Ontario Cancer Statistics 2024

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Table of Contents

Figures and Tables

Foreword

We are pleased to present *Ontario Cancer Statistics 2024*, the fifth in a series of reports that serve as the definitive source of cancer surveillance information in Ontario. Cancer surveillance is a cornerstone of improving cancer system performance and outcomes for people with cancer. This information plays a critical role in developing the Ontario Cancer Plans, including the *Ontario Cancer Plan 6*, which is a roadmap for ensuring an integrated cancer system that works for everyone in the province.

The main data source for *Ontario Cancer Statistics 2024* is the Ontario Cancer Registry, which is one of the largest and most frequently used cancer registries in North America. The analyses and interpretation of Ontario Cancer Registry data in this report provide a clear picture of cancer in Ontario: who gets what type of cancer and when, their likelihood of surviving or dying from cancer, and how these patterns and trends have changed over time. This information provides a better understanding of the current and future state of cancer, identifies priority areas and helps evaluate cancer control efforts. Therefore, the collection and reporting of these data are the first steps in reducing the burden of cancer.

This year marks the 60th anniversary of the Ontario Cancer Registry. It also marks the four-year anniversary since the start of the worldwide COVID-19 pandemic, whose impacts are still being experienced today. A special chapter in *Ontario Cancer Statistics 2024* explores how population-level cancer outcomes were affected during the early years of the COVID-19 pandemic.

As Ontario Health (Cancer Care Ontario) continues to work with its many partners to further cancer control efforts, it is important to remember the human lives behind the numbers in this report. People living with a cancer diagnosis, their care partners and families, as well as people at risk for cancer, are at the centre of everything we do. *Ontario Cancer Statistics 2024* helps foster continued collaboration to ensure the quality and sustainability of the cancer system and reduce the risk of cancer for people in Ontario.

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Introduction

Ontario Cancer Statistics 2024 is the fifth in a series of reports that provide comprehensive information on the burden of cancer in Ontario. Produced by the Surveillance Program at Ontario Health (Cancer Care Ontario), the report is organized around four main types of indicators: incidence, mortality, survival and prevalence.

The information in this report is intended to support decision-makers, the public health community, health care providers, researchers and others involved in planning, investigating, measuring and monitoring population-based cancer control efforts such as cancer screening, prevention and treatment. The report may also be useful for members of the general public who have an interest in cancer.

This edition of the report provides the most up-to-date cancer burden statistics in Ontario using the latest years of data available at the time of analysis (i.e., actual data from 1986 to 2020) and projections (i.e., estimates) for the most recent years (2021 to 2024). A special focus chapter in this edition (Chapter 1) provides insight into the patterns and trends of cancer during the COVID-19 pandemic using actual (2019 to 2020) and provisional data[1] (2021 to 2022).

This report also includes statistics about cancer in children (ages zero to 14 years) up to the year 2022, which were provided by the Pediatric Oncology Group of Ontario (POGO). POGO is the official advisor to Ontario's Ministry of Health on children's cancer control and treatment and works to ensure that everyone affected by childhood cancer has access to the best care and support. See the spotlights on childhood cancer in Chapter 2 (Incidence), Chapter 3 (Mortality) and Chapter 4 (Survival).

Important information about the report, including data notes, can be found in About This Report. The appendices contain information on the data sources (Appendix 1: Data Sources), methodology (Appendix 2: Analysis) and terms (Appendix 3: Glossary) used in this report.

The data for all figures and tables in this report are provided in downloadable Excel workbooks that can be found on the report's web page: cancercareontario.ca/ocsreport.

[1] In this report, statistics using provisional data should be interpreted with caution. See Chapter 1: COVID-19 and Cancer in Ontario for more information.

Also in this series

Ontario Cancer Statistics 2022 features a special focus on the estimated future prevalence of cancer in Ontario.

Ontario Cancer Statistics 2020 features a special focus on long-term projections of cancer incidence and mortality, and on the burden of rare cancers in Ontario.

Ontario Cancer Statistics 2018 features a special focus on the burden of comorbidity among people with cancer and the impact of wait times for surgical treatment on survival for selected cancers. Cancer statistics are also provided by public health unit.

Ontario Cancer Statistics 2016 includes "in-focus" spotlights with statistics on clinically relevant indicators for breast, cervical, colorectal, head and neck, lung and prostate cancers.

Related resources

Cancer Risk Factors in Ontario is a series of reports that reviews the epidemiologic evidence linking a broad range of risk factors to various types of cancer in Ontario. These reports serve as a reference and foundation for prevention efforts, especially for planning and reporting on cancer prevention actions.

Cancer System Quality Index highlights where cancer service providers can advance the quality and performance of care. The report includes indicators spanning the continuum of cancer care, along with several measures related to cancer prevention.

My CancerIQ is a website that helps people understand their risk for certain cancers, what factors help to keep their cancer risk down, what factors increase their risk of developing cancer and specific changes they can make to reduce their risk.

Ontario Cancer Profiles is a self-serve, interactive mapping tool that gives users the ability to create custom graphs, maps and tables that show recent provincial and regional statistics on selected cancer burden, risk factor and screening indicators. This customizability allows users to create profiles that support targeted cancer control and prevention efforts.

Ontario Cancer Registry SEER*Stat Package is a statistical software package that contains Ontario cancer data files derived from the Ontario Cancer Registry. It helps analysts produce incidence, mortality, survival and prevalence statistics for studying the impact of cancer on the Ontario population.

Prevention System Quality Index is a report that, using a health equity perspective, focuses on policy and program indicators to reduce chronic disease risk factors and exposures in Ontario.

POGO's Research & Data web page is a gateway to information, resources, statistics and data specific to childhood cancer in Ontario, including practical tools and insights for research projects and planning.

About This Report

This report provides comprehensive information about cancer incidence, mortality, survival and prevalence in Ontario. A special focus chapter provides insight into the patterns and trends of new cancer cases, deaths and survival during the COVID-19 pandemic (Chapter 1).

Data sources and methods

Data for this report came from the following sources:

- Ontario Health (Ontario Cancer Registry)
- Ontario Ministry of Finance (Population projections)
- Ontario Ministry of Health (Public Health Case and Contact Management Solution)
- Pediatric Oncology Group of Ontario [Pediatric Oncology Group of Ontario Networked Information System (POGONIS)]
- Statistics Canada (Population estimates; life tables)

More detailed information on the data used in this report, include data quality measures, can be found in Appendix 1: Data Sources. Information on the methodology used in this report can be found in Appendix 2: Analysis.

Statistics by sex

Female and male sex terms refer to the sex that is received by the Ontario Cancer Registry. Due to limitations in the data sources used, sex statistics in this report refer to sex assigned at birth, which only includes the binary categories “male” and “female.” Sex statistics are not reported on intersex people or gender identities such as nonbinary, trans and Two-Spirit because this information is not currently received by the Ontario Cancer Registry.

Data notes

- This report examines statistics by sex, age group, cancer type for primary cancers (including all cancers combined) and over time.
- Chapter 1 (COVID-19 and Cancer in Ontario) provides statistics using actual data (i.e., available at the time of analysis) and provisional data[2] (i.e., incomplete data) and makes distinctions between them when applicable.
- Chapters 2 to 5 (Cancer Incidence, Mortality, Survival, Prevalence) provide statistics using actual data (i.e., available at the time of analysis) and projections (i.e., estimates, in Chapter 2 and Chapter 3 only) for the years that data are not yet available and makes distinctions between them when applicable.
- The data in this report include the first year(s) of the COVID-19 pandemic period. A decrease in new cancer cases was observed in the year 2020 for almost all cancer sites compared to previous years. For this reason:
    - The year 2020 was excluded in the analyses of lifetime probability of developing cancer, incidence trends and incidence projections. For more information about projections, see Appendix 2: Analysis.
    - The special focus chapter (Chapter 1) provides insight into the patterns and trends of new cancer cases, deaths and survival during the COVID-19 pandemic.
- This report focuses mainly on cancer in adults, but it also includes some statistics related to incidence, mortality and survival for selected childhood cancers (ages zero to 14 years) contributed by our partner, the Pediatric Oncology Group of Ontario (POGO). For additional in-depth statistics on childhood cancers in Ontario, read the Pediatric Oncology Group of Ontario surveillance report.
- This report uses shortened forms of the names of cancer types. See **Table A.5** in Appendix 1: Data Sources for the corresponding full names and definitions.
- The Ontario Cancer Registry and Pediatric Oncology Group of Ontario Networked Information System (POGONIS) is a set of dynamic databases that routinely receive new case information and updates to existing records. As a result, statistics in this report should be considered accurate only at the time of analysis. For details, see Appendix 1: Data Sources.
- The Ontario Cancer Registry adopted new coding rules for multiple primary cancers in 2010, which increased incidence statistics for some cancers from that year onward. For details, see Appendix 1: Data Sources.
- Changes were made to cancer coding, case creation and staging standards for cases diagnosed from January 1, 2018, onward. This change affected the incidence of some cancer subtypes and resulted in a shift in stage distribution (particularly an increase in unknown stage) for certain cancer types compared with previous years. For details, see Appendix 1: Data Sources.
- The word “significant” in this report refers to statistical significance using the 5% level of significance. For details, see Appendix 2: Analysis.

[2] In this report, statistics using provisional data should be interpreted with caution. See Chapter 1: COVID-19 and Cancer in Ontario for more information.

Inclusions and exclusions

Malignant versus non-malignant tumours

Statistics included in this report almost always refer to malignant (i.e., cancerous) tumours. The exceptions are for bladder, brain and other nervous system cancers, and selected childhood cancers.

- Similar to other jurisdictions, Ontario Cancer Statistics reports bladder carcinoma *in situ* jointly with malignant bladder cases to monitor incidence due to the clinical significance of *in situ* bladder cancer cases. The Ontario Cancer Registry began routinely registering bladder carcinoma *in situ* cases in 2010. In this report, bladder carcinoma *in situ* cases are handled as follows:
    - incidence: included in all analyses (see "Trends in age-standardized rates" in Appendix 2: Analysis for information on how these cases are handled in incidence trend analyses)
    - mortality: included in all analyses, although deaths due to *in situ* bladder cancer are relatively rare
    - survival: included only in analyses for 2010 onward, unless otherwise specified
    - prevalence: excluded from all analyses
- Statistics on the incidences of malignant and non-malignant brain and other nervous system tumours are included in this report because their symptoms are common and their treatment can be similar. Non-malignant cases include benign and borderline tumours. Because the Ontario Cancer Registry began routinely registering non-malignant brain and other nervous system tumours in 2010, incidence, survival and prevalence statistics on these cases are only provided for 2010 to 2020. Also, they are excluded from all mortality analyses.
- For childhood cancers, selected benign tumours and tumours of indeterminate behaviour (central nervous system and germ cell tumours) are included and classified according to the International Classification of Childhood Cancer.

Cancer subsites and subtypes

- Because the Ontario Cancer Registry does not register certain types of non-melanoma skin cancer (basal and squamous cell), this report excludes statistics for these cases and they are excluded from statistics on all cancers combined. Non-melanoma skin cancers represent the most common type of cancer in most jurisdictions.
- Statistics on incidence, survival and prevalence are provided for all cancers combined, 23 major cancer types and for certain anatomical subsites (topographical) and subtypes (histological) of these cancers, which were selected based on consultation with clinical experts.
- Due to limitations in the software used for generating statistics, producing mortality statistics for a comprehensive list of subsites and subtypes is challenging. Therefore, in this report, statistics for cancer deaths are reported for all cancers combined and the 23 major cancer types, but not by topography (subsite) and histology (subtype).
- Childhood cancer statistics on incidence, mortality and survival are provided for all cancers combined. Childhood cancer incidence is also reported by cancer type. For additional in-depth statistics on childhood cancers in Ontario, read the Pediatric Oncology Group of Ontario surveillance report.

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Contact us

Ontario Cancer Registry

Learn about Ontario's comprehensive population-based cancer registry, which records data on nearly 90,000 new cases of cancer each year.
View Ontario Cancer Registry

Cancer Surveillance Program

Learn about the Ontario Health program that analyzes and interprets cancer data to examine and report on Ontario's cancer burden and trends.
View Cancer Surveillance Program

Pediatric Oncology Group of Ontario (POGO) and POGO Networked Information System (POGONIS)

Learn more about POGO, childhood cancer and POGO's comprehensive registry and database on childhood cancer in Ontario, which has captured information about this unique population since 1985.
Read more about POGO.
View POGONIS

The Surveillance Program welcomes comments and suggestions. To provide feedback or to be notified about future editions of this report or related information products, send us an email.

To submit suggestions or questions about childhood cancer, please contact Pediatric Oncology Group of Ontario (POGO by email).

Ch 1: COVID-19 and Cancer in Ontario

This chapter provides insight into the patterns and trends among people with cancer in Ontario during the novel coronavirus disease 2019 (COVID-19) pandemic. This chapter examines changes in the number of new cancer cases, severity of cancer cases measured by changes in stage at diagnosis and hospitalizations, and changes in the number of cancer deaths and survival in people with cancer in Ontario. The analysis uses data from 2019 up to the end of 2022, or to the end of 2020 or 2021 if more recent data were not available.

Collecting cancer incidence and mortality data in the Ontario Cancer Registry takes time, especially during a disruptive period like the COVID-19 pandemic. Therefore, some estimates provided in this chapter for 2021 and 2022 may change over time as new data become available to the registry.

Overview

The first years of the COVID-19 pandemic led to major social, economic and health care disruptions in Ontario and worldwide. Despite public health restrictions to limit the spread of COVID-19, it was evident in Ontario that certain subgroups of the general population were at higher risk of COVID-19, such as those living in communities experiencing marginalization (1,2), ethnic minority populations (3), people living in long-term care homes (4) and newcomers to Ontario.(5) People with cancer, especially people with hematological cancers, were also more susceptible than the general population to severe COVID-19 disease due to immunosuppression, comorbidities or ongoing treatment.(6) In addition, despite being vaccinated against COVID-19, people with cancer continue to be at higher risk of breakthrough infections and more severe outcomes.(7)

Prior reports and publications examined various impacts of early-pandemic public health restrictions on Ontario's cancer system: access to primary care services, cancer screening participation, access to cancer diagnostic services including surgical biopsies and imaging-guided biopsy services, and cancer surgeries and other treatment.(8–10) Reduced access to and use of health services affected most people seeking medical care for cancer and other health conditions.(11,12) Many health care resources were diverted to prioritize the treatment of people with COVID-19, leading to delays in cancer diagnosis (13) and deferred cancer testing and treatment.(14) See **Box 1** for key events during the first year of the pandemic.

BOX 1. Key events during the first year of the COVID-19 pandemic in Ontario

- First COVID-19 case in Ontario identified on January 25, 2020.
- Government of Ontario declares its first provincial emergency in response to COVID-19 on March 17, 2020.
- Elective surgeries halted March 15 to May 26, 2020. Cancer screening programs mainly paused from March 23 to May 26, 2020, with re-start of screening correspondence letters delayed until 2021.
- After the start of the second COVID-19 wave in September 2020, a province-wide shutdown was announced on December 26, 2020, to limit infection spread.
- Stay-at-home order announced on April 8, 2021, to further preserve health system capacity.

It was anticipated that the delays and barriers in accessing health care services during the early part of the pandemic would result in lower-than-expected numbers of new cancer cases, more cases with advanced stage at diagnosis and greater mortality for certain cancer types.(15,16)

While the published literature to date overwhelmingly shows reductions in cancer incidence, there is conflicting evidence about changes in the stage at diagnosis for certain cancers. Despite data suggesting that there were increases in cancer mortality in the first year of the pandemic, there is a lack of more recent statistics on this measure.

Population-based cancer registry data have only recently started being published on the full impact of the COVID-19 pandemic on cancer. With the availability of more recent years of cancer registry data in Ontario, it is now possible to provide a comprehensive picture of the patterns and trends in cancer incidence, mortality and survival during the first few years of the COVID-19 pandemic.

