Research

Projected estimates of cancer in Canada in 2022

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Cite as: *CMAJ* 2022 May 2;194:E601-7. doi: 10.1503/cmaj.212097

Abstract

Background: Regular cancer surveillance is crucial for understanding where progress is being made and where more must be done. We sought to provide an overview of the expected burden of cancer in Canada in 2022.

Methods: We obtained data on new cancer incidence from the National Cancer Incidence Reporting System (1984–1991) and Canadian Cancer Registry (1992–2018). Mortality data (1984–2019) were obtained from the Canadian Vital Statistics — Death Database. We projected cancer incidence and mortality counts and rates to 2022 for 22 cancer types by sex and province or territory. Rates were age standardized to the 2011 Canadian standard population.

Results: An estimated 233 900 new cancer cases and 85 100 cancer deaths are expected in Canada in 2022. We expect the most commonly diagnosed cancers to be lung overall (30 000), breast in females (28 600) and prostate in males (24 600). We also expect lung cancer to be the leading cause of cancer death, accounting for 24.3% of all cancer deaths, followed by colorectal (11.0%), pancreatic (6.7%) and breast cancers (6.5%). Incidence and mortality rates are generally expected to be higher in the eastern provinces of Canada than the western provinces.

Interpretation: Although overall cancer rates are declining, the number of cases and deaths continues to climb, owing to population growth and the aging population. The projected high burden of lung cancer indicates a need for increased tobacco control and improvements in early detection and treatment. Success in breast and colorectal cancer screening and treatment likely account for the continued decline in their burden. The limited progress in early detection and new treatments for pancreatic cancer explains why it is expected to be the third leading cause of cancer death in Canada.

The impact of cancer on the Canadian population and health care systems is substantial. Cancer is the leading cause of death in Canada[1,2] and previous estimates have shown that 43% of all people in Canada are expected to receive a cancer diagnosis in their lifetime.[3] With an aging and growing population, the number of new cancer cases and deaths in Canada is also increasing.[4] In addition to its impact on health, cancer is costly. The economic burden of cancer care in Canada rose from $2.9 billion in 2005 to $7.5 billion in 2012, annually.[5]

Given the considerable health and economic impact of cancer in Canada, comprehensive and reliable surveillance information is necessary for identifying where progress has been made and where more attention and resources are needed. To meet these needs, the Canadian Cancer Statistics Advisory Committee, in collaboration with the Canadian Cancer Society, Statistics Canada and the Public Health Agency of Canada, produces the latest surveillance statistics on cancer in Canada.

Cancer data often lag the current date by several years, owing to the time associated with collecting, verifying and analyzing the data. Short-term cancer incidence and mortality rates can be projected by extrapolating past trends to estimate future trends, using statistical models. These short-term projections provide a more up-to-date estimate of the cancer landscape in Canada. Incidence and mortality counts, along with age-standardized rates, provide a picture of the impact of cancer in Canada, which is essential for resource planning, research and informing cancer-control programs.

Canadian Cancer Statistics 2021[3] provided detailed estimates of cancer incidence, mortality and survival in Canada by age, sex, geographic region and over time for 22 cancer types.[3] Here, we provide updated estimates of the counts and age-standardized rates of new cancer cases (incidence) and cancer deaths (mortality) expected in 2022 by sex and province and territory, for all ages combined.

Methods

Unless otherwise noted, the methods and data sources used in this study are as described in detail in *Canadian Cancer Statistics 2021*,[3] with additional years of data included in the projections shown previously.

Sources of data

We obtained data for cancer incidence from 1984 to 1991 from the National Cancer Incidence Reporting System, and data from 1992 to 2018 from the Canadian Cancer Registry Tabulation Master File,[6] released May 19, 2021. We obtained mortality data from 1984 to 2019 from the Canadian Vital Statistics — Death Database, released Nov. 26, 2020.[7] These national, population-based databases are housed at Statistics Canada and populated by provincial and territorial data submissions. We also obtained actual and projected population estimates from Statistics Canada.[8,9]

Statistical analysis

To obtain current estimates of cancer incidence and mortality, we projected counts and rates up to 2022 using the CANPROJ projection package.[10] CANPROJ uses trends in actual (i.e., historical) data to select the best-fit model for subsequent years based on a decision algorithm from a series of 6 age-, period- and cohort-based models. Details on the CANPROJ model selection are provided in Appendix 1 (available at www.cmaj.ca/lookup/doi/10.1503/cmaj.212097/tab-related-content).

