARSRS for stage II ranged from 86.0% in Prince Edward Island (95% CI: 75.4% to 92.3%) to 95.2% in New Brunswick (95% CI: 91.1% to 97.4%). The ARSRS for stage III ranged from 83.1% in Newfoundland and Labrador (95% CI: 77.6% to 87.4%) to 88.7% in New Brunswick (95% CI: 84.3% to 92.0%). The ARSRS for stage IV ranged from 24.3% in Prince Edward Island (95% CI: 15.2% to 34.4%) to 38.8% in New Brunswick (95% CI: 33.3% to 44.2%).

Lung Cancer

Most lung cancer cases were diagnosed at stage IV (Table 1). Again, designations of “unknown stage” were higher in British Columbia and Ontario than in other provinces (7.1% and 16.2% respectively, compared with a low of 0.8% in Manitoba).

The 2-year ARSRS ranged from 26.6% in Prince Edward Island (95% CI: 22.7% to 30.7%) to 35.0% in New Brunswick (95% CI: 31.9% to 38.2%; Figure 2, Table 1). The ARSRS for stage I lung cancer ranged from 66.5% in Prince Edward Island (95% CI: 54.5% to 76.5%) to 84.8% in Ontario (95% CI: 83.5% to 86.0%). The ARSRS for stage II ranged from 42.5% in Newfoundland and Labrador (95% CI: 30.0% to 54.7%) to 64.2% in Ontario (95% CI: 61.4% to 66.8%). The ARSRS for stage III ranged from 28.7% in Prince Edward Island and Saskatchewan (95% CI: 20.3% to 37.6% and 23.9% to 33.7% respectively) to 37.0% in New Brunswick (95% CI: 31.0% to 43.1%). The ARSRS for stage IV ranged from 7.6% in Manitoba (95% CI: 5.8% to 9.7%) to 13.2% in British Columbia (95% CI: 11.8% to 14.6%).

DISCUSSION AND CONCLUSIONS

This article presents a first look at early results for 2-year relative survival by stage for colorectal and lung cancer in Canada. Relative survival can be influenced by numerous factors. Variations in the distribution of stage at diagnosis (resulting from different screening and early-detection practices) can influence overall relative survival (all stages combined), and differences in treatment options or access to care (or both) can affect relative survival both overall and by stage^{9,10}. Comorbidities can also influence patient outcomes^{11,12}.

Stage distribution can affect overall relative survival outcomes. More late-stage diagnoses will result in lower overall relative survival. For example, Saskatchewan and Alberta have low overall lung cancer ARSRS relative to the other provinces although the ARSRS for the individual stages are comparable. However, the proportion of stage IV cases is high. That observation would suggest that reducing the number of cases diagnosed late, potentially through increased early detection and screening, could help to improve the overall relative survival. Comparing relative survival by stage with stage distribution could identify how screening and early detection practices evolve over time and how they influence patient outcomes.

Relative survival by stage can potentially also illustrate how successful different provinces are at treating colorectal and lung cancers and can provide insight into whether treatment practices vary across the country. Because all provinces use Collaborative Stage version 2, the expectation is that staging is performed consistently across the country, meaning that colorectal and lung cancer patients diagnosed at the same stage should have generally the same characteristics. Any difference in relative survival for a particular stage should be minimal across the country. However, even the early data show a statistically significant difference in 2-year relative survival between provinces for 3 of the 4 lung cancer stages (I, II, and IV). For example, the ARSR for stage IV lung cancer in British Columbia is almost double that in Manitoba. Differentials might indicate that where a patient lives in Canada influences how their cancer is treated and how likely they are to survive. Differences observed at this point might or might not be sustained as the data mature; however, they merit monitoring over time. Striving for consistency in cancer treatment across Canada could minimize differences in relative survival.

TABLE I Case distribution and 2-year age-standardized relative survival ratios (ARSRs) for colorectal cancer and lung cancer, by province, 2010–2012 diagnosis years combined^a