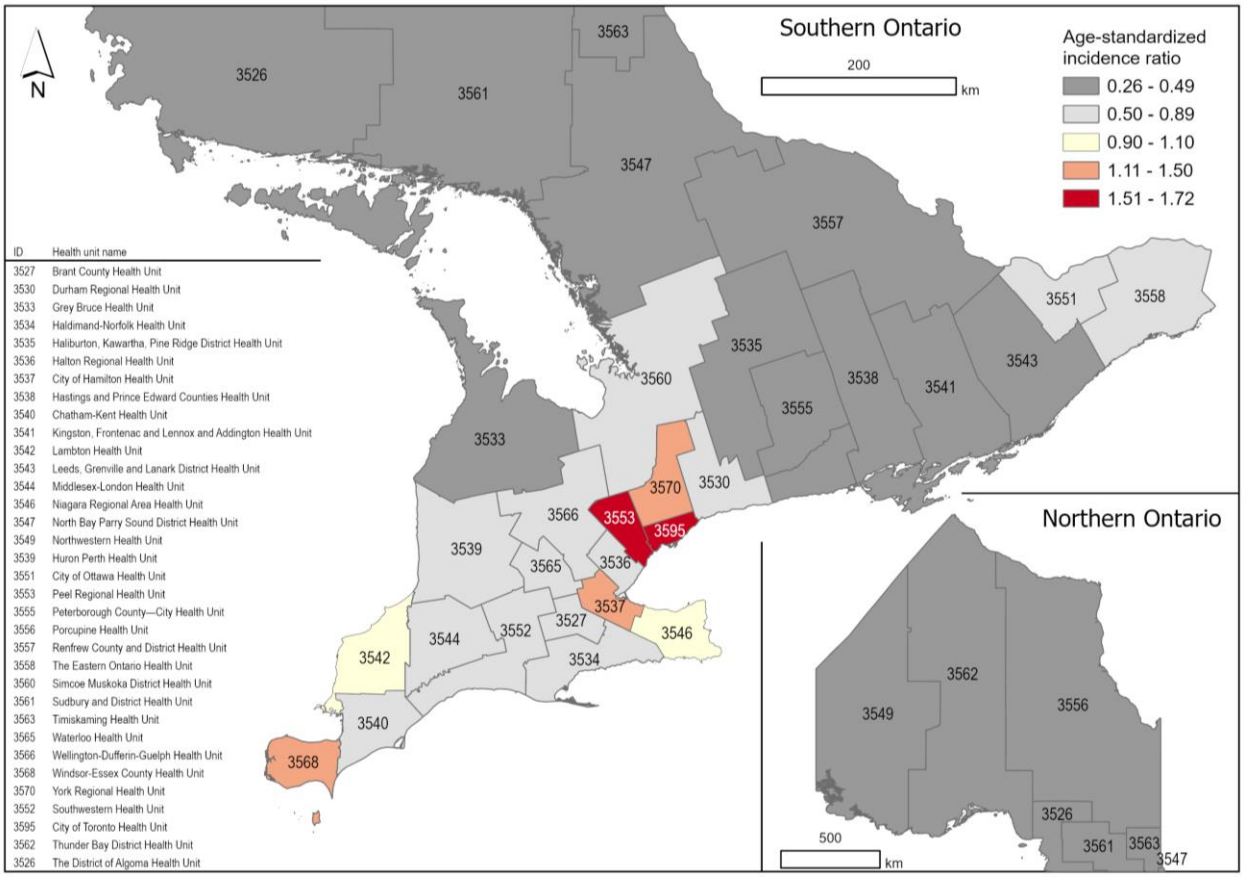
As childhood cancers are generally distinct from adult cancers, the results described in this chapter may not reflect the trends and patterns for childhood cancers.

Incidence

Geographic variation

Among people with cancer in Ontario, COVID-19 rates differed geographically by public health unit, with higher rates occurring in the greater Toronto area (**Figure 1.1**).

Figure 1.1 Age-standardized COVID-19 incidence rate ratios comparing public health unit rates to the Ontario rate, for people diagnosed with cancer, 2020 to 2021



Notes:

- Incidence rate ratios were indirectly standardized using age-specific rates among people in Ontario diagnosed with cancer from 2015 to 2020.
- The number of cases of COVID-19 in the Case and Contact Management Solution is an underestimate because not all people with COVID-19 develop symptoms, seek medical treatment or testing, so the disease goes unreported. The data source includes only confirmed cases.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data sources: Ontario Cancer Registry (September 2023), Ontario Health (Cancer Care Ontario); Case and Contact Management Solution (Ministry of Health)

Trends in cancer incidence

In general, an increasing number of new cancer cases would be expected over time because Ontario's population is growing and aging, which are two major contributors to cancer incidence (see Chapter 2: Cancer Incidence). However, as with many other jurisdictions, Ontario had a lower-than-expected number of new cancer cases during the first year of the pandemic due to the pausing of screening programs, less access to diagnostic services and fewer people interacting with the health system.

Tracking of cases by diagnosis year and month showed that the number of new cases decreased from 6,378 in March 2020 to 4,637 in April and 5,076 in May (**Figure 1.2**) but returned to 6,338 by June. The drop in new cases appears to have been transient because the number of monthly new cases returned to near usual levels throughout the remainder of 2020.

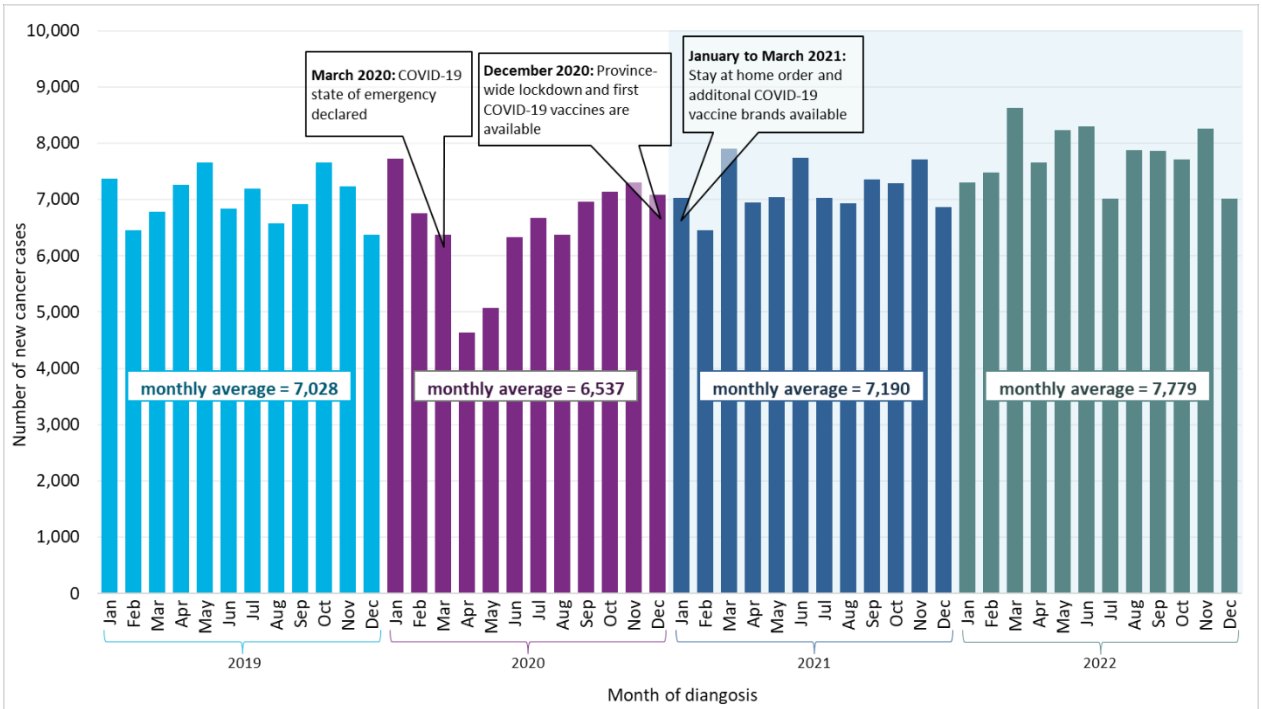
The average decrease in new cases during April and May 2020 (the first two full months following the state of emergency announcement by the Ontario government) was 35% less than during the same period in 2019 (**Figure 1.3**). Relative increases in new cases during March 2021 (16% increase compared to 2019) and June 2021 (13% increase compared to 2019) suggest the cancer system was working to catch-up on diagnostic delays that occurred early in the COVID-19 pandemic. In general, an increase in new cases followed each peak during a pandemic wave. See **Box 2** for the timing of COVID-19 waves in Ontario.(17)

It should be noted that statistics for 2021 and 2022 are based on provisional data. Counts for these years are likely underestimated because "death certificate only" (DCO) cases were not yet accounted for at the time of this analysis. Some registered cases for 2022 were also still being validated by the Ontario Cancer Registry at the time of this analysis.

BOX 2. Timeline of COVID-19 pandemic waves in Ontario, 2020 to 2022

- Wave 1: February 26, 2020 to August 31, 2020 (duration 188 days).
- Wave 2: September 1, 2020 to February 28, 2021 (duration 181 days).
- Wave 3: March 1, 2021 to July 31, 2021 (duration 153 days).
- Wave 4: August 1, 2021 to December 14, 2021 (duration 135 days).
- Wave 5: December 15, 2021 to February 28, 2022 (duration 75 days).
- Wave 6: March 1, 2022 to June 18, 2022 (duration 109 days).
- Wave 7: June 19, 2022 to November 12, 2022 (duration 146 days).

Figure 1.2 Incidence counts by month, Ontario, 2019 to 2022

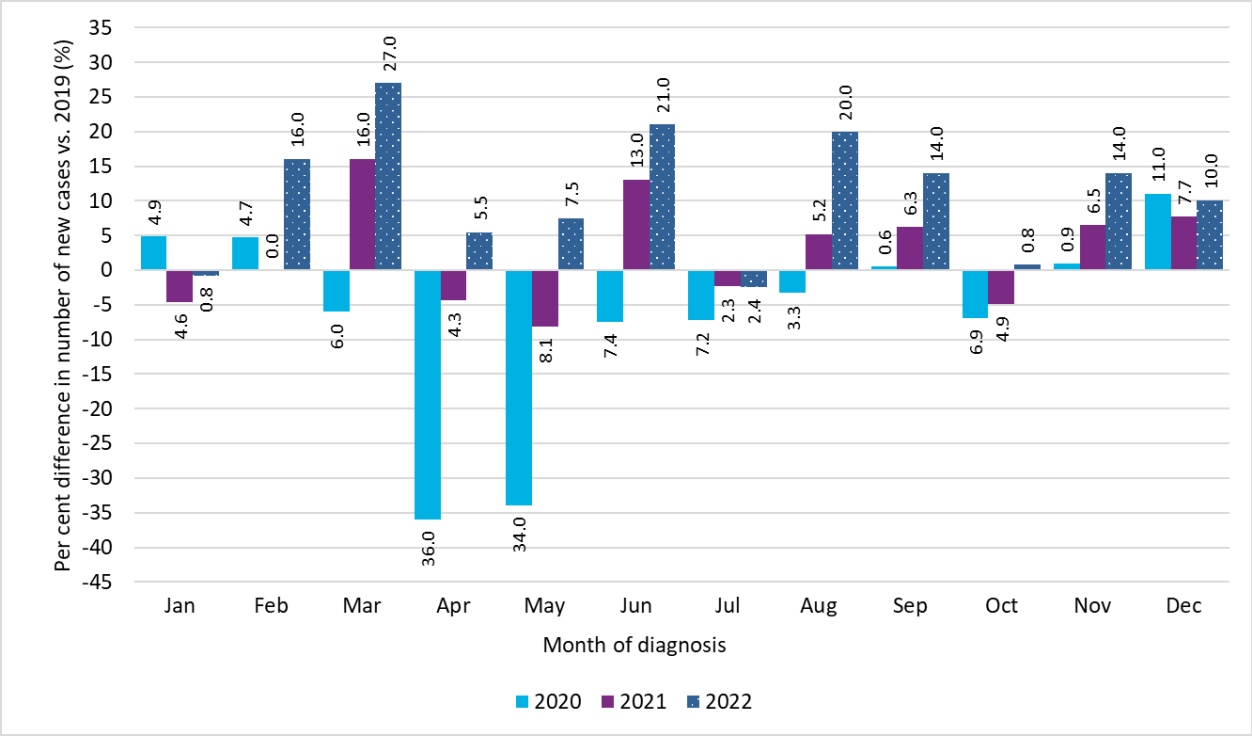


Notes:

- Incidence counts are based on the National Cancer Institute's Surveillance, Epidemiology and End Results standards for counting multiple primary cancers, which were adopted by the Ontario Cancer Registry for cases diagnosed from 2010 onward.
- Years with a blue shaded background indicate provisional cancer case counts and should therefore be interpreted with caution.
- Data for diagnosis years 2021 and 2022 are provisional; they do not include the approximately 1.4% of cases among people that are identified as having cancer only at death because this information was not available in the Ontario Cancer Registry at the time of analysis. In addition, the data for diagnosis year 2022 include some cases that were still undergoing validation by the registry.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (September 2023), Ontario Health (Cancer Care Ontario)

Figure 1.3 Per cent difference in incidence counts by month, Ontario, 2020 to 2022 versus 2019



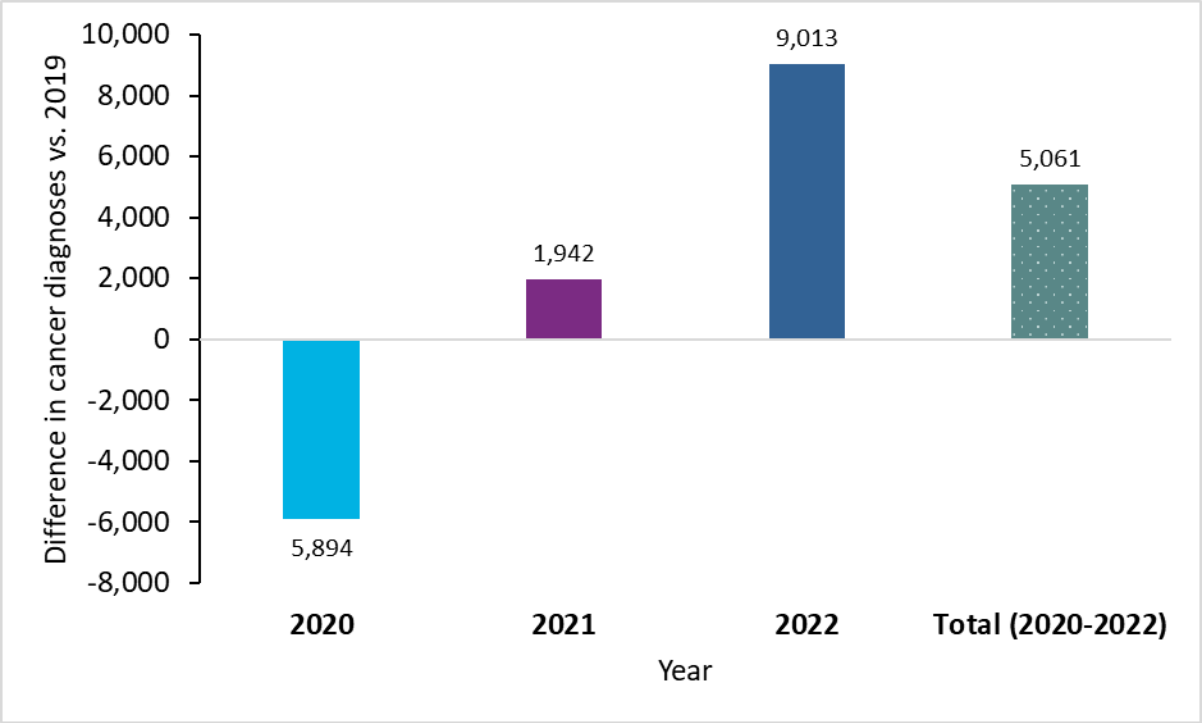
Notes:

- Incidence counts are based on the National Cancer Institute's Surveillance, Epidemiology and End Results standards for counting multiple primary cancers, which were adopted by the Ontario Cancer Registry for cases diagnosed from 2010 onward.
- Data for diagnosis years 2021 and 2022 are provisional; they do not include the approximately 1.4% of cases among people that are identified as having cancer only at death because this information was not available in the Ontario Cancer Registry at the time of analysis. In addition, the data for diagnosis year 2022 include some cases that were still undergoing validation by the registry.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (September 2023), Ontario Health (Cancer Care Ontario)

Annual cancer counts also reflected the monthly fluctuations observed in the first years of the pandemic. In 2020, there were 78,438 new cancer cases reported in Ontario, which represented almost 6,000 fewer cases than the previous year (84,332 new cancer cases in 2019) (**Table 1.1**). The number of new cancer cases returned to and surpassed pre-pandemic levels in subsequent years, with 86,274 new cases reported in 2021 and 93,345 cases in 2022. Cumulatively, there were 5,061 additional new cancer cases diagnosed between 2020 and 2022 than in 2019, which is suggestive of a catch-up in new diagnoses in the two years following 2020 for cases that had been previously undiagnosed (**Figure 1.4**). The extra new cases also partly reflect the usual increases in new diagnoses due to population growth and aging (see **Figure 2.3** in Chapter 2: Cancer Incidence).

Figure 1.4 Difference in annual incidence counts, Ontario, 2020 to 2022 versus 2019



Notes:

- Annual incidence counts are compared to cases diagnosed in 2019, when there were 84,332 new cancer cases (**Table 1.1**).
- Incidence counts are based on the National Cancer Institute's Surveillance, Epidemiology and End Results standards for counting multiple primary cancers, which were adopted by the Ontario Cancer Registry for cases diagnosed from 2010 onward.
- Data for diagnosis years 2021 and 2022 are provisional; they do not include the approximately 1.4% of cases among people that are identified as having cancer only at death because this information was not available in the Ontario Cancer Registry at the time of analysis. In addition, the data for diagnosis year 2022 include some cases that were still undergoing validation by the registry.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (September 2023), Ontario Health (Cancer Care Ontario)

The age-standardized incidence rate (ASIR) for all cancers combined decreased 9.0% from 528.7 in 2019 to 481.0 per 100,000 in 2020 (**Table 1.1**) but returned to pre-2019 levels by 2022 (**Figure 2.1** in Chapter 2: Cancer Incidence).