Data on cancer cases diagnosed in the province of Quebec from 2011 onward were unavailable, as they had yet to be submitted to the Canadian Cancer Registry. Because data were available only up to 2010 for Quebec, we estimated Quebec-specific cases and incidence rates for 2011–2022 by first applying the rates of Canada without Quebec to the Quebec population. We then corrected Quebec rates based on the average rate for the rest of the country, multiplied by the ratio of sex-, age- and cancer-specific estimates for Quebec relative to Canada (excluding Quebec) for 2006–2010. Some additional correction factors were applied based on provisional 2011 counts for traditionally underreported cancers such as prostate cancer and melanoma.

We generated projected estimates for 22 cancer types by sex assigned at birth and geographic region (provinces and territories). Definitions of cancer types are shown in Appendix 1, Supplementary Table 1. We computed projected estimates for Canada as a whole as sums of the projections for each individual province and territory. All incidence and mortality rates were age standardized to the 2011 Canadian standard population[11] using the direct method.

Ethics approval

Because this study involved the analysis of administrative data publicly available in Statistics Canada's Research Data Centres and did not involve contacting individuals, consideration and approval by an ethics review board was not required.

Results

Incidence in 2022

In 2022, an estimated 233 900 new cancer cases will be diagnosed in Canada (Table 1). We expect lung cancer to be the most commonly diagnosed cancer in Canada, with an estimated 30 000 new cases in 2022. We project breast (28 900 cases), prostate (24 600) and colorectal (24 300) cancers to be the next most common cancers. The estimated 107 800 new cases of these 4 types represent 46% of all cancers expected to be diagnosed in Canada in 2022.

Among those assigned male at birth, we project prostate cancer to remain the most commonly diagnosed cancer, representing about 1 in 5 new cancers, followed by lung (12%), colorectal (11%) and bladder (8%) cancers. We expect the most commonly diagnosed cancers among those assigned female at birth to be breast (25%), lung (13%), colorectal (10%) and uterine (7%).

Age-standardized incidence rates (ASIRs) (Table 1) for Canada, excluding Quebec, show that cancer is diagnosed at a higher rate among males than females for all non-female-specific cancers, except thyroid and breast. The ASIR for all cancers combined in 2022 is 15% higher among males than females (555.4 v. 483.3 per 100 000). We project the total number of new cancer diagnoses to be 7% higher among males (121 100) than females (112 800).

Mortality in 2022

We project that 85 100 Canadians will die of cancer in 2022 (Table 2). The most common cause of cancer death is expected to be lung cancer, accounting for about one-quarter of all cancer deaths (20 700) in Canada. We project the next most common causes of cancer death will be colorectal (9400), pancreas (5700), breast (5500) and prostate (4600). We expect these 5 top causes of cancer death to account for 54% of all cancer deaths in Canada in 2022.

Among both males and females, lung cancer accounts for the highest number of cancer deaths (10 600 [24%] and 10 100 [25%] projected deaths, respectively). Colorectal (5200 [12%]), prostate (4600 [10%]) and pancreas (3000 [7%]) are the next most common causes of cancer death among males, while among females, the next leading causes of cancer death are breast (5500 [14%]), colorectal (4200 [11%]) and pancreas (2800 [7%]).

The number of cancer deaths expected in 2022 among males is 13% higher than among females. However, we expect the age-standardized mortality rate (ASMR) to be markedly higher (34% higher) among males than females (ASMR = 212.3 v. 158.5 per 100 000, respectively). Apart from breast cancer, we expect that males will have higher mortality rates from cancer for all other non-female-specific types of cancer (Table 2).