Province	Cancer stage ^b	Colorectal cancer				Lung cancer			
		Total cases		ARSR	95% CI	Total cases		ARSR	95% CI
		(n)	(%)	(%)		(n)	(%)	(%)	
BC	All	8,288	100	76.9	75.8 to 77.9	8,457	100	31.5	30.2 to 32.8
	I	1,171	14.1	98.4	96.2 to 99.3	1,192	14.1	79.7	76.6 to 82.4
	II	2,053	24.8	94.2	92.6 to 95.4	665	7.9	60.9	56.7 to 64.8
	III	2,285	27.6	83.6	81.7 to 85.3	1,740	20.6	36.3	33.4 to 39.2
	IV	1,570	18.9	33.1	30.5 to 35.6	4,259	50.4	13.2	11.8 to 14.6
	Unknown	1,209	14.6			601	7.1		
AB	All	5,282	100	74.8	73.5 to 76.1	5,535	100	30.2	28.7 to 31.8
	I	1,038	19.7	94.6	92.5 to 96.2	906	16.4	81.9	78.9 to 84.6
	II	1,263	23.9	93.4	91.2 to 95.0	429	7.8	63.7	58.5 to 68.4
	III	1,512	28.6	86.0	83.7 to 88.0	1,011	18.3	35.4	31.9 to 39.0
	IV	1,250	23.7	29.5	26.8 to 32.2	3,113	56.2	9.7	8.3 to 11.2
	Unknown	219	4.1			76	1.4		
SK	All	2,190	100	75.6	73.5 to 77.7	2,246	100	28.9	26.3 to 31.7
	I	524	23.9	95.3	92.2 to 97.2	365	16.3	83.0	78.1 to 86.9
	II	545	24.9	90.7	86.9 to 93.4	147	6.5	57.4	46.8 to 66.7
	III	541	24.7	87.0	83.1 to 90.1	420	18.7	28.7 ^c	23.9 to 33.7
	IV	492	22.5	29.7	25.3 to 34.2	1,276	56.8	10.3	8.1 to 12.9
	Unknown	88	4.0			38	1.7		
MB	All	2,441	100	76.4	74.3 to 78.3	2,479	100	32.5	30.2 to 34.7
	I	530	21.7	93.4	89.7 to 95.8	492	19.8	84.3	79.8 to 88.0
	II	617	25.3	91.4	88.1 to 93.9	234	9.4	61.3	53.9 to 67.9
	III	717	29.4	85.2	81.7 to 88.1	427	17.2	35.8	29.8 to 41.7
	IV	485	19.9	31.1	26.6 to 35.6	1,305	52.6	7.6	5.8 to 9.7
	Unknown	92	3.8			21	0.8		
ON	All	22,629	100	77.1	76.5 to 77.8	26,211	100	32.9	32.2 to 33.6
	I	4,420	19.5	96.4	95.5 to 97.2	3,932	15.0	84.8	83.5 to 86.0
	II	5,159	22.8	92.1	91.1 to 92.9	1,830	7.0	64.2	61.4 to 66.8
	III	5,760	25.5	85.2	84.1 to 86.3	4,451	17.0	36.9	35.1 to 38.7
	IV	3,682	16.3	34.4	32.7 to 36.1	11,748	44.8	10.7	9.9 to 11.5
	Unknown	3,608	15.9			4,250	16.2		
NB	All	1,619	100	77.9	75.4 to 80.1	1,992	100	35.0	31.9 to 38.2
	I	327	20.2	96.2	91.2 to 98.4	460	23.1	75.9 ^c	71.0 to 80.2
	II	427	26.4	95.2	91.1 to 97.4	185	9.3	59.2 ^c	50.8 to 66.8
	III	380	23.5	88.7	84.3 to 92.0	409	20.5	37.0	31.0 to 43.1
	IV	358	22.1	38.8	33.3 to 44.2	912	45.8	9.1	6.3 to 10.0
	Unknown	127	7.8			26	1.3		
NS	All	2,374	100	74.2	72.2 to 76.1	2,673	100	29.3	26.9 to 31.9
	I	520	21.9	92.2	88.6 to 95.1	519	19.4	77.2	70.6 to 82.6
	II	652	27.5	88.6	85.5 to 91.2	203	7.6	54.1	45.5 to 61.9
	III	644	27.1	83.3	79.8 to 86.2	457	17.1	30.5 ^c	25.9 to 35.2
	IV	488	20.6	28.5	24.1 to 33.2	1,449	54.2	9.3	7.1 to 11.9
	Unknown	70	2.9			45	1.7		