Cancers with decreased case counts in 2020

During the first year of the pandemic, the number of new cases in 2020 in Ontario was lower than in 2019 for 18 out of the 23 cancer types examined in this report. The largest percentage drop in new cancer cases was observed in several cancer types (**Table 1.1**):

- 18.4% fewer thyroid cases
- 12.1% fewer breast (female) cancer cases
- 12.0% fewer prostate cancer cases
- 11.1% fewer melanoma cases

These decreases in new cases are generally consistent with respect to the type of cancer (13) and in their magnitude of decrease with reports from Canada comparing 2015–2019 cases versus 2020 (18), and from the United States comparing 2019 versus 2020 cases.(19)

Following the large decrease in new cases during 2020, the relative increase in new cancer cases in 2022 compared with 2019 was 9.0% or greater for melanoma, breast (female) cancer and prostate cancer. The large increase for these cancers suggests an increasing clearance of diagnostic backlogs.

By comparison, there were 9.3% fewer cervical cancer cases, 7.2% fewer colorectal cancer cases (5.2% for colon and 11.0% for rectum, data not shown) and 4.8% fewer lung cancer cases in 2020 than in 2019. The lesser impact on these cancers compared to breast cancer, which was also affected by a temporary screening program closure, is likely multi-fold. First, breast cancers are detected more often by screening than the other screening program cancers, which for cervical and colorectal can identify pre-cancerous lesions. Moreover, colorectal cancer screening offers at-home sampling for fecal immunochemical testing and therefore reduces the need for an in-person clinical visit. Finally, a province-wide lung cancer screening program was not yet fully established during the early pandemic and this could explain the smaller reduction in newly diagnosed cases in 2020 compared with breast, cervical and colorectal cancers. Among cervical, colorectal and lung cancers, the relative increase following the temporary decline in 2020 was greatest for cervical cancer (+40.3%) in 2021, which is suggestive of a clearing of diagnostic backlogs. Newly diagnosed cases of lung cancer continued to be low through 2021 (-5.7%) and 2022 (-1.2%).

Thyroid cancer continued to show decreases in new cases in 2020 and in subsequent years. Similarly, kidney and liver cancer, both of which had decreases in new cases during the first year of the pandemic, continued to have fewer cases diagnosed in 2021 (-1.6% for kidney and -10.4% for liver) and 2022 (-8.3% for kidney and -1.0% for liver).

Cancers with increased case counts in 2020

A few cancer types had more new cases reported during the pandemic than in 2019, suggesting that their diagnoses were less affected by COVID-19 related public health measures. These cancers included (**Table 1.1**):

- Brain cancer (+1.3% in 2020)
- Esophageal cancer (+4.4%)
- Hodgkin lymphoma (+2.3%)
- Pancreatic cancer (+4.8%)

Because these cancers cause obvious symptoms earlier in the disease progression, it is possible that people with the above cancer types sought medical care when symptoms occurred, even during public health restrictions. However, there are exceptions to this pattern. For example, non-Hodgkin lymphoma and myeloma, which are also often diagnosed following symptoms, experienced decreases in new cases in 2020 compared with 2019. Despite decreases in 2020, both cancer types showed higher numbers of cases in 2021 and 2022.

Cancers with unchanged case counts in 2020

There was only a small change (±0.2%) in new cases of ovarian and stomach cancers in 2020 compared with 2019 (**Table 1.1**). However, unlike ovarian cancer, stomach cancer experienced one of the largest increases in new cases (+11.1%) in 2021.

Table 1.1 Incidence counts, age-standardized rates and per cent difference in incidence counts by cancer type, Ontario, 2020 to 2022 versus 2019

Cancer type	2019 – new cases	2019 – ASIR	2020 – new cases	2020 – ASIR	2021 – new cases	2021 – ASIR	2022 – new cases	2022 – ASIR	2020 vs. 2019 – relative difference in counts (%)	2021 vs. 2019 – relative difference in counts (%)	2022 vs. 2019 – relative difference in counts (%)
All cancers	**84,332**	**528.7**	**78,438**	**481.0**	**86,274**	**517.8**	**93,345**	**549.5**	**-7.0**	**2.3**	**10.7**
Bladder	4,217	25.5	3,867	22.8	4,434	25.5	4,347	24.3	-8.3	5.1	3.1
Brain	1,170	7.6	1,185	7.5	1,167	7.4	1,331	8.2	1.3	-0.3	13.8
Breast (female)	11,884	146.7	10,450	127.4	12,801	152.9	14,391	169.3	-12.1	7.7	21.1
Cervix	643	8.8	583	7.9	635	8.6	902	11.8	-9.3	-1.2	40.3
Colorectal	8,372	52.1	7,773	47.4	8,948	53.3	9,516	56.0	-7.2	6.9	13.7
Esophagus	894	5.5	933	5.6	858	5.0	1,008	5.7	4.4	-4.0	12.8
Hodgkin lymphoma	429	2.9	439	3.0	472	3.2	477	3.1	2.3	10.0	11.2
Kidney	2,644	16.8	2,384	14.9	2,602	16.0	2,425	14.6	-9.8	-1.6	-8.3
Larynx	409	2.5	394	2.4	396	2.3	413	2.4	-3.7	-3.2	1.0
Leukemia	2,413	15.2	2,335	14.3	2,502	15.1	2,386	14.1	-3.2	3.7	-1.1
Liver	1,393	8.5	1,344	8.0	1,248	7.3	1,379	7.9	-3.5	-10.4	-1.0
Lung	10,259	61.8	9,769	57.2	9,676	55.2	10,131	56.4	-4.8	-5.7	-1.2
Melanoma	4,272	27.0	3,798	23.5	4,255	25.9	4,655	27.5	-11.1	-0.4	9.0
Myeloma	1,406	8.6	1,356	8.1	1,544	9.0	1,558	8.9	-3.6	9.8	10.8
Non-Hodgkin lymphoma	4,348	27.2	4,025	24.6	4,527	27.1	4,602	26.9	-7.4	4.1	5.8
Oral cavity and pharynx	2,006	12.7	1,918	11.9	2,085	12.7	2,192	13.1	-4.4	3.9	9.3
Ovary	1,271	15.6	1,274	15.5	1,302	15.5	1,452	17.3	0.2	2.4	14.2
Pancreas	2,235	13.7	2,342	14.0	2,207	12.9	2,210	12.6	4.8	-1.3	-1.1
Prostate	8,546	111.1	7,524	95.3	9,305	114.3	10,898	130.1	-12.0	8.9	27.5
Stomach	1,537	9.5	1,536	9.3	1,708	10.1	1,914	11.1	-0.1	11.1	24.5
Testis	468	6.7	453	6.4	483	6.7	470	6.7	-3.2	3.2	0.4
Thyroid	2,946	20.4	2,404	16.3	2,561	17.2	2,772	18.2	-18.4	-13.1	-5.9
Uterus	3,122	38.3	2,931	35.2	3,298	38.7	3,620	42.2	-6.1	5.6	16.0

Abbreviation: ASIR means age-standardized incidence rate

Notes:

- Cancer types are defined according to the International Classification of Diseases for Oncology (ICD-O-3)(20) (see Appendix 1: Data Sources).
- Incidence counts are based on the National Cancer Institute's Surveillance, Epidemiology and End Results standards for counting multiple primary cancers, which were adopted by the Ontario Cancer Registry for cases diagnosed from 2010 onward.
- Rates are per 100,000 and are standardized to the age distribution of the 2011 Canadian Standard population.
- Data for diagnosis years 2021 and 2022 are provisional; they do not include the approximately 1.4% of cases among people that are identified as having cancer only at death because this information was not available in the Ontario Cancer Registry at the time of analysis. In addition, the data for diagnosis year 2022 include some cases that were still undergoing validation by the registry.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (September 2023), Ontario Health (Cancer Care Ontario)

Other Canadian provinces also reported decreases in the number of new diagnoses during the first year of the pandemic, although the magnitude of these decreases varied based on cancer type and jurisdiction.(21–23) These variations likely reflect differences in lockdowns and other public health measures that affected cancer screening and diagnostic services, access to primary care services and the amount of virtual versus in-person care. Some people may have been reluctant to seek medical attention at the height of the pandemic, either out of personal fear of COVID-19 or in compliance with government orders to stay at home. Others may have ignored early warning signs of their cancer and only sought medical care later in the pandemic.

Changes in new cases by sex and age group

Males and females experienced decreases in new cancer cases during the first year of the pandemic (**Table 1.2**), followed by similar increases relative to 2019 in subsequent years. In 2020, the larger decrease in new cases among females (-7.9%) compared to males (-6.1%) likely reflects the temporary pause to the female breast and cervical cancer screening programs.

Every age group experienced a decrease in new cancer cases during the first year of the pandemic (**Table 1.2**). The impact was greatest in the 40 to 59 age group. Although they represent only about a quarter (21.8%) of all new incident cancer cases, during the first year of the pandemic this age group had the largest decrease in diagnoses at 9.7%. By comparison, there was a slightly smaller decrease among people ages 60 to 79, who usually represent more than half of all new cancer cases.

Unlike other adult age groups, the decrease in diagnoses in people ages 40 to 59 and people age 80 and older continued into 2021. In other words, the number of new cancer cases in these age groups did not return to typical levels in 2021.

Table 1.2 Incidence counts and per cent difference by binary sex and age group, Ontario, 2020 to 2022 versus 2019

	2019 – new cases	2020 – new cases	2021 – new cases	2022 – new cases	2020 vs. 2019 – relative difference (%)	2021 vs. 2019 – relative difference (%)	2022 vs. 2019 – relative difference (%)
Total	**84,332**	**78,438**	**86,274**	**93,345**	**-7.0**	**2.3**	**10.7**
Males	41,724	39,193	42,768	46,080	-6.1	2.5	10.4
Females	42,608	39,245	43,506	47,265	-7.9	2.1	10.9
Ages 0–19	616	563	591	525	-8.6	-4.1	-14.8
Ages 20–39	3,515	3,363	3,622	3,930	-4.3	3.0	11.8
Ages 40–59	18,964	17,131	18,379	20,039	-9.7	-3.1	5.7
Ages 60–79	45,540	42,225	48,601	53,003	-7.3	6.7	16.4
Age 80 and older	15,697	15,156	15,081	15,848	-3.4	-3.9	1.0

Notes:

- Incidence counts are based on the National Cancer Institute's Surveillance, Epidemiology and End Results standards for counting multiple primary cancers, which were adopted by the Ontario Cancer Registry for cases diagnosed from 2010 onward.
- Statistics by sex in this chapter refer to sex data that are binary and assigned at birth. For more information, refer to About This Report: Statistics by sex.
- Data for diagnosis years 2021 and 2022 are provisional; they do not include the approximately 1.4% of cases among people that are identified as having cancer only at death because this information was not available in the Ontario Cancer Registry at the time of analysis. In addition, the data for diagnosis year 2022 include some cases that were still undergoing validation by the registry.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (September 2023), Ontario Health (Cancer Care Ontario)

Changes in the severity of cancer cases

A more severe cancer diagnosis could reflect less access to and use of health services, which is associated with delayed health care seeking, delayed screening, deferred diagnostic procedures and health workforce challenges. In this report, changes in the severity of cancer as a result of the pandemic were evaluated by examining shifts in the distribution of stage at diagnosis and rates of hospitalization of people with cancer.

Stage distribution

Stage at diagnosis is one of the most important prognostic factors for cancer. Population-level stage data in Ontario are available from 2010 onward for the four most common cancers (breast, colorectal, lung and prostate) and cervical cancer. During the first year of the pandemic, some cancers with population-level stage data in Ontario were diagnosed at more advanced stages, although not all changes in stage distribution were statistically significant. To evaluate whether a shift towards advanced stage at diagnosis occurred, the distributions of early stage (stage 1 or 2) and advanced stage (stage 3 or 4) cancers from 2018 to 2020 were compared (**Table 1.3**). A statistically significant shift ($p<0.001$) towards advanced stage at diagnosis occurred for breast (female) and colorectal cancers.

Some changes were also observed by each stage group, although these changes were not tested for statistical significance. Compared with earlier years, 2020 showed a lower proportion of stage 1 cases and slight increases in the proportion of stages 2, 3 and 4 cases for breast (female), cervical and colorectal cancers (**Figure 1.5**). Each of these cancers have organized screening programs in Ontario: the Ontario Breast Screening Program, Ontario Cervical Screening Program and ColonCancerCheck. The number of people screened in Ontario's organized screening programs from March to December 2020 remained lower than in 2019.(24) The temporary pause in organized screening led to lower numbers of screened individuals in 2020, as well as the delay in restarting correspondence letters until 2021, may have played a role in the stage distribution changes in 2020. There was likely a greater number of people being diagnosed through presentation of symptoms during this period.

No notable change was observed in the stage distribution of lung cancer cases (**Figure 1.5**), which represent screen-detected and cases identified by symptoms. Following a pilot program that began in 2017, Ontario implemented a high-risk lung cancer screening program in 2021.(24) Unlike other cancers with organized screening programs, the stage distributions for lung cancer shown here are not influenced by interruptions to a population-based screening program during the first year of the COVID-19 pandemic.

There was a higher proportion of stage 4 prostate cancer cases in 2020 than in previous years (**Figure 1.5**). However, unlike other cancer types, the higher proportion of stage 4 prostate cases continues an increasing trend that began before the pandemic and could be associated with declining use of prostate-specific antigen testing over time (see Chapter 2: Cancer Incidence for a description about factors influencing the use of prostate-specific antigen testing in Canada).

Given the larger than usual number of new cases identified in 2022 (see **Figure 1.4 and Table 1.1**), it is likely that some of these cases will be diagnosed at more advanced stage of disease. Data in future editions of this report will help verify this assumption.

There are several implications of delayed cancer diagnoses that are often related to more advanced stage of disease, such as worse survival. Advanced stage also affects the type and frequency of cancer-related services someone might need, such as surgery, radiation therapy, systemic treatment and palliative care.

Evidence from the literature about changes in stage distribution for various cancer types during the COVID-19 pandemic is mixed. Similar to the findings presented here, a study on colorectal cancer in The Netherlands (25) and a study on various cancers in the United States (19) showed that the proportion of stage 1 and 2 cases were greatly reduced by early pandemic lockdowns, while stage 3 and 4 cases increased. In contrast, several institution-based (i.e., not population-based) studies in Ontario found no change in stage distribution for breast, colorectal, prostate, endometrial and lung cancers.(26,27) These disparate findings may be due to differences in case-mix of study populations as well as the inability to detect substantial differences in smaller study samples. The differences could also point to local variability in the investigations during the pandemic from suspicion of cancer through to a cancer diagnosis.

Some research also suggests that the changes in the distribution of cancer stage at diagnosis between wave 1 and wave 2 of the COVID-19 pandemic may have occurred gradually as public health restrictions were eased over the course of 2020. For example, a small study in New York City (28) that took place in the calendar quarter immediately following the first wave found that there was a higher than usual proportion of newly diagnosed stage 1 and stage 2 lung cancer cases. This change likely reflected a backlog of surgical cases from the previous quarter. However, by the last quarter of 2020 and first quarter of 2021, the distribution had shifted to a greater proportion of stage 3 and 4 cases.