Incidence over time

Figure 1 depicts the trends in ASIR for the most common cancers among both males and females in Canada, between 1984 and 2022. The lung cancer incidence rate among males has declined significantly over this period and the ASIR in 2022 is projected to

Table 1: Projected estimates of new cases and age-standardized incidence rates (excluding Quebec) for cancers by sex, Canada, 2022*

	No. of new cases			ASIR†		
Type of cancer	Total‡	Males	Females	Both sexes	Males	Females
All cancers§	**233 900**	**121 100**	**112 800**	**514.0**	**555.4**	**483.3**
Lung and bronchus	30 000	15 000	15 000	58.7	61.0	57.2
Breast	28 900	270	28 600	67.6	1.2	129.0
Prostate	24 600	24 600	NA	NA	117.8	NA
Colorectal	24 300	13 500	10 800	52.9	62.3	44.6
Bladder	13 300	10 000	3200	25.8	42.6	11.7
Non-Hodgkin lymphoma	11 400	6600	4800	25.6	31.4	20.6
Melanoma	9000	4900	4000	23.1	26.6	20.5
Uterus (body, NOS)	8100	NA	8100	NA	NA	36.8
Kidney and renal pelvis	8100	5400	2700	17.9	25.0	11.4
Head and neck	7500	5400	2000	16.3	24.6	8.7
Pancreas	6900	3800	3100	14.2	16.6	12.0
Leukemia	6700	4000	2700	15.4	19.4	11.9
Thyroid	6700	1850	4800	17.1	9.4	24.6
Stomach	4100	2600	1450	8.6	12.0	5.6
Multiple myeloma	4000	2400	1550	8.5	10.9	6.4
Liver	3500	2700	840	7.2	11.6	3.2
Brain or CNS	3200	1850	1350	7.2	8.7	5.7
Ovary	3000	NA	3000	NA	NA	13.4
Esophagus	2500	1900	580	5.5	9.0	2.4
Cervix	1450	NA	1450	NA	NA	7.5
Testis	1200	1200	NA	NA	6.6	NA
Hodgkin lymphoma	1050	600	460	2.6	2.9	2.3
All other cancers	24 500	12 400	12 100	51.0	55.7	47.6

Note: ASIR = age-standardized incidence rate, CNS = central nervous system, NA = not applicable, NOS = not otherwise specified.
*Rates are age standardized to the 2011 Canadian standard population. The complete definition of the specific cancers included here can be found in Appendix 1, Supplementary Table 1, available at www.cmaj.ca/lookup/doi/10.1503/cmaj.212097/tab-related-content.
†Quebec is included in the cases because of its importance in determining the national total projected number. Quebec is excluded from the rates because a different projection method was used for this province than for other regions.
‡Column totals may not sum to row totals due to rounding.
§"All cancers" includes in situ bladder cancer and excludes nonmelanoma skin cancer (neoplasms, NOS; epithelial neoplasms, NOS; and basal and squamous).

be 52% what it was in 1984. The incidence rate for lung cancer among females increased from 1984 to about 2014 before starting to decline; however, despite this recent decline, in 2022 we expect the ASIR to be 43% higher than the rate in 1984. The colorectal cancer incidence rate among males and females has declined since the early 2000s; however, the decline has accelerated since 2013–2014 for both sexes. The prostate cancer incidence rate increased dramatically among males in the early 1990s and experienced several waves of increasing and decreasing incidence, but the rates have been relatively stable since 2014 and we expect them to remain fairly constant to 2022. The incidence rate of breast cancer among females increased to the mid-1990s and has oscillated throughout the last 2 decades.

Mortality over time

Figure 2 shows the ASMRs between 1984 and 2022 for the leading causes of cancer death among both males and females in Canada. Mortality rates for lung, prostate and colorectal cancer have consistently declined in Canada over the past 2 decades. Among females, lung cancer mortality rates increased from 1984, but rates have declined since 2015. Colorectal and breast cancer mortality rates among females have both declined steadily over this period. Pancreatic cancer mortality rate among males decreased from 1984 to 2000, after which rates have remained generally stable; ASMRs for pancreatic cancer have been relatively stable in females since 1984.