TABLE I Continued

Province	Cancer stage ^b	Colorectal cancer				Lung cancer			
		Total cases		ARSR	95% CI	Total cases		ARSR	95% CI
		(n)	(%)	(%)		(n)	(%)	(%)	
PE ^d	All	524	100	71.9	66.7 to 76.4	617	100	26.6 ^c	22.7 to 30.7
	I	102	19.5	96.1	84.0 to 99.1	100	16.2	66.5 ^c	54.5 to 76.5
	II	148	28.2	86.0	75.4 to 92.3	37	6.0	54.3 ^c	35.5 to 70.4
	III	131	25.0	88.5	78.2 to 94.1	153	24.8	28.7	20.3 to 37.6
	IV	119	22.7	24.3	15.2 to 34.4	319	51.7	8.3 ^c	5.1 to 12.4
	Unknown	24	4.6			8	1.3		
NL	All	1,534	100	77.0	73.9 to 79.9	1,236	100	31.1	27.1 to 35.1
	I	297	19.4	98.3	87.4 to 99.8	238	19.3	75.9 ^c	67.4 to 82.9
	II	414	27.0	93.2	87.7 to 96.3	108	8.7	42.5 ^c	30.0 to 54.7
	III	473	30.8	83.1	77.6 to 87.4	277	22.4	34.6	26.3 to 43.0
	IV	307	20.0	33.0	25.8 to 40.4	592	47.9	9.7	6.1 to 14.2
	Unknown	43	2.8			21	1.7		

^a Data source: Provincial cancer agencies.

^b "Unknown" generally includes unknown stage, missing stage, and stage not available.

^c The estimates were the corresponding crude relative survival ratios.

^d To increase the size of the sample, data include cases diagnosed during 2008–2012.

CI = confidence interval.

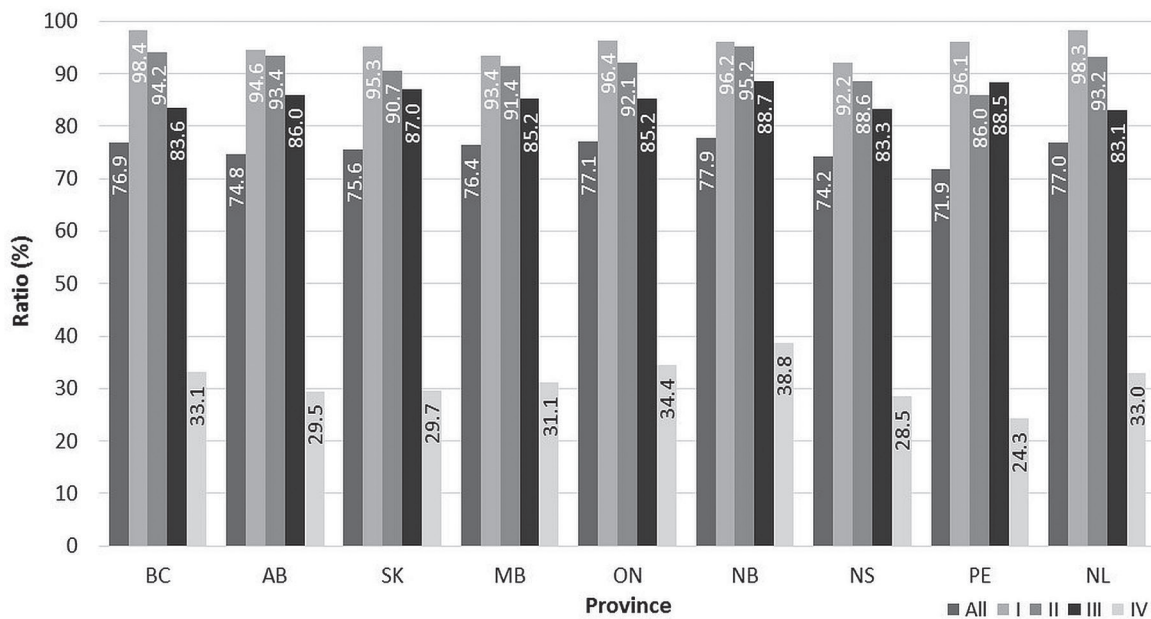


FIGURE 1 Two-year age-standardized relative survival ratios for colorectal cancer, by province and stage, 2010–2012 diagnosis years combined. To increase the size of the sample, data for Prince Edward Island include cases diagnosed during 2008–2012. Data source: Provincial cancer agencies.

It is important to note that “unknown stage” was recorded more often in British Columbia and Ontario than in other provinces. In British Columbia, the high proportion of unknown stage could result from a lack of available documentation for patients who are not referred to the BC Cancer Agency²; in Ontario, it could result from the cancer registry’s change to the multiple primary rules set out by

North American Association of Central Cancer Registries, starting with 2010 cases. That change could affect the distribution of cases, particularly for stages I and IV, because missing cases are likely to be early- or late-stage cancers, which could in turn influence the associated ARSRs.