Table 1.3 Percentage of incident cases of early versus advanced stage by selected cancer types, Ontario, 2018 to 2020

Cancer type	2018 – Early (stage 1 and 2) (%)	2018 – Advanced (stage 3 and 4) (%)	2019 – Early (stage 1 and 2) (%)	2019 – Advanced (stage 3 and 4) (%)	2020 – Early (stage 1 and 2) (%)	2020 – Advanced (stage 3 and 4) (%)
Breast (female)*	87.2	12.8	87.4	12.6	86.3	13.7
Cervix	84.5	15.5	81.0	19.0	80.5	19.5
Colorectal*	47.1	52.9	48.2	51.8	44.8	55.2
Lung	35.1	64.9	37.0	63.1	34.7	65.3
Prostate	61.4	38.7	55.2	44.8	55.1	44.9

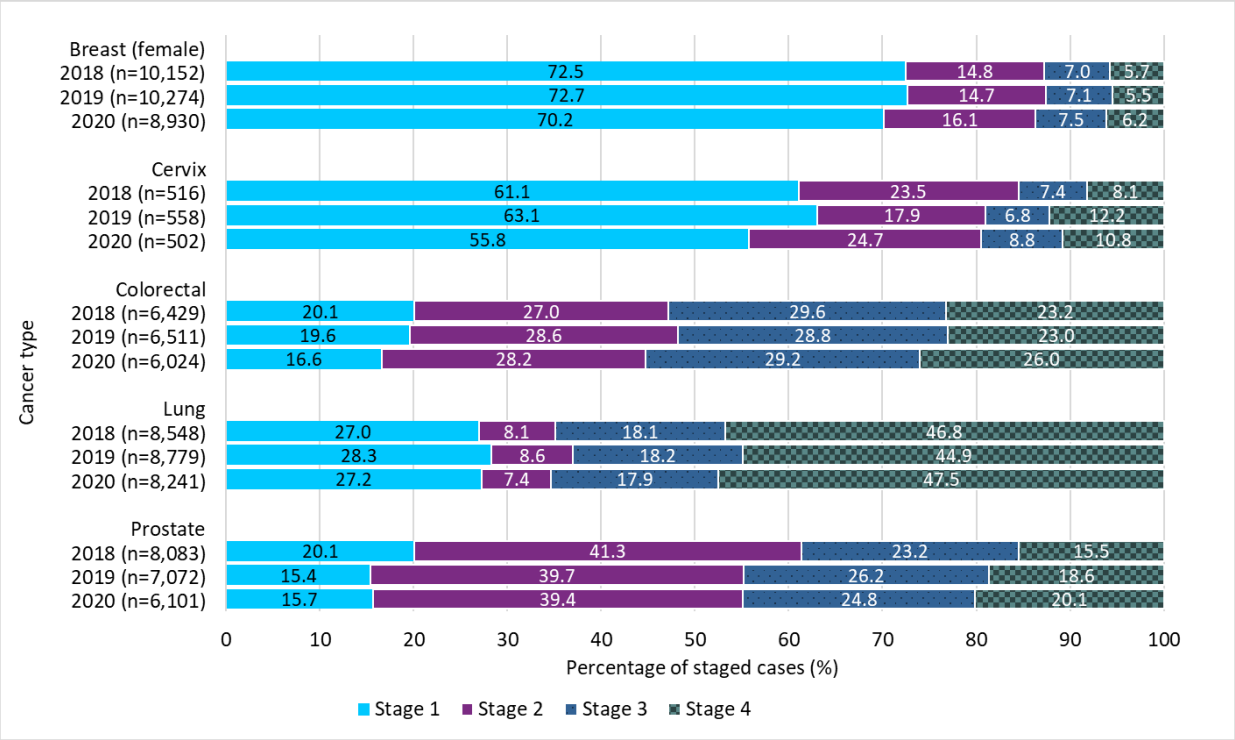
Symbol: * Statistically significant shift to more cancers diagnosed at advanced stage in 2020 than in the pre-pandemic years of 2018 and 2019. See Appendix 2: Analysis for more information.

Notes:

- Cases with unknown stage or that were not staged by the OCR were excluded from this analysis. Over all years, case counts were as follows: prostate n = 21,256 (excludes unknown stage or not staged = 4,503), breast n = 29,356 (excludes unknown stage or not staged = 4,669), colorectal n = 18,964 (excludes unknown stage or not staged = 5,549), lung n = 25,568 (excludes unknown stage or not staged = 4,747), cervix n = 1,576 (excludes unknown stage or not staged = 269).
- Breast (female) and prostate cancers had a significantly higher number of cases with unknown stage or that were not staged in 2020 than in 2019 and 2018. Lung cancer had more cases of unknown stage or that were not staged in 2020 than in 2019, but significantly fewer than in 2018. Cervical and colorectal cancers had similar numbers of cases with unknown stage or that were not staged from 2018 to 2020. See Appendix 1: Cancer stage at diagnosis for more information.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (September 2023), Ontario Health (Cancer Care Ontario)

Figure 1.5 Percentage of new cases by stage at diagnosis and cancer type for selected cancers, Ontario, 2018 to 2020



Notes:

- Cases with unknown stage or that were not staged by the OCR were excluded from this analysis. Over all years, case counts were as follows: prostate n = 21,256 (excludes unknown stage or not staged = 4,503); breast (female) n = 29,356 (excludes unknown stage or not staged = 4,669); colorectal n = 18,964 (excludes unknown stage or not staged = 5,549); lung n = 25,568 (excludes unknown stage or not staged = 4,747); cervix n = 1,576 (excludes unknown stage or not staged = 269).
- Breast (female) and prostate cancers had a significantly higher number of cases with unknown stage or that were not staged in 2020 than in 2019 and 2018. Lung cancer had more cases of unknown stage or that were not staged in 2020 than in 2019, but significantly fewer than in 2018. Cervical and colorectal cancers had similar numbers of cases with unknown stage or that were not staged from 2018 to 2020. See Appendix 1: Cancer stage at diagnosis for more information.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (September 2023), Ontario Health (Cancer Care Ontario)

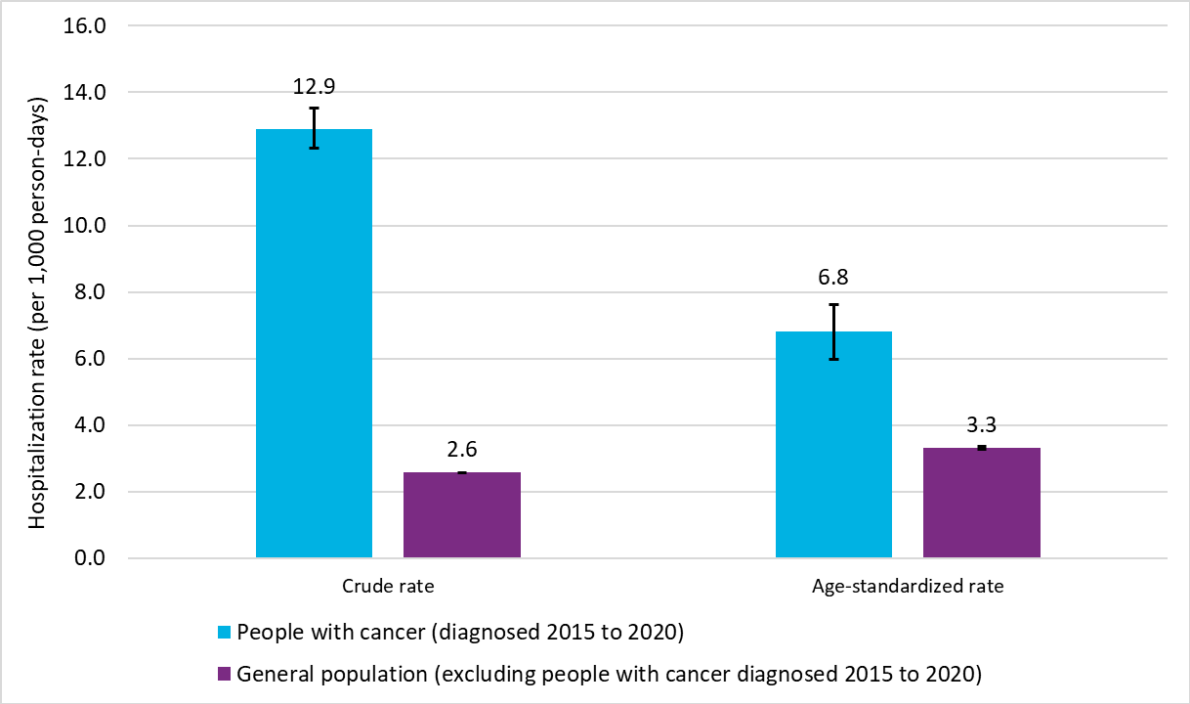
Hospitalizations among COVID-19 positive cancer patients

Early in the pandemic, people with cancer were identified as being at higher risk for COVID-19, having greater morbidity, being more likely to end up in the intensive care unit and being at increased risk of death.(29–32) Similar to other immunocompromised patients (e.g., dialysis and organ transplant patients), people with cancer may be more susceptible to COVID-19 and complications than people without cancer because they may experience immune suppression as a result of their disease, its treatment and an increased risk of secondary infections.(33)

While unplanned hospitalization rates are usually higher in people with cancer than in the general population (34), hospitalization rates in people with cancer may have been even higher during the pandemic. Being hospitalized during the pandemic can serve as a proxy for COVID-19 severity and can allow differences in outcomes, such as mortality, to be tracked in people with cancer and the general population.

In Ontario, people with cancer and COVID-19 were hospitalized at a higher rate than members of the general population who had COVID-19 (**Figure 1.6**). After adjusting for the higher proportion of older people in the cancer population, the rate of hospitalization in people with cancer was found to be twice as high as the rate in the general population (6.8 versus 3.3 per 1,000 person-days).

Figure 1.6 Age-standardized hospitalization rates from any cause among people with confirmed COVID-19 in the general and cancer populations, Ontario, 2020 to 2021



Notes:

- Rates are per 1,000 person-days.
- Age-standardized rates are standardized to the age distribution of the 2011 Canadian Standard population.
- People with cancer include those diagnosed from 2015 to 2020. People with a confirmed COVID-19 case before their cancer diagnosis were included in the general population group.
- Incidence counts are based on the National Cancer Institute's Surveillance, Epidemiology and End Results standards for counting multiple primary cancers, which were adopted by the Ontario Cancer Registry for cases diagnosed from 2010 onward.
- COVID-19 hospitalization data are from the Case and Contact Management Solution. Hospitalization includes all people with a reported hospital admission date and a positive COVID-19 test within 14 days before or three days after hospitalization. Emergency room visits are not included in the number of reported hospitalizations.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data sources: Ontario Cancer Registry (September 2023), Ontario Health (Cancer Care Ontario); Case and Contact Management Solution, Ministry of Health (March 2023)

The higher hospitalization rate in people with cancer and COVID-19 is consistent with a study in Ontario (35) that found an 11% higher risk of hospitalization between January 2020 and November 2021 in people with solid tumours and a 75% higher risk in people with hematological cancers than people without cancer. Furthermore, one study in the UK shows that the difference in COVID-19 hospitalization risk between people with and without cancer decreased over the course of the pandemic.(36)

The likelihood of hospitalization during the pandemic was influenced by several factors. One study showed that people with a previous history of cancer were 16% more likely to be hospitalized with COVID-19 than the general population.(37) Furthermore, the study found that people with cancer who were hospitalized with COVID-19 tended to be slightly older than people with cancer who were not hospitalized (mean age of 74 versus 68.2), which is also evident in this report (see **Figure 1.6**). People with cancer who were hospitalized with COVID-19 were also diagnosed with a later stage cancer (19.4% versus 11.3%), had multiple cancers (16.6% versus 11.2%) and were within five years of their most recent cancer diagnosis (i.e., were being actively treated or receiving follow-up). People with myeloma, leukemia, kidney cancer, lung cancer, liver cancer and non-Hodgkin lymphoma were more likely to be hospitalized with COVID-19 than people with breast (female), cervical, melanoma, oral cavity, prostate, testicular and thyroid cancers. Other studies have found an elevated risk of hospitalization with COVID-19 in people with liver, lung and hematological cancers.(38,39)

Mortality

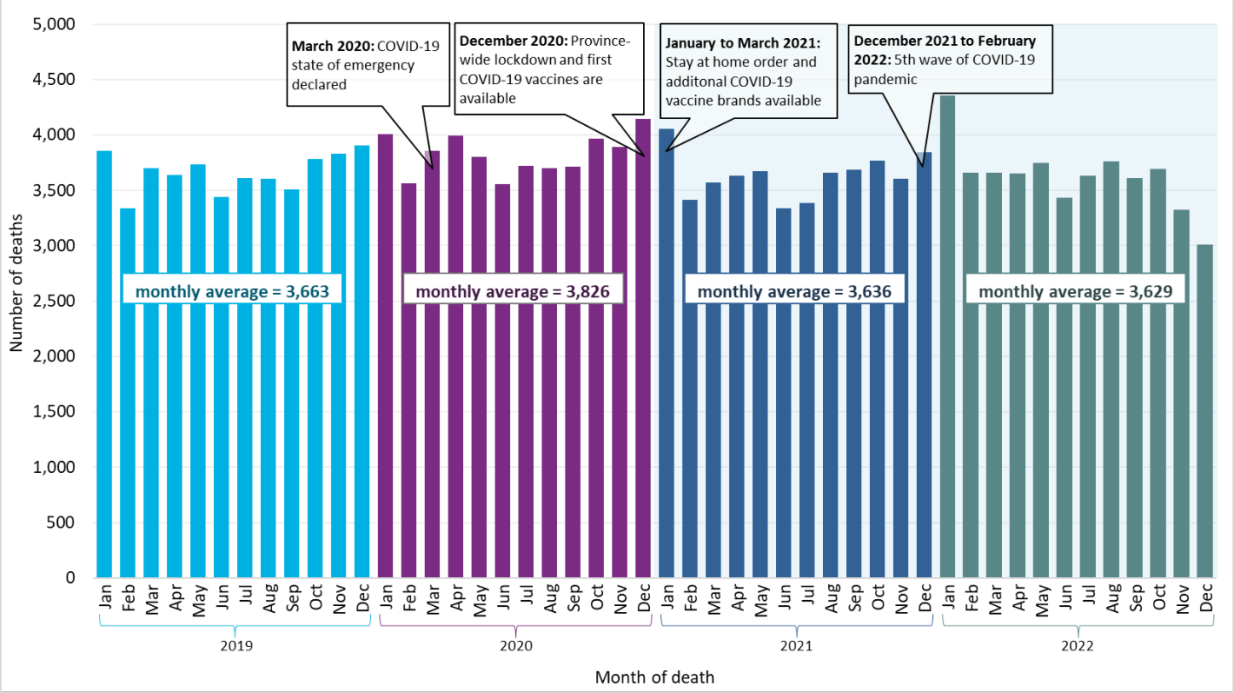
Deaths during the COVID-19 pandemic reflect the usual background mortality, as well as deaths directly or indirectly related to COVID-19. The historical trend of an increasing number of deaths among people with cancer was expected to continue during the pandemic. This trend is a result of Ontario's increasing incidence of cancer from a growing and aging population, which are major contributors of cancer incidence (see Chapter 2: Cancer Incidence) and therefore also of mortality.

In 2020, there were 4,758 confirmed COVID-19 deaths in Ontario (40), and, based on Ontario Health data, 333 of these deaths were among people diagnosed with cancer between 2015 and 2020 and which represents an age-standardized rate of 60.8 COVID-19 related deaths per 100,000 person-years. Many of the COVID-19 deaths in people with and without cancer are likely to have occurred in residents of long-term care facilities (41) because Canada had the highest proportion of COVID-19 deaths in long-term care residents compared with other Organization for Economic Cooperation and Development countries.(42)

Mortality trends among people with cancer

Overall, the number of deaths among people with cancer was higher in 2020 than in the previous year (45,931 in 2020 versus 43,955 in 2019). Although average monthly death counts were lower in 2021 and 2022 (**Figure 1.7**), the available data for these years do not reflect deaths that occurred among people who were only identified as having cancer at the time of their death, so called "death certificate only" (DCO) cases. DCO cases for 2021 and 2021 were not available at the time of this analysis. DCOs are estimated to represent about 1.4% of all new cancer cases in Ontario every year during this period.

Figure 1.7 All-cause mortality counts among people with cancer by month, Ontario, 2019 to 2022



Notes:

- Includes deaths from all causes among people who were diagnosed with cancer from 1981 to 2022.
- Years with a blue shaded background indicate provisional death counts and therefore should be interpreted with caution.
- Data for 2021 and 2022 do not include deaths among the approximately 1.4% of people with new cases identified as having cancer only at the time of death (i.e., death certificate only cases).

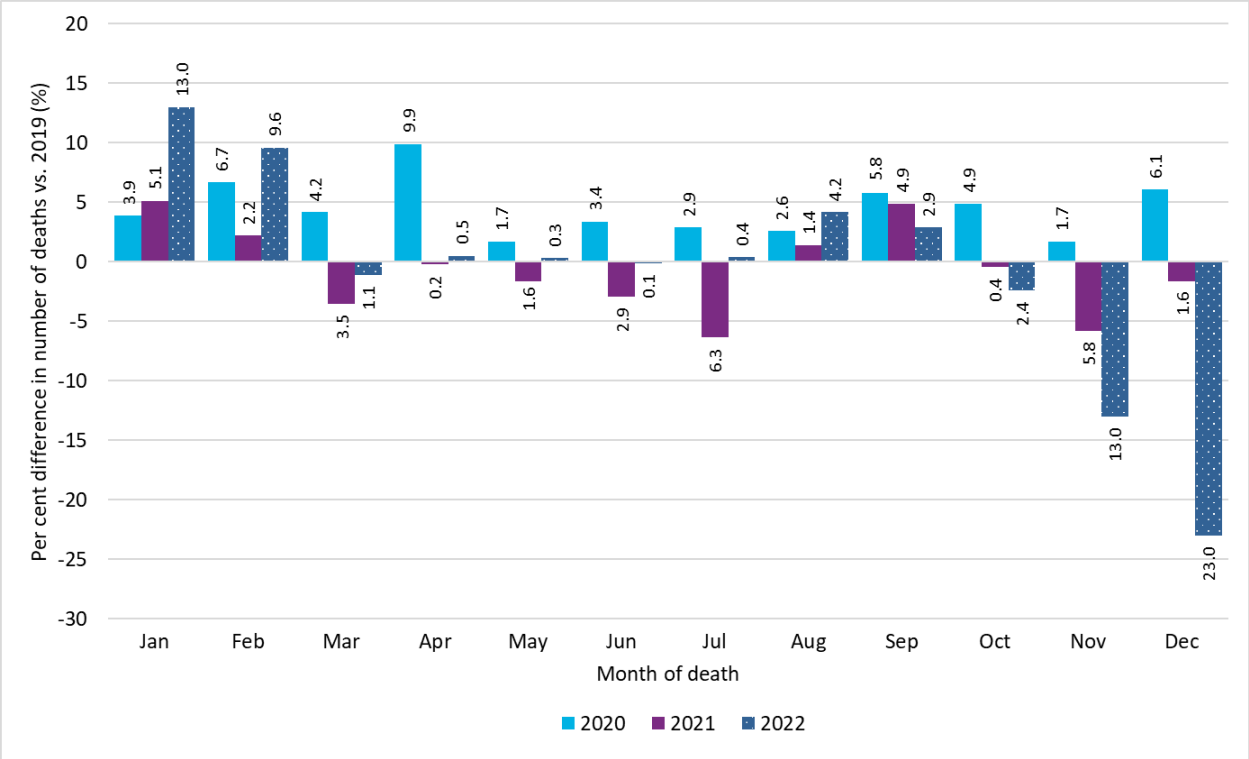
Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (March 2023), Ontario Health (Cancer Care Ontario)

While every month during 2020 showed a higher number of deaths among people with cancer compared with 2019 (**Figure 1.7**), April 2020 (the second month of the pandemic in Ontario) showed an almost 10% spike in deaths (**Figure 1.8**). This observation is consistent with overall death counts in Canada among people with cancer and COVID-19.(10)

A high number of deaths was also reported in the first two months of 2022, representing 13.0% and 9.6% more deaths compared with January and February 2019 (**Figure 1.8**). This period in 2022 occurred during the fifth wave of the COVID-19 pandemic in Ontario, which started in December 2021, and the arrival of the Omicron variant. This fifth wave coincides with the highest single day of new COVID-19 cases, which occurred in December 2021. The higher risk of death following the Omicron variant was also observed in jurisdictions other than Ontario.(43)

It is reasonable to hypothesize that the full impact of the COVID-19 pandemic on cancer deaths has not yet been observed. The delays in diagnosis as suggested by the shift in stage distribution for some cancers in 2020, higher hospitalization rates among people with cancer, and reduced access to or use of cancer services points to the possibility of higher mortality rates in years to come. It will be important to continue monitoring mortality rates as new data become available.