Table 2: Projected estimates of deaths and age-standardized mortality rates for cancers by sex, Canada, 2022*

Type of cancer	No. of deaths			ASMR		
	Total†	Males	Females	Both sexes	Males	Females
All cancers	**85 100**	**45 100**	**40 000**	**181.6**	**212.3**	**158.5**
Lung and bronchus	20 700	10 600	10 100	43.4	48.6	39.5
Colorectal	9400	5200	4200	20.2	24.9	16.2
Pancreas	5700	3000	2800	12.2	13.7	10.8
Breast	5500	55	5500	12.2	0.2	22.6
Prostate	4600	4600	NA	NA	22.6	NA
Leukemia	3100	1800	1300	6.6	8.5	5.1
Non-Hodgkin lymphoma	3000	1700	1250	6.3	8.1	4.9
Bladder	2500	1800	720	5.3	8.8	2.7
Brain or CNS	2500	1450	1050	5.7	6.8	4.6
Esophagus	2400	1800	540	5.0	8.4	2.1
Head and neck	2100	1500	560	4.5	7.1	2.2
Stomach	2000	1250	730	4.3	5.9	2.9
Ovary	1950	NA	1950	NA	NA	8.0
Kidney and renal pelvis	1950	1300	670	4.2	6.1	2.6
Liver‡	1650	1350	340	3.6	6.1	1.4
Multiple myeloma	1650	970	700	3.5	4.5	2.7
Uterus (body, NOS)	1500	NA	1500	NA	NA	5.9
Melanoma	1200	770	440	2.7	3.7	1.8
Cervix	380	NA	380	NA	NA	1.8
Thyroid	250	120	130	0.5	0.6	0.5
Hodgkin lymphoma	110	65	40	0.2	0.3	0.2
Testis	35	35	NA	NA	0.2	NA
All other cancers	10 900	5700	5200	23.2	27.2	20.0

Note: ASMR = age-standardized mortality rate, CNS = central nervous system, ICD-10 = *International Statistical Classification of Diseases and Related Health Problems, 10th Revision*, NA = not applicable, NOS = not otherwise specified.
*Rates are age standardized to the 2011 Canadian standard population. The complete definition of the specific cancers included here can be found in Appendix 1, Supplementary Table 1, available at www.cmaj.ca/lookup/doi/10.1503/cmaj.212097/tab-related-content.
†Column totals may not sum to row totals due to rounding.
‡Liver cancer mortality was underestimated because deaths from liver cancer, unspecified (ICD-10 code C22.9), were excluded.

Incidence and mortality across Canada

Appendix 2, Supplementary Tables 2–5 (available at www.cmaj.ca/lookup/doi/10.1503/cmaj.212097/tab-related-content) include incidence and mortality estimates for each individual province and territory. Projected estimates for the territories are presented in Appendix 3 (available at www.cmaj.ca/lookup/doi/10.1503/cmaj.212097/tab-related-content) but could not be further disaggregated by cancer type because of small cell counts. Appendix 3, Supplementary Figure 1A shows the variation in estimated ASIRs for 2022 by region for all cancers combined. Age-standardized incidence rates are lowest in western and higher in eastern Canada. Similarly, ASMRs (Appendix 3, Supplementary Figure 1B) are lower in western and central Canada and generally higher in the east. Of note, incidence rates are not available for Quebec in this analysis as the approach taken to estimate provincial cancer incidence is not comparable with the other regions. Projected ASIRs and counts of new cancer cases for 2022 are provided by cancer type and region in Appendix 2, Tables S2 and S3, respectively, and ASMRs and cancer deaths in 2022 are provided in Appendix 2, Tables S4 and S5, respectively.