Because of the timing of the National Cancer Staging Initiative (2010) and the most recent death clearance date

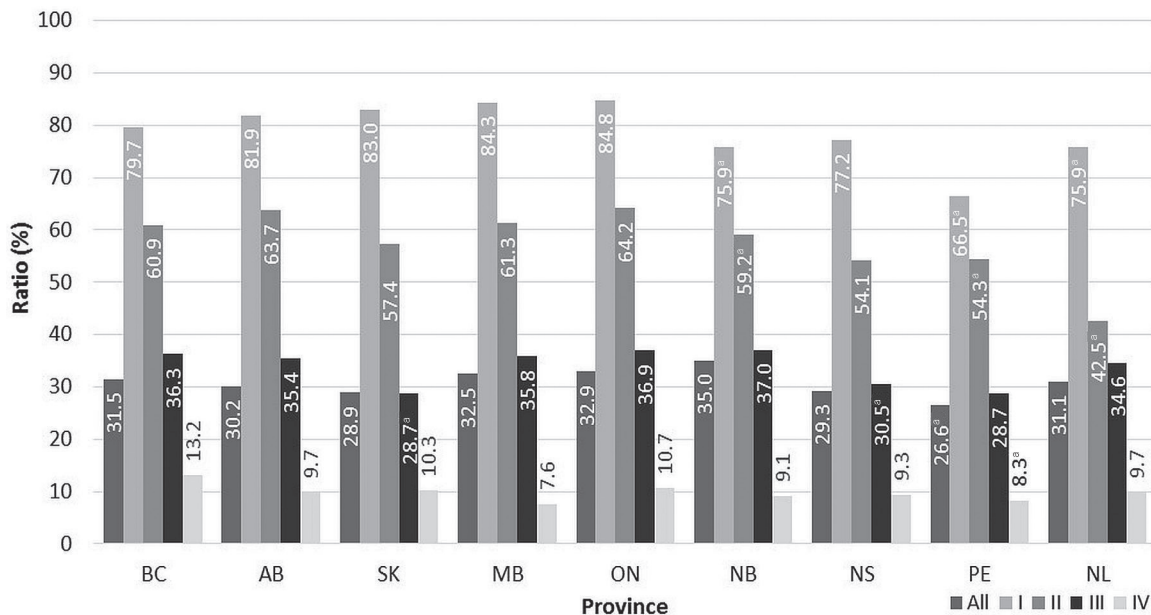


FIGURE 2 Two-year age-standardized relative survival ratios for lung cancer, by province and stage, 2010–2012 diagnosis years combined. To increase the size of the sample, data for Prince Edward Island include cases diagnosed during 2008–2012. ^a Estimates were the corresponding crude relative survival ratios. Data source: Provincial cancer agencies.

in each jurisdiction (2012 or 2013), only 2-year relative survival by stage could be calculated for most provinces at this time. It is therefore too soon to draw conclusions about provincial differences, because some provinces have small numbers of cases for particular stages, and additional years of data could not be combined to reach more precise estimates. However, relative survival at 2 years post-diagnosis is meaningful for colorectal and lung cancers and could yield an early signal of disparities across the country, which might be confirmed as Canada's staging data mature and more cases are captured, stabilizing the estimates. With the data collection and analysis foundation set, provincial estimates of relative survival by stage will be extended to include 5-year relative survival and also to look at other cancer sites.

It is important both to measure and to understand relative survival by stage so as to add to the evidence about the burden of cancer in Canada and to begin exploring whether differences in relative survival within stage exist between provinces and why. The results will allow for the deployment of targeted cancer control strategies that could ultimately improve equity in Canada's cancer control system and help to prevent potentially avoidable deaths.

ACKNOWLEDGMENTS

The authors gratefully acknowledge the efforts of the provincial analysts who conducted the analyses of relative survival by stage: Jinyu (Vickey) Bu, Ron Dewar, Katie Galloway, Yalda Jafari, Grace Musto, Gopinath Narasimhan, Devbani Raha, Gordon Walsh, Audrey Wong, Julie Xu, Yaling Yin, Bin Zhang. The authors also thank the System Performance Steering Committee and the Technical Working Group for reviewing the manuscript. This project was funded by the Canadian Partnership Against Cancer's Analytic Capacity Building and Coordinated Data Development Initiative.

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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