Figure 1.8 Per cent difference in all-cause mortality counts among people with cancer by month, Ontario, 2020 to 2022 versus 2019



Notes:

- Deaths from all causes among people with cancer diagnosed from 1981 to 2022.
- Data for 2021 and 2022 do not include deaths among the approximately 1.4% of people with new cases identified as having cancer only at the time of death (i.e., death certificate only cases).

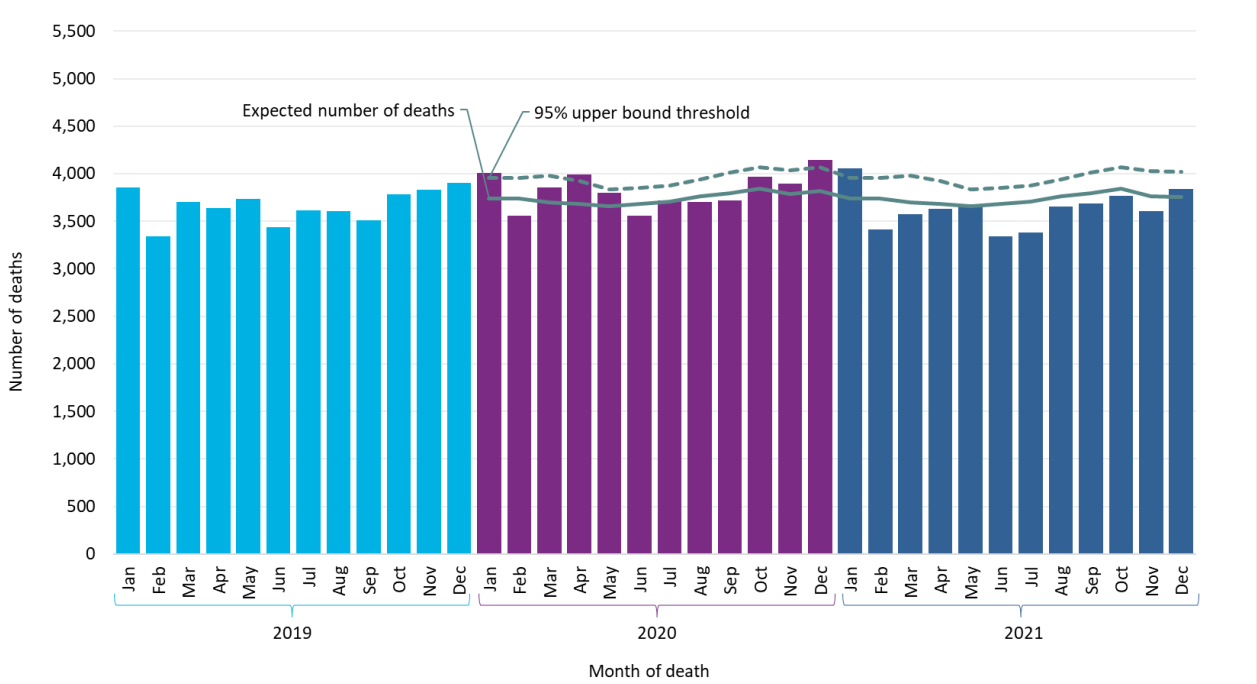
Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (March 2023), Ontario Health (Cancer Care Ontario)

Excess mortality

The number of deaths in Ontario has been increasing steadily over time due to the province's aging and growing population. The COVID-19 pandemic further contributed to overall deaths. Excess deaths suggest a departure from the usual mortality trend and serve as another way to measure the impact of the COVID-19 pandemic.

Figure 1.9 shows the observed and expected monthly number of deaths in the cancer population from all causes from 2020 to 2021. During 2020, there were 1,443 excess deaths among the cancer population and during 2021, there were 417 excess deaths. These findings mirror the excess mortality reported in the general population in Ontario during the first year of the pandemic.(44)

Figure 1.9 Excess deaths (from all causes) among people with cancer, Ontario, 2020–2021



Notes:

- Deaths for 2019 to 2021 includes people diagnosed with cancer from 1981 to 2021.
- Expected number of deaths was calculated using the Farrington algorithm (see Appendix 2: Analysis), based on all causes of death among the 2015 to 2019 cohort of people with cancer.
- The upper bound threshold represents the upper 95% prediction interval for the number of expected deaths.

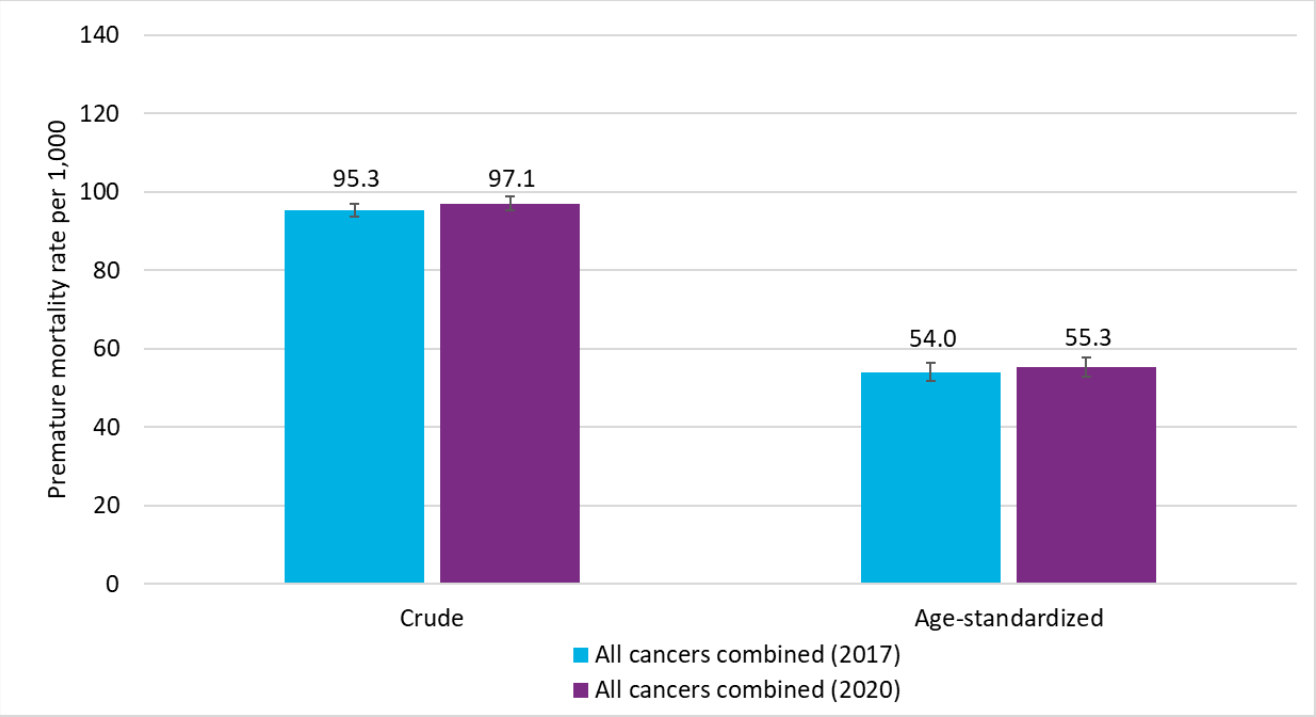
Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (March 2023), Ontario Health (Cancer Care Ontario)

Premature mortality

Premature deaths are defined as deaths that occur before age 75.(45,46) In Ontario, the age-standardized premature mortality rates among people with cancer are similar between the pre-pandemic period (54.0 per 1,000 in 2017) and the first year of the pandemic (55.3 per 1,000 in 2020) (**Figure 1.10**).

In addition, there was no difference in the age-standardized premature mortality rates among people with cancer who had COVID-19 (53.5 per 1,000) and people with cancer who did not have COVID-19 in 2020 (55.4 per 1,000) (**Figure 1.11**). There was also no difference in the unadjusted (i.e., crude) rates.

Figure 1.10 Premature mortality rate among people with cancer, Ontario, pre-COVID-19 pandemic (2017) and first year of the pandemic (2020)

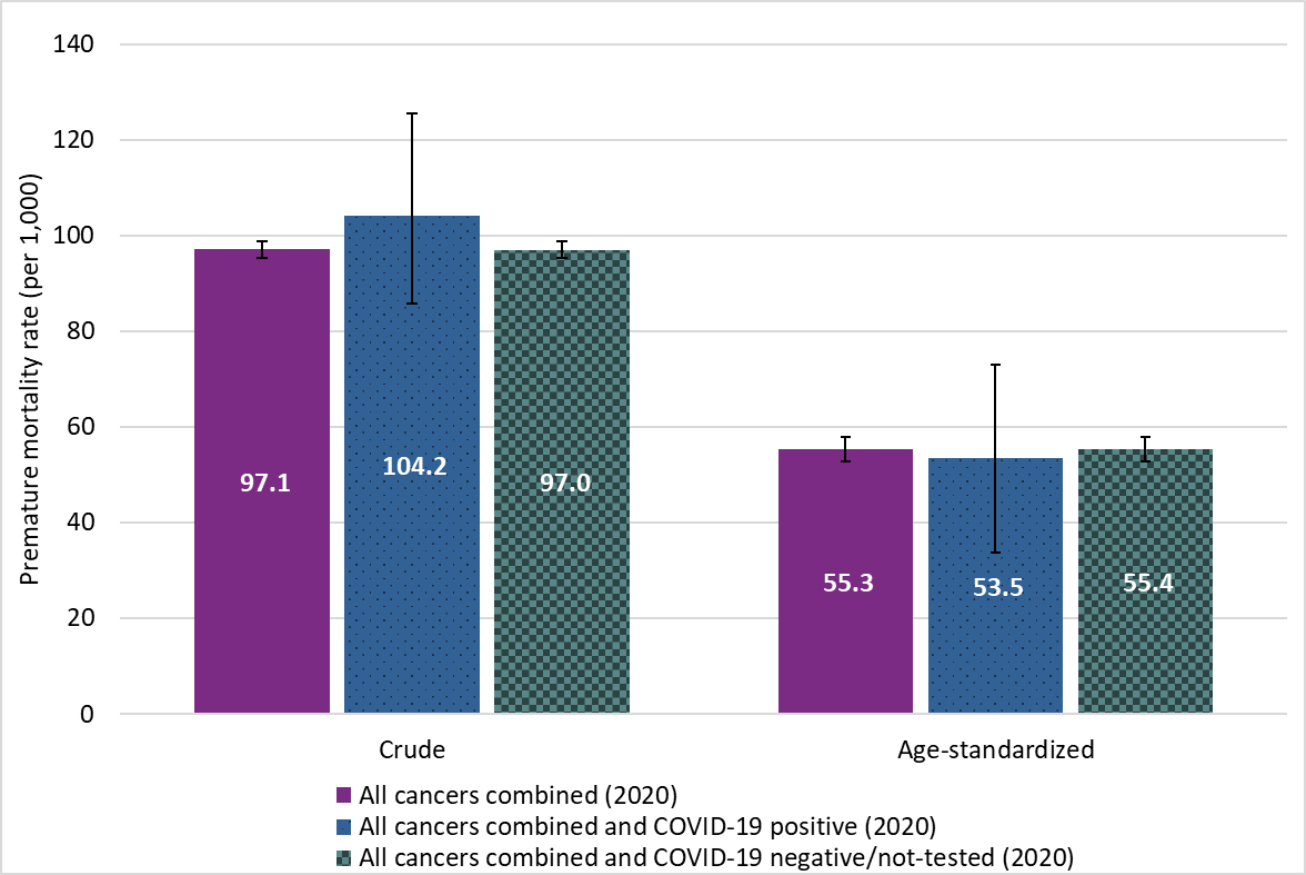


Notes:

- Premature death rates in 2017 were calculated for the cohort of people diagnosed with cancer in 2015 to 2017. Premature death rates in 2020 were calculated for the cohort of people diagnosed with cancer in 2018 to 2020.
- Rates are per 1,000.
- Age-standardized rates are standardized to the age distribution of the 2011 Canadian Standard population.
- Error bars represent 95% confidence intervals.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (March 2023), Ontario Health (Cancer Care Ontario)

Figure 1.11 Premature mortality rate among people with cancer by COVID-19 status, Ontario, 2020



Notes:

- Premature death rates in 2020 were calculated for the cohort of people diagnosed with cancer in 2018 to 2020.
- Rates are per 1,000.
- Age-standardized rates are standardized to the age distribution of the 2011 Canadian Standard population.
- Error bars represent 95% confidence intervals.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data sources: Ontario Cancer Registry (March 2023), Ontario Health (Cancer Care Ontario); Case and Contact Management Solution, Ministry of Health (March 2023)

Survival

Changes in short-term (one-year and two-year) survival are a way of estimating the impact on cancer detection and delays in treatment during the pandemic. Short-term survival also captures the morbidity related to concurrent, acute health conditions such as COVID-19. Because people with cancer are highly susceptible to COVID-19 (47,48), it is likely that many of them chose to limit their exposure to the virus by self-isolating and reducing or avoiding health care encounters during the pandemic. To avoid the negative impacts of delaying health care, Ontario implemented strategies to help minimize COVID-19 exposure in hospitals and align with public health guidelines. These strategies included increased use of virtual care, prioritizing certain populations (e.g., people fit enough to undergo treatment), radiation hypofractionation (i.e., larger doses of radiation over fewer appointments), modifying systemic treatment regimens and same-day discharge after surgery.

During the first year of the pandemic, one-year and two-year relative survival ratios (RSRs) decreased slightly. In 2020, one-year RSR decreased for all cancers combined by 1.9 percentage points and two-year RSR decreased by 2.5 percentage points compared with 2019 (**Figure 1.12 and Figure 1.13**).