Interpretation

Cancer-control efforts are having an impact on the cancer burden in Canada. The overall ASIRs and ASMRs continue to decline, in large part, we believe, as a result of continued effort and investment in cancer prevention, screening, and early detection and treatment. In addition, people in Canada diagnosed with cancer have seen an overall increase in survival.[12] However, cancer continues to be a growing burden on the Canadian health care system, as we expect the annual increase in the total number of new primary cancers to continue through 2022, in large

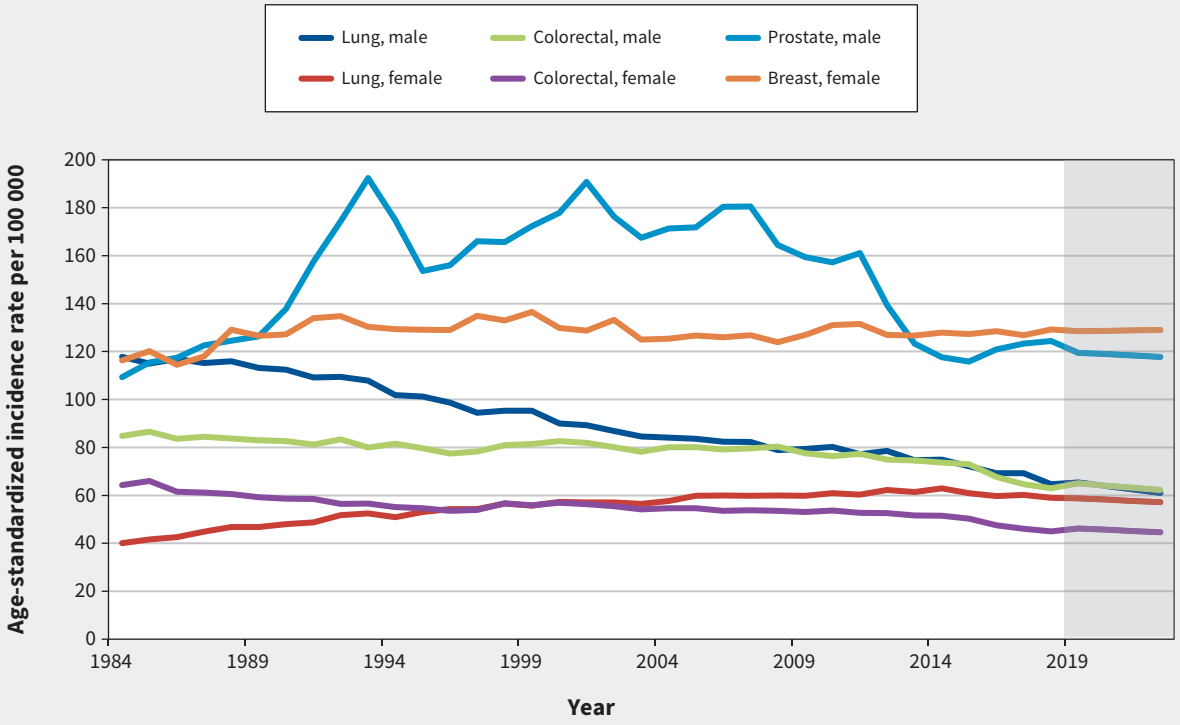

Figure 1: Age-standardized incidence rates for selected cancers, in Canada (excluding Quebec), 1984–2022, by sex. Note: Shading indicates projected data.