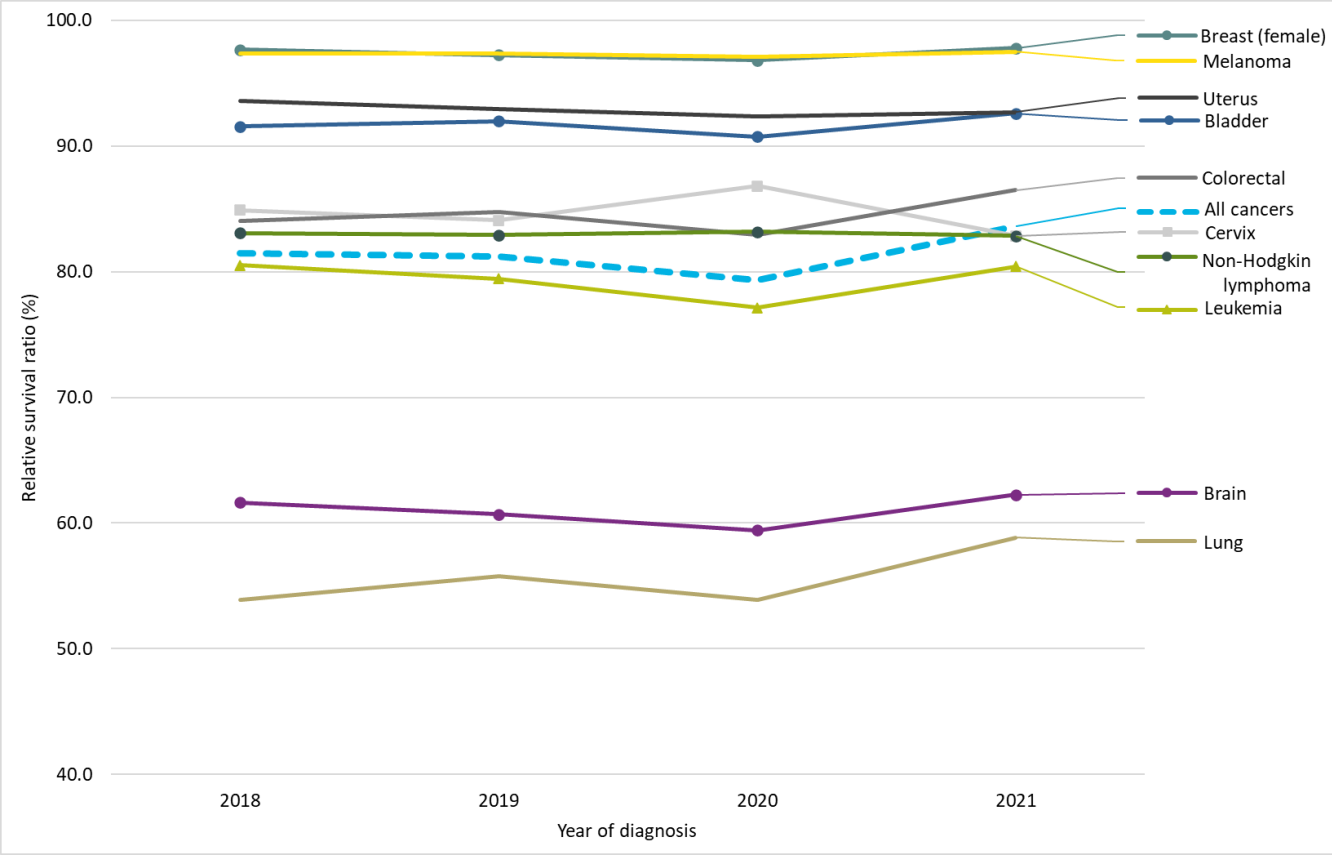
Only the two-year RSR for colorectal cancer showed a statistically significant decrease of 2.7 percentage points compared with 2019 (**Figure 1.12 and Figure 1.13**). While decreases also occurred for other cancer types, they were not statistically significant. It will be important to continue to monitor survival changes as more time accrues to allow analysis of five-year RSR (a more common population-based statistic).

Only cervical cancer had an increase in RSR compared to 2019, although it was statistically non-significant. In 2020, cervical cancer showed a 2.7 percentage point increase in one-year RSR and a 1.4 percentage point increase in two-year RSR compared with 2019.

Over time, it is expected that there will be a greater focus on and availability of published population-based survival statistics using pandemic data, which can then be compared to the findings reported here. Based on the limited literature to date, a modelling study in Alberta found significant decreases in one-year relative survival for recent diagnoses among people with colorectal cancer and non-Hodgkin lymphoma.(23)

One effect of the pandemic is that wait times for accessing some diagnostic services and surgery for certain cancers were shorter than usual. These reductions in wait time have been reported in the United Kingdom for skin cancer diagnosis and treatment.(49) In Canada, there were reductions of up to five days in the median wait time for a magnetic resonance imaging scan for all indications during the first year of the pandemic and smaller reductions for a CT scan.(50) Moreover, there were reductions of up to five days in the median wait time for surgery for bladder, breast, colorectal, lung and prostate cancers.(50) In Ontario, non-surgical treatments, such as chemotherapy and radiotherapy, were prioritized over surgery during the first few weeks of the pandemic.(51) The time to access non-surgical treatment or surgery was shorter during the early period of the pandemic compared with the pre-pandemic period.(51) It is not yet known whether these deviations in wait time will have an impact on survival.

Figure 1.12 Age-standardized one-year relative survival ratios by selected cancer types, Ontario, 2018 to 2021

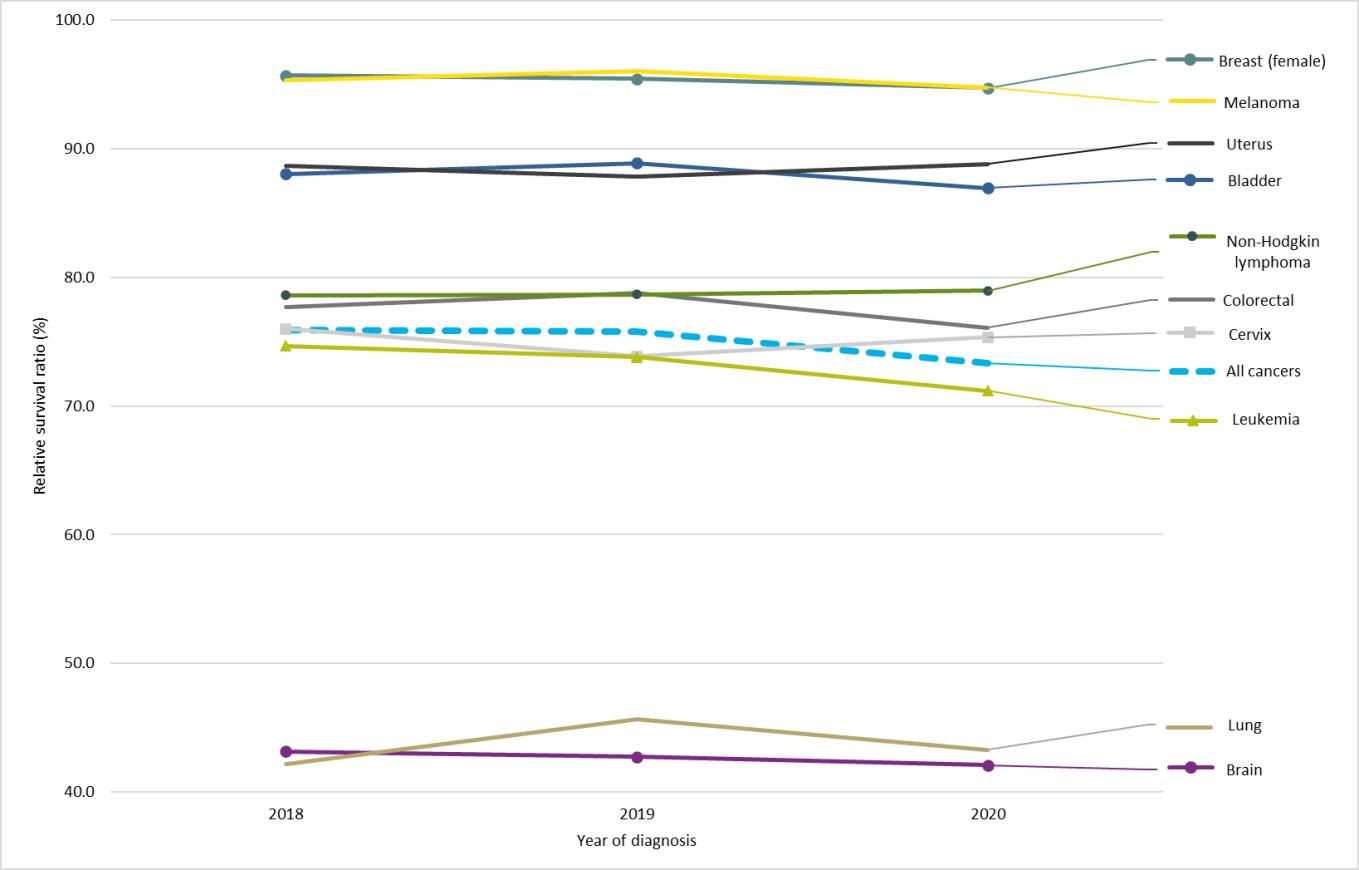


Notes:

- Analysis was restricted to cancer cases in people ages 15 to 99.
- The cohort method was used to derive relative survival ratios for all periods.
- Cases were selected based on the National Cancer Institute's Surveillance, Epidemiology and End Results Program standards for counting multiple primary cancers.
- Relative survival ratios were age-standardized using the International Cancer Survival Standards.(52)
- Bladder cancer includes malignant cases only (bladder carcinoma *in situ* cases are excluded).

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (September 2023), Ontario Health (Cancer Care Ontario)

Figure 1.13 Age-standardized two-year relative survival ratios by selected cancer types, Ontario, 2018 to 2020



Notes:

- Analysis was restricted to cases in people ages 15 to 99.
- The cohort method was used to derive relative survival ratios for all periods.
- Cases are selected based on the National Cancer Institute's Surveillance, Epidemiology and End Results Program standards for counting multiple primary cancers.
- Relative survival ratios were age-standardized using the International Cancer Survival Standards.(52)
- Bladder cancer includes malignant cases only (bladder carcinoma *in situ* cases are excluded).

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (September 2023), Ontario Health (Cancer Care Ontario)

Conclusion

The analysis presented in this chapter provides a glimpse into the impact of COVID-19 on the cancer population in Ontario during the first three years of the COVID-19 pandemic. Continued monitoring will be important for understanding the full breadth of the pandemic's effect on cancer outcomes. One of the main strengths of this analysis is that it uses provincial population-based data rather than solely regional data or data from selected institutions, which makes the conclusions of the analysis more representative.

The analysis provides several takeaways, as follows.

Incidence:

- In Ontario, the impact on the diagnosis of cancer was greatest during the first year of the pandemic. Although there was a gradual return to the usual monthly level of new cancer diagnoses by late 2020, substantial catch-ups did not appear to occur until 2022.
- The impact of COVID-19 on cancer diagnosis differed for different cancer types. While most cancer types experienced decreases in new diagnoses in 2020, there were variable amounts of decreases, with some extending into subsequent years. In other cases, some cancer types saw little change or experienced increases in diagnoses in 2020. For some cancers, the return to pre-pandemic diagnosis levels or surpassing those levels during 2021 and 2022 suggests a catch up on diagnostic delays. The largest decreases in new cases during the first year of the pandemic were for thyroid (-18.4% compared with 2019), breast (-12.1%), prostate (-12.0%) cancers and melanoma (-11.1%). Cancers that had an organized screening program appear to have returned to near usual incidence levels by late 2020 as program participation ramped up gradually throughout 2020.
- Among the cancers with population-level stage data in Ontario, there was a slight shift to advanced stage for breast and colorectal cancers. The shift to an advanced stage may lead to lower survival for these cancers in the coming years.
- During the first year of the COVID-19 pandemic, people with cancer had 2-fold higher hospitalization rates shortly after being diagnosed with COVID-19 compared to the general Ontario population, after accounting for age differences in these populations. Higher hospitalization rates among people with cancer may have occurred because of their higher susceptibility to COVID-19 and greater complications compared to people without cancer.

Mortality:

- In Ontario, there were substantially more deaths in people with cancer in 2020 compared with 2019, which could be directly or indirectly related to the impact of COVID-19.
- Premature mortality rates were similar among people diagnosed with cancer in the most recent years (2018 to 2020) and those diagnosed up to five years (2015 to 2017) prior to the pandemic, regardless of whether they had COVID-19.

Survival:

- Survival for several common cancers was affected in 2020, showing decreases compared with 2019 in one-year and two-year survival, ranging from 0.6% to 2.7%. However, only the decrease in two-year survival for colorectal cancer of 2.7% was statistically significant.

Limitations

There are several caveats that should be noted about this analysis:

- The inability to examine population subgroups based on their vulnerability is a limitation. People with cancer in the most vulnerable populations, such as those experiencing marginalization, are at higher risk of COVID-19 and are therefore at higher risk of dying. Current research is evaluating COVID-19 outcomes in Ontario according to indicators of marginalization in order to address this topic.
- It was not possible to determine whether the cause of a hospital admission was due to COVID-19 because that information was not captured in the Case and Contact Management Solution, which was the source of the COVID-19 data.
- Data on stage at diagnosis was only available at the population level for breast (female), prostate, lung, colorectal and cervix. Changes in stage may have been different during the first year of the pandemic for other cancer types, but because of the lack of adequate data, it was not possible to confirm this assumption.
- The number of deaths reported in this analysis would be underestimated if people with undiagnosed cancer died from COVID-19 before being diagnosed with their cancer. Because autopsies are rarely done, it would be hard to quantify this type of occurrence.
- The current analysis did not consider differences in comorbidities, timing of COVID-19 infection relative to cancer treatment (e.g., before, during or after treatment) or long-term effects of COVID-19 infection, which are all known to have an impact on survival.(53,54)
- Examining mortality and survival in relation to different COVID-19 variants of concern may provide more nuanced insights about differential outcomes among people with cancer. However, this type of analysis was out of scope for this report but is an important area for future analysis.
- The analyses in this report were not stratified by COVID-19 vaccination status, which could provide more information on variations in outcomes for people with cancer.
- It is acknowledged that health human resources were severely impacted by the COVID-19 pandemic. The ability of the cancer system to provide high-quality cancer care is recognized as an important determinant of cancer outcomes. Despite this fact, an examination of health system capacity was out of scope for this report.

Implications

The analysis of patterns and trends in cancer incidence, mortality and survival during the first years of the COVID-19 pandemic helps signal possible gaps in the health system and subgroups of people with cancer who fared poorly during the pandemic, whether due to barriers to access, their preferences in care, their biological characteristics, their personal behaviour, or due to other determinants of health. This type of analysis can help set priorities for future crises to ensure the provision of equitable care. It can also identify parts of the cancer system that require further attention, such as screening, diagnosis and treatment, as well as inform which services may be safely opened to serve certain subpopulations. By identifying the highest at-risk subgroups, the health system can also help triage the backlog of cases based on their propensity for undesirable outcomes, such as poor survival and high mortality.

Ch 2: Cancer Incidence

Cancer incidence refers to the number of new cancer cases diagnosed in a specific timeframe. This chapter reports projections for 2021 to 2024 and actual (non-projected) incidence rates based on counts considered complete as of 2020, which is the latest available year. Because 2020 was an anomalous year that can bias some estimates, incidence data for 2020 are excluded from the following statistics in this chapter: projected incidence counts and rates, probability of developing cancer and incidence trends. Therefore, these statistics do not account for the effects of the COVID-19 pandemic.

Incidence overview

Although the number of new cancer cases diagnosed in Ontario (incidence) increased over the past three decades, the incidence rate has been decreasing for several years. ln general, the incidence of cancer is influenced by:

- socio-demographic factors
- the availability of early detection of and screening for cancer
- the prevalence of cancer risk and protective factors

Cancer risk factors and protective factors can include (55,56):

- modifiable factors (e.g., smoking, diet, alcohol consumption, physical activity, body weight, sun exposure)
- non-modifiable factors (e.g., age of first menstrual cycle, menopause, family history of cancer)
- previous treatments (e.g., hormone replacement therapy, medical radiation)
- exposure to environmental and occupational carcinogens (e.g., radon, air pollution, ultraviolet rays, asbestos, diesel engine exhaust)
- medical conditions and infectious agents (e.g., Crohn's disease, *Helicobacter pylori*)
- vaccination status (e.g., hepatitis B vaccine, human papillomavirus vaccine)
- genetic predispositions (e.g., BRCA1 and BRCA2 genes, RB1 gene)

Statistics by sex in this chapter refer to sex data that are binary and assigned at birth. For more information, refer to About This Report: Statistics by sex.

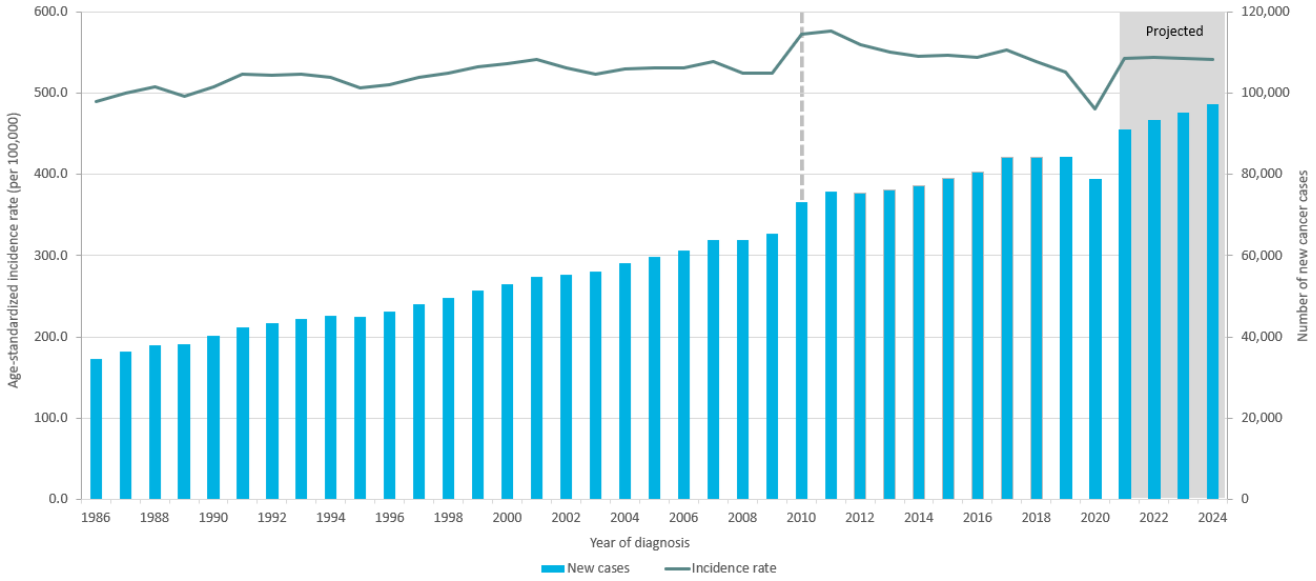
Estimated cancer incidence in 2024

In 2024, there will be an estimated 97,193 new cases of cancer (excluding non-melanoma skin cancer) in Ontario, which will result in an age-standardized incidence rate of 542.0 cases per 100,000 people (**Figure 2.1**). Over time, the number of cancer cases has been steadily increasing, with some notable changes:

- An abrupt increase occurred in the cancer incidence count and rate in 2010, which is a result of the Ontario Cancer Registry's adoption of the National Cancer Institute's Surveillance, Epidemiology and End Results Program rules for counting multiple primary cancers (**Figure 2.1**). These rules were applied to the registry for people diagnosed from 2010 onward, so the higher numbers starting in that year reflect an adoption of the new rules and not a true increase in the cancer incidence (see Appendix 2: Analysis).(57)

- A lower-than-expected cancer incidence count and rate is noted in 2020 compared to previous years (**Figure 2.1**). This decrease was seen in many jurisdictions and is due to an overall drop in cancer diagnoses as a result of the COVID-19 pandemic (see Chapter 1: COVID-19 and Cancer in Ontario).

Figure 2.1 Incidence counts and age-standardized rates for all cancers combined, Ontario, 1986 to 2024



Notes:

- Rates are per 100,000 and standardized to the age distribution of the 2011 Canadian Standard population.
- Incidence rates are based on the National Cancer Institute's Surveillance, Epidemiology and End Results standards for counting multiple primary cancers, which were adopted by the Ontario Cancer Registry for cases diagnosed from 2010 onward (indicated by the dashed line). Direct comparisons between rates for 2010 onward and previous years should generally not be made. The years before 2010 are only shown to highlight the impact on new cases and rates created by the change in counting standards for multiple primary cancers.
- The shaded area indicates projected data for 2021 onward.

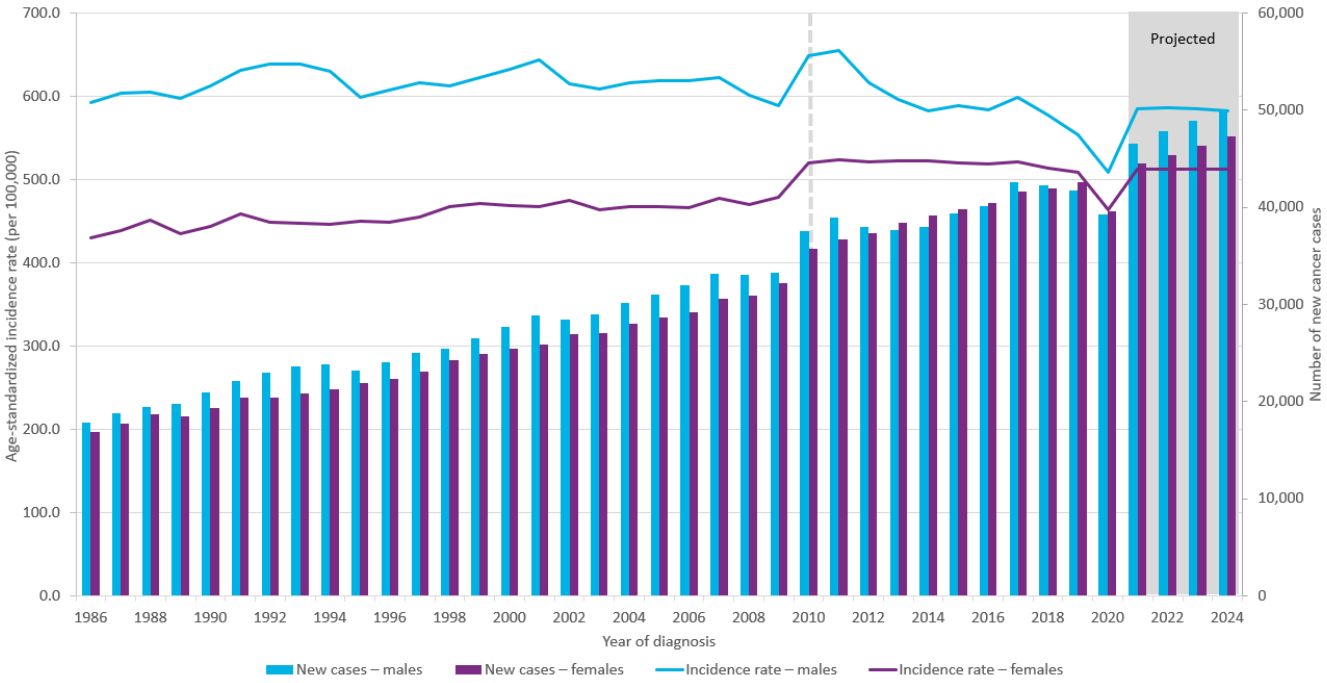
Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (December 2022), Ontario Health (Cancer Care Ontario)

Projected incidence by sex

Among males, 49,923 cancer cases are expected to be diagnosed in 2024 for an age-standardized incidence rate of 582.9 per 100,000 (**Figure 2.2**). The rapid drop in the count and rate after 2011 is partly due to a decrease in prostate cancer. This decrease followed the 2012 recommendations from the U.S. Preventive Services Task Force (USPSTF) against prostate-specific antigen-based screening for prostate cancer in men, regardless of age.(58) Similarly, the Canadian Task Force on Preventive Health Care recommended against screening for prostate cancer with the prostate-specific antigen test in 2014.(59) The latest statement by the USPSTF, released in 2018, made the same recommendations as in 2012 for men age 70 and older and was modified to recommend individualized decision-making for men ages 50 to 69.(60)

Among females, 47,270 new cases are expected to be diagnosed in 2024 with an age-standardized incidence rate of 512.3 per 100,000 (**Figure 2.2**). The incidence rate has been higher for males than females every year since at least 1986. This sex difference has been observed in many other jurisdictions.(61,62) Higher rates of cancer among males have been attributed to differences in their behaviour (63–65), immunity (66), hormones (67) and exposures (e.g., workplace carcinogens).(68,69)

Figure 2.2 Incidence counts and age-standardized rates by binary sex for all cancers combined, Ontario, 1986 to 2024



Notes:

- Rates are per 100,000 and standardized to the age distribution of the 2011 Canadian Standard population.
- Incidence rates are based on the National Cancer Institute's Surveillance, Epidemiology and End Results standards for counting multiple primary cancers, which were adopted by the Ontario Cancer Registry for cases diagnosed from 2010 onward (indicated by the dashed line). Direct comparisons with rates for 2010 onward and previous years should generally not be made. The years before 2010 are only shown to highlight the impact on new cases and rates created by the change in counting standards for multiple primary cancers.
- The shaded area indicates projected data for 2021 onward.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (December 2022), Ontario Health (Cancer Care Ontario)

Projected incidence by sex and cancer type

In 2024, the most commonly diagnosed cancer is expected to be female breast cancer (13,039 cases or 13.4% of all new cases), followed by lung cancer (10,738 cases or 11.0%), prostate cancer (10,192 cases or 10.5%) and colorectal cancer (9,244 cases or 9.5%) (**Table 2.1**). These four cancers are projected to account for 44.4% of all new cancers diagnosed in 2024.

Among males, the most commonly diagnosed cancer is expected to be prostate cancer, with an age-standardized incidence rate of 114.5 per 100,000. Breast cancer, with an age-standardized incidence rate of 147.5 per 100,000, is projected to be the most commonly diagnosed cancer among females.

The age-standardized incidence rate is expected to be higher in males than females for all cancer types that affect males and females listed in **Table 2.1**, except for thyroid cancer (age-standardized incidence rate in females is greater by 15.8 per 100,000) and lung cancer (age-standardized incidence rate in females is greater by 0.5 per 100,000). A higher prevalence of certain risk factors likely explains the mostly higher cancer incidence in males (see Chapter 2: Incidence by Sex and Cancer Type for a more detailed discussion).

In 2024, the number of new thyroid cancer cases in females is expected to outnumber male cases by more than double, with an age-standardized incidence rate of 28.0 per 100,000 in females, and 12.2 per 100,000 in males. For a detailed discussion on possible reasons for the sex disparity in thyroid cancer incidence, see Chapter 2: Incidence by Sex and Cancer Type.

The number of new lung cancer cases in females is expected to outnumber male cases by 882 in 2024. This cancer has a projected age-standardized incidence rate of 56.6 per 100,000 in females and 56.1 per 100,000 in males. For more information on lung cancer incidence trends, see Chapter 2: Incidence Trends by Cancer Type.

Table 2.1 Projected incidence counts and age-standardized rates by cancer type and binary sex, Ontario, 2024

Cancer type	Males and females combined – new cases	Males and females combined – ASIR	Males – new cases	Males – ASIR	Females – new cases	Females – ASIR
All cancers	**97,193**	**542.0**	**49,923**	**582.9**	**47,270**	**512.3**
Bladder	4,567	23.9	3,534	40.7	1,033	10.1
Brain	1,253	7.4	707	8.8	546	6.2
Breast (female)	n/a	n/a	n/a	n/a	13,039	147.5
Cervix	n/a	n/a	n/a	n/a	669	8.4
Colorectal	9,244	51.0	5,281	62.7	3,963	40.7
Esophagus	1,016	5.5	767	9.0	249	2.4
Hodgkin lymphoma	455	2.8	248	3.1	207	2.5
Kidney	3,310	19.0	2,205	27.0	1,105	12.0
Larynx	411	2.2	351	4.1	60	0.6
Leukemia	2,694	15.2	1,479	17.7	1,215	12.8
Liver	1,744	9.3	1,216	13.9	528	5.2
Lung	10,738	56.2	4,928	56.1	5,810	56.6
Melanoma	4,922	27.6	2,832	33.7	2,090	22.9
Myeloma	1,759	9.4	1,007	11.7	752	7.5
Non-Hodgkin lymphoma	5,117	28.2	2,838	33.7	2,279	23.6
Oral cavity and pharynx	2,122	12.1	1,448	17.5	674	7.2
Ovary	n/a	n/a	n/a	n/a	1,368	15.3
Pancreas	2,655	14.2	1,373	16.0	1,282	12.6
Prostate	n/a	n/a	10,192	114.5	n/a	n/a
Stomach	1,850	10.1	1,207	14.3	643	6.6
Testis	n/a	n/a	564	7.1	n/a	n/a
Thyroid	3,181	20.2	955	12.2	2,226	28.0
Uterus	n/a	n/a	n/a	n/a	3,629	40.4

Abbreviations:
ASIR means age-standardized incidence rate
n/a means not applicable

Notes:

- Rates are per 100,000 and standardized to the age distribution of the 2011 Canadian Standard population.
- Projected incidence rates are based on the National Cancer Institute's Surveillance, Epidemiology and End Results standards for counting multiple primary cancers, which were adopted by the Ontario Cancer Registry for cases diagnosed from 2010 onward.
- Projections are based on malignant cases only.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)

Data source: Ontario Cancer Registry (December 2022), Ontario Health (Cancer Care Ontario)

Projected incidence by age and cancer type

The greatest number of new cancer cases is expected in people ages 60 to 79. An estimated 56.8% of all cases in 2024 are projected to be diagnosed in this age group (**Table 2.2**). The age group with the second highest number of new cancer cases will be people ages 40 to 59 (19.7%), followed by those age 80 and older (18.8%). Only 4.7% of cases are expected to be diagnosed in people under age 40.

The incidence rate for all cancers combined in 2024 is projected to range from 59.5 per 100,000 in people age 39 and younger to 2,445.5 per 100,000 in people age 80 and older. The projected rates for 2024 increase with advancing age for most cancers, except:

- cervical cancer, which increases with advancing age, but peaks in people ages 40 to 59
- oral and pharynx, prostate, thyroid and uterine cancers, which increase with advancing age, but peak in people ages 60 to 79
- testicular cancer, which decreases with advancing age
- Hodgkin lymphoma, which is highest in people age 39 and younger, and in people age 80 and older

The incidence rates of the 23 cancers listed in **Table 2.2** are projected to be very low in people under age 40. Exceptions include breast cancer at 17.1 per 100,000, testicular cancer at 9.8 per 100,000 and thyroid cancer at 8.2 per 100,000.

Female breast cancer will account for the largest proportion of all cases among people ages 40 to 59 (21.4%). In people ages 60 to 79, breast (11.8%), lung (12.6%) and prostate (14.2%) will be the most commonly diagnosed cancers. Among people age 80 and older, lung will be the most commonly diagnosed cancer (14.7%), followed by colorectal cancer (12.3%).

Table 2.2 Projected incidence counts and age-specific rates by cancer type and age group, Ontario, 2024

Cancer type	Ages 0 to 39 – new cases	Ages 0 to 39 – age-specific rate	Ages 40 to 59 – new cases	Ages 40 to 59 – age-specific rate	Ages 60 to 79 – new cases	Ages 60 to 79 – age-specific rate	Age 80 and older – new cases	Age 80 and older – age-specific rate
All cancers	**4,599**	**59.5**	**19,116**	**495.9**	**55,237**	**1,690.3**	**18,241**	**2,445.5**
Bladder	34	0.4	444	11.5	2,698	82.6	1,391	186.5
Brain	272	3.5	278	7.2	552	16.9	151	20.2
Breast (female)	645	17.1	4,085	207.8	6,536	382.6	1,773	402.9
Cervix	182	4.8	283	14.4	172	10.1	32	7.3
Colorectal	186	2.4	1,724	44.7	5,099	156.0	2,235	299.6
Esophagus	8	0.1	157	4.1	630	19.3	221	29.6
Hodgkin lymphoma	241	3.1	93	2.4	94	2.9	27	3.6
Kidney	134	1.7	856	22.2	1,865	57.1	455	61.0
Larynx	**	**	70†	1.8	270	8.3	70	9.4
Leukemia	357	4.6	401	10.4	1,429	43.7	507	68.0
Liver	21	0.3	218	5.7	1,134	34.7	371	49.7
Lung	57	0.7	1,033	26.8	6,972	213.3	2,676	358.8
Melanoma	307	4.0	997	25.9	2,513	76.9	1,105	148.1
Myeloma	9	0.1	239	6.2	1,037	31.7	474	63.5
Non-Hodgkin lymphoma	305	3.9	859	22.3	2,779	85.0	1,174	157.4
Oral cavity and pharynx	50	0.6	518	13.4	1,270	38.9	284	38.1
Ovary	92	2.4	391	19.9	682	39.9	203	46.1
Pancreas	26	0.3	350	9.1	1,544	47.2	735	98.5
Prostate	**	**	1,250†	66.2	7,849	503.2	1,096	358.4
Stomach	43	0.6	319	8.3	1,038	31.8	450	60.3
Testis	390	9.8	139	7.4	30†	2.0	**	**
Thyroid	634	8.2	1,303	33.8	1,129	34.5	115	15.4
Uterus	83	2.2	1,043	53.1	2,137	125.1	366	83.2

Symbols:
**Suppressed due to small case count of less than six
†Count has been rounded to ensure confidentiality, and associated rate and confidence interval have been adjusted to reflect rounded count

Notes:

- Rates are per 100,000.
- Projected incidence rates are based on the National Cancer Institute's Surveillance, Epidemiology and End Results standards for counting multiple primary cancers, which were adopted by the Ontario Cancer Registry for cases diagnosed from 2010 onward.
- Projections are based on malignant cases only.