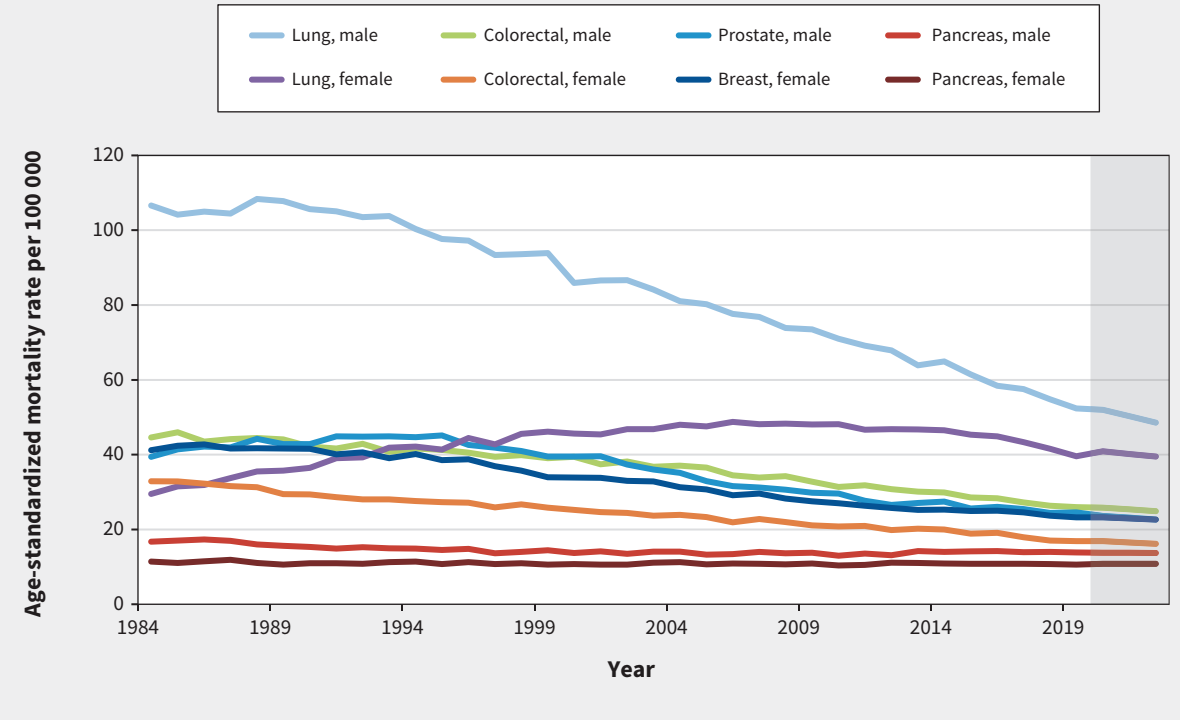

Figure 2: Age-standardized mortality rates for selected cancers in Canada, 1984–2022, by sex. Note: Shading indicates projected data.

part owing to population growth and aging. Although population-level cancer outcomes in Canada are generally improving, the individual-level data required to compare differences within and across population subgroups (such as people of different socioeconomic status, race or ethnicity) are currently limited or lacking in registries. Census area-level data suggest that disparities in incidence and mortality exist across socioeconomic and demographic groups within Canada, however.[13,14] Efforts and investments are under way to develop a pan-Canadian cancer data strategy to better understand cancer control and outcomes, with more granularity across population groups.[3]

Our estimates highlight where additional efforts are needed. In terms of primary prevention, given steady rising incidence of lung cancer among females before the recent declines, targeted measures to reduce tobacco consumption among younger populations and females remains necessary.[15] In addition, smoking rates are higher among several populations, such as individuals with lower income, those living in rural areas, and First Nations, Inuit and Métis people.[16] Increases in melanoma incidence rates suggest the need for further efforts to reduce ultraviolet exposure and increase sun safety.[17] Prostate cancer incidence trends follow an unusual pattern that can be attributed to historical changes in population-based testing practices. Prostate-specific antigen (PSA) testing was rapidly introduced into practice, which drove the peaks in prostate cancer incidence through the 1990s and early 2000s.[3] With the discovery that a large number of nonaggressive prostate cancers were being overdiagnosed, PSA is no longer recommended as a primary testing modality in Canada, but as one part of a broader health surveillance for prostate cancer.[18]

Medium-incidence cancers such as bladder, head and neck, melanoma, kidney and renal pelvis, as well as non-Hodgkin lymphoma, have a considerable impact on overall cancer burden in Canada. Given this impact on patients, there is active research into prevention, potential screening programs and novel therapeutics for these cancers.[19]

Organized screening programs have made an impact in reducing cancer incidence in Canada. Successful efforts in breast, colorectal and cervical cancer screening likely account for the continued decline in their relative impact. Additional efforts should be taken to maximize uptake and adherence among all segments of the Canadian population through culturally safe practices. In most provinces and territories, screening rates are far below the recommended levels, often with considerably lower rates among historically underscreened populations (visible minorities, immigrants, people in lower socioeconomic groups, and First Nations, Inuit and Métis people).[20,21] Recently, several provinces have launched organized lung-cancer screening programs for individuals at high risk of getting lung cancer,[22,23] while others have implemented business cases, pilots and studies.[24]

Although mortality and survival have improved considerably over the past 3 decades for many cancer types, for others, additional research and investment into novel screening approaches and therapies are needed. For example, the limited progress in early detection of and treatment for pancreatic cancer likely explains why it is the third leading cause of cancer death in Canada despite being the 11th most commonly diagnosed cancer.[25] Presently, no screening tests are available for pancreatic cancer and, owing to the organ's retroperitoneal location, more than 60% of cases are diagnosed at a late stage.[26] As detection and treatment options remain sparse, greater efforts are needed to improve primary prevention, early detection and treatment for pancreatic cancer.

In contrast, survival and mortality for lung and hematologic cancers have improved considerably since the 1990s, with the advent of targeted therapies, immunotherapies, advances in radiotherapy and surgery among other technological advances in the management of these advanced cancers.

Limitations

The potential for COVID-19-related impacts on cancer incidence and mortality are not included in our projections. Owing to the complexities in the registration and verification of cancer, considerable lags in data collection exist. We used the most up-to-date, complete available data for incidence (2018) and death (2019) for all analyses. We anticipate that measures to combat the spread of COVID-19 have affected many cancer-control activities in Canada. Interruptions in screening programs and diagnostic pathways may have led to a reduction in diagnoses and may result in a shift in some cancers to more advanced stages.[27,28] We expect that cancers that were initially undiagnosed during the pandemic will be diagnosed in subsequent months and years, leading to an eventual balancing in incidence over time. We hypothesize that the shift to later-diagnosed cancers and any pandemic-related delays in treatment will affect mortality and survival.

Absence of incidence data from the province of Quebec after 2010 also limits our study. To overcome this, we assumed similar trends in cancer incidence in Quebec as observed in the rest of Canada. Although it is unlikely that this assumption will be accurate for all cancer types, it was necessary to have some approximation to estimate complete national cancer statistics. Discussions are ongoing to include and standardize additional data from Quebec into the Canadian Cancer Registry through the Canadian Council of Cancer Registries.

Conclusion

Our projections show the considerable impact of cancer on people in Canada. Continued reductions in ASIRs and ASMRs highlight the meaningful advances in cancer control from prevention, screening, early diagnosis and treatment. Continued support and investment in innovative research and effective healthy public policies with implementation across the cancer-control spectrum are needed to further reduce the impact of cancer on people in Canada.

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Competing interests: Ryan Woods reports receiving a research grant from the Michael Smith Foundation for Health Research, and funding from the Canadian Partnership Against Cancer. Donna Turner reports receiving a salary as an employee of CancerCare Manitoba, and funding for travel from the Canadian Cancer Society. Dr. Turner is also a volunteer board member of the Manitoba Tobacco Reduction Alliance. No other competing interests were declared.

This article has been peer reviewed.

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Contributors: All of the authors contributed to the conception and design of the work, and the acquisition, analysis and interpretation of data. All of the authors drafted the manuscript, revised it critically for important intellectual content, gave final approval of the version to be published and agreed to be accountable for all aspects of the work.

Funding: This study was developed by the Canadian Cancer Statistics Advisory Committee in collaboration with the Canadian Cancer Society, Statistics Canada, and the Public Health Agency of Canada was therefore supported by public and donor dollars. No external sources of funding were obtained for this study.

Data sharing: The data included in these analyses are available to the public and researchers through application and access from the Research Data Centres of Statistics Canada.

Disclaimer: The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Canadian Cancer Society.

Accepted: Mar. 3, 2022

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