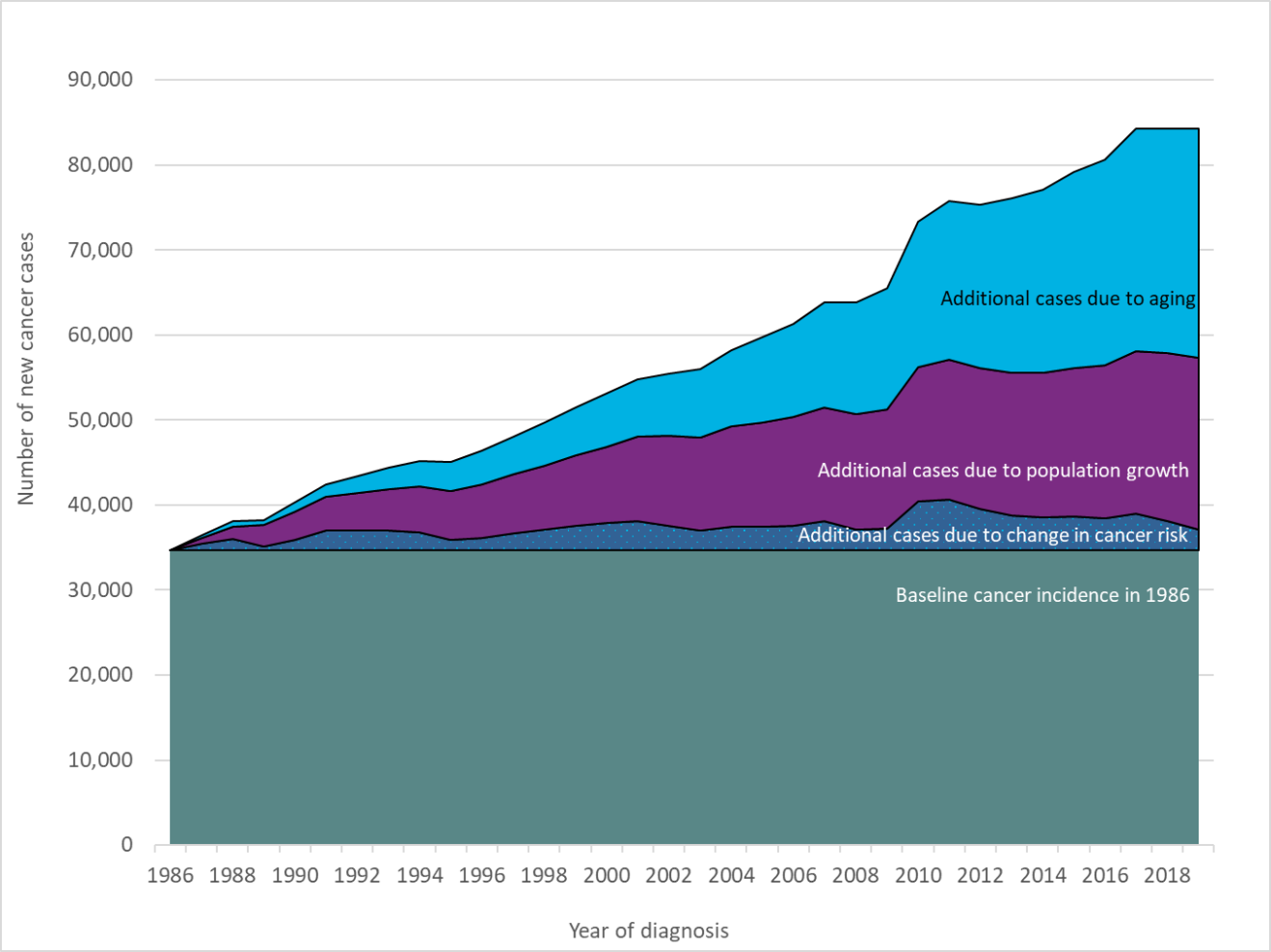
Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (December 2022), Ontario Health (Cancer Care Ontario)

Cancer incidence 1986 to 2020

Cancer incidence in 2020 was lower than expected compared to previous years in Ontario. This decrease was seen in many jurisdictions and is due to an overall drop in cancer cases diagnosed as a result of the COVID-19 pandemic.(70,71) Please refer to Chapter 1: COVID-19 and Cancer in Ontario for more information on the impact of the pandemic on cancer diagnoses in Ontario. Because 2020 was an anomalous year that can bias some estimates, incidence data for 2020 are excluded from the following statistics in this section: probability of developing cancer and incidence trends.

From 1986 to 2019, population aging and growth have contributed far more to the number of new cancer cases than actual changes in cancer risk and cancer control practices (**Figure 2.3**). In 2019, 84,305 new cancer cases were diagnosed in Ontario, representing a 143% increase since 1986 (34,660 cases). Of this 143% increase, approximately 78% is due to aging of the population, 58% is due to population growth and only 7% is due to changes in cancer risk and cancer control practices (see Appendix 2: Analysis).

Figure 2.3 Incidence due to changes in cancer risk, population growth and aging, Ontario, 1986 to 2019



Note:

- Number of new cancer cases is based on the National Cancer Institute's Surveillance, Epidemiology and End Results standards for counting multiple primary cancers, which were adopted by the Ontario Cancer Registry for cases diagnosed from 2010 onward. Direct comparisons between counts for 2010 onward and previous years should generally not be made.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (December 2022), Ontario Health (Cancer Care Ontario)

Probability of developing cancer

The lifetime probability of developing cancer refers to the average chance of being diagnosed with cancer over the course of a lifetime.

The probability of developing a specific type of cancer depends on many factors, including:

- population characteristics
- the prevalence of risk factors
- current life expectancy

In addition, the probabilities in this report reflect the average risks for the overall population and do not consider personal risk factors. In other words, an individual's risk may be higher or lower than the numbers reported here.

In Ontario, nearly one out of two people (43.7%) will develop cancer in their lifetime (not including non-melanoma skin cancer) (**Table 2.3**). The probability of developing cancer is expected to be lower for females than for males and varies based on cancer type:

- Among males, the probability is highest for prostate (1 in 9), lung (1 in 18) and colorectal (1 in 21) cancers.
- Among females, the probability is highest for breast (1 in 9), lung (1 in 18) and colorectal (1 in 24) cancers.

Table 2.3 Lifetime probability of developing cancer by cancer type and binary sex, Ontario, 2016 to 2019

Cancer type	Males and females combined – %	Males and females combined – 1 in	Males – %	Males – 1 in	Females – %	Females – 1 in
All cancers	**43.7**	**2**	**45.1**	**2**	**42.6**	**2**
Bladder	2.4	42	3.7	27	1.2	87
Brain	0.6	165	0.7	145	0.5	192
Breast (female)	n/a	n/a	n/a	n/a	11.1	9
Cervix	n/a	n/a	n/a	n/a	0.5	214
Colorectal	4.5	22	4.8	21	4.2	24
Esophagus	0.4	239	0.6	163	0.2	436
Hodgkin lymphoma	0.2	456	0.2	415	0.2	503
Kidney	1.2	83	1.6	64	0.8	118
Larynx	0.2	491	0.4	282	0.1	1689
Leukemia	1.3	76	1.5	65	1.1	91
Liver	0.8	129	1.0	96	0.5	194
Lung	5.5	18	5.6	18	5.4	18
Melanoma	1.8	56	2.0	49	1.6	63
Myeloma	0.9	117	0.9	105	0.8	130
Non-Hodgkin lymphoma	2.3	43	2.6	39	2.1	47
Oral cavity and pharynx	0.9	115	1.2	83	0.5	182
Ovary	n/a	n/a	n/a	n/a	1.3	78
Pancreas	1.3	80	1.3	78	1.2	82
Prostate	n/a	n/a	10.7	9	n/a	n/a
Stomach	0.8	119	1.1	92	0.6	165
Testis	n/a	n/a	0.4	229	n/a	n/a
Thyroid	1.4	73	0.7	141	2.0	49
Uterus	n/a	n/a	n/a	n/a	3.0	34

Abbreviation: n/a means not applicable

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (December 2022), Ontario Health (Cancer Care Ontario)
Statistics Canada, Table 13-10-0709-01 Mortality rates, by age group

Incidence by sex and cancer type

In 2020, 78,772 new cancer cases were diagnosed in Ontario for an age-standardized incidence rate of 480.7 per 100,000 (**Table 2.4**).

Non-melanoma skin cancers represent the most common type of cancer in most jurisdictions (72), but they are not included in this report because Ontario does not routinely collect data on them. Other jurisdictions have reported an increasing trend in non-melanoma skin cancers.(73–75)

The four most commonly diagnosed cancers (breast, lung, colorectal and prostate) were responsible for almost 50% of all new cancer cases in 2020. Colorectal, lung and prostate cancers accounted for 43% of new cases among males, while breast, colorectal and lung cancers accounted for 49% of new cases among females (**Figure 2.4**). Lung cancer (58.6 per 100,000), colorectal cancer (48.6 per 100,000) and lymphoma (27.4 per 100,000) had the highest age-standardized incidence rates among cancers that occur in males and females.

The age-standardized incidence rates for all cancers combined was significantly higher in males (508.4 per 100,000) than in females (463.4 per 100,000) (**Table 2.4**).

- In males, the most commonly diagnosed cancers were prostate (7,517 or 19.2% of all new male cancer cases), lung (5,003 or 12.8%) and colorectal (4,332 or 11.0%).
- In females, the most commonly diagnosed cancers were breast (10,688 or 27.0% of all new female cancer cases), lung (5,048 or 12.8%) and colorectal (3,672 or 9.3%).

The greatest differences in incidence between males and females were for laryngeal, esophageal, bladder, oral cavity and pharynx, liver, kidney and stomach cancers. The risk of developing these cancer types is associated with the use of tobacco or alcohol (76,77), and in Ontario, tobacco and alcohol use are more prevalent among men.(78)

- Laryngeal cancer: The male rate was six times higher than the female rate. Smokers are seven times more likely to develop laryngeal cancer (79) and heavy alcohol use more than doubles laryngeal cancer risk.(76)
- Esophageal cancer: The male rate for esophageal cancer overall was more than four times higher than the female rate, with the rate of adenocarcinoma of the esophagus being seven times higher in males than in females. Smoking more than doubles the risk of esophageal cancer.(79) Alcohol use and overweight and obesity, also more common in males, are other risk factors for esophageal cancer.(79,80)
- Bladder cancer: The male rate was nearly four times higher than the female rate. One of the main risk factors for bladder cancer is smoking, with smokers being two to three times more likely to develop bladder cancer than non-smokers.(81,82)
- Oral cavity and pharynx cancer: The male rate for oral cavity and pharynx cancer overall was almost three times higher than the female rate, with the rate of hypopharynx cancer in males being five times higher than in females and the rate of oropharynx cancer being over five times higher in males than in females. Tobacco and alcohol use are risk factors for oral cavity cancer while prior infections with human papillomavirus (HPV) are strongly associated with cancers of the pharynx.(83) Alcohol use increases the risk of oral cavity and pharynx cancer by more than five times.(76)

- Liver cancer: The male rate for liver cancer was more than double the female rate. Tobacco and alcohol use are linked to increased risk of liver cancer.(76) Chronic viral hepatitis is another risk factor for liver cancer and in Ontario, the rate of chronic viral hepatitis is higher in males than in females.(84,85) Overweight and obesity, which is more prevalent among males in Ontario than among females, is another independent risk factor for liver cancer.(80,86)
- Kidney cancer: The male rate for kidney cancer was more than double the female rate. Heavy alcohol use is associated with increased risk of kidney cancer.(76)
- Stomach cancer: The male rate for stomach cancer was double the female rate. Heavy alcohol use is associated with a 20% increase in risk of stomach cancer.(76)

The incidence rate was higher in males than in females for almost all cancers. One exception was less aggressive types of thyroid cancer, such as papillary carcinoma, which had an age-standardized incidence rate in females of 21.7 per 100,000, compared with 7.9 per 100,000 in males. The rates of more aggressive types, such as anaplastic and medullary thyroid cancers, were generally similar for males and females. As a result, thyroid mortality rates have been fairly equal for males and females (see Chapter 3: Cancer Mortality). The same pattern is seen in other jurisdictions.(87,88) Several possible reasons for the higher thyroid cancer incidence in females have been proposed, including:

- a greater likelihood of diagnostic investigation among females because they are more likely to have thyroid disease (89) and they have a greater tendency to seek medical attention (90,91)
- the differences in hormone levels for males and females (such as thyroid stimulated hormone and sex steroids) (92,93)
- other biological and hormonal factors, such as menstrual cycling, use of birth control, pregnancies and menopause (89)

The incidence rates of non-malignant tumours of the brain and nervous system were higher in females than in males, as seen in many other jurisdictions.(94–98) Although the reason for these sex differences is not clear, some studies suggest that exposure to female hormones may increase risk of meningiomas.(99,100)

Table 2.4 Age-standardized incidence rates and counts by cancer type and binary sex, Ontario, 2020

Cancer type	Males and females combined – new cases	Males and females combined – % of cases	Males and females combined – ASIR	Males and females combined – 95% CI	Males – new cases	Males – % of cases	Males – ASIR	Males – 95% CI	Females – new cases	Females – % of cases	Females – ASIR	Females – 95% CI
All cancers	**78,772**	**100**	**480.7**	**477.3–484.1**	**39,236**	**100**	**508.4**	**503.4–513.5**	**39,536**	**100**	**463.4**	**458.7–468.0**
Brain and other nervous system – malignant	1,201	1.5	7.6	7.1–8.0	702	1.8	9.3	8.6–10.0	499	1.3	6.0	5.5–6.6
Glioblastoma	660	0.8	4.1	3.7–4.4	387	1.0	5.0	4.5–5.6	273	0.7	3.2	2.8–3.6
All other gliomas	272	0.3	1.8	1.6–2.0	166	0.4	2.2	1.9–2.6	106	0.3	1.4	1.1–1.7
Brain and other nervous system – non-malignant	2,123	2.7	13.5	13.0–14.1	836	2.1	11.2	10.5–12.0	1,287	3.3	15.7	14.8–16.6
Meningiomas	573	0.7	3.7	3.4–4.0	180	0.5	2.4	2.1–2.8	393	1.0	4.9	4.4–5.4
Pituitary, pineal and craniopharyngeal duct	486	0.6	3.2	2.9–3.5	229	0.6	3.1	2.7–3.5	257	0.7	3.3	2.9–3.8
Breast (female)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	10,688	27.0	130.1	127.6–132.6
Cervix	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	604	1.5	8.1	7.4–8.7
Ovary	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1,276	3.2	15.5	14.6–16.4
Prostate	n/a	n/a	n/a	n/a	7,517	19.2	94.3	92.2–96.5	n/a	n/a	n/a	n/a
Testis	n/a	n/a	n/a	n/a	452	1.2	6.2	5.6–6.8	n/a	n/a	n/a	n/a
Uterus	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2,929	7.4	34.8	33.6–36.1
Uterus – endometrial	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2,634	6.7	31.2	30.0–32.5
Uterus – uterine sarcoma	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	81	0.2	1.1	0.8–1.3
Colorectal	8,004	10.2	48.6	47.5–49.7	4,332	11.0	57.1	55.4–58.8	3,672	9.3	41.2	39.9–42.6
Colon excluding rectum	5,364	6.8	32.2	31.4–33.1	2,750	7.0	36.2	34.8–37.6	2,614	6.6	28.8	27.7–30.0
Colon – left sided	1,959	2.5	12.1	11.5–12.6	1,099	2.8	14.5	13.6–15.4	860	2.2	10.0	9.3–10.7
Colon – right sided	3,078	3.9	18.2	17.6–18.9	1,503	3.8	19.7	18.7–20.7	1,575	4.0	17.0	16.1–17.8

Cancer type	Males and females combined – new cases	Males and females combined – % of cases	Males and females combined – ASIR	Males and females combined – 95% CI	Males – new cases	Males – % of cases	Males – ASIR	Males – 95% CI	Females – new cases	Females – % of cases	Females – ASIR	Females – 95% CI
Rectum and rectosigmoid junction	2,624	3.3	16.3	15.7–16.9	1,578	4.0	20.9	19.8–21.9	1,046	2.6	12.3	11.5–13.0
Rectosigmoid junction	690	0.9	4.3	3.9–4.6	387	1.0	5.1	4.6–5.6	303	0.8	3.5	3.1–4.0
Rectum	1,934	2.5	12.0	11.5–12.6	1,191	3.0	15.8	14.9–16.7	743	1.9	8.7	8.1–9.4
Esophagus	933	1.2	5.5	5.2–5.9	727	1.9	9.3	8.6–10.0	206	0.5	2.2	1.9–2.5
Esophagus – adenocarcinoma	525	0.7	3.1	2.9–3.4	452	1.2	5.8	5.3–6.4	73	0.2	0.8	0.6–1.0
Esophagus – squamous cell carcinoma	285	0.4	1.7	1.5–1.9	187	0.5	2.4	2.0–2.7	98	0.2	1.0	0.8–1.3
Liver	1,346	1.7	8.0	7.6–8.4	914	2.3	11.7	10.9–12.5	432	1.1	4.8	4.3–5.2
Pancreas	2,347	3.0	14.0	13.4–14.6	1,242	3.2%	16.2	15.3–17.1	1,105	2.8%	12.1	11.4–12.9
Stomach	1,556	2.0	9.4	8.9–9.9	1,015	2.6%	13.3	12.5–14.2	541	1.4%	6.1	5.6–6.6
Larynx	394	0.5	2.3	2.1–2.6	330	0.8%	4.2	3.8–4.7	64	0.2%	0.7	0.6–1.0
Oral cavity and pharynx	1,914	2.4	11.8	11.3–12.4	1,349	3.4%	17.6	16.7–18.6	565	1.4%	6.5	6.0–7.1
Lip and oral cavity	876	1.1	5.4	5.0–5.8	543	1.4%	7.2	6.6–7.8	333	0.8%	3.8	3.4–4.2
Hypopharynx	101	0.1	0.6	0.5–0.7	80	0.2%	1	0.8–1.3	21	0.1%	0.2	0.1–0.4
Nasopharynx	116	0.1	0.8	0.6–0.9	76	0.2%	1.0	0.8–1.3	40	0.1%	0.5	0.4–0.7
Oropharynx	749	1.0	4.6	4.3–5.0	605	1.5%	7.8	7.2–8.5	144	0.4%	1.7	1.4–2.0
Thyroid	2,406	3.1	16.2	15.6–16.9	650	1.7%	9.0	8.3–9.7	1,756	4.4%	23.3	22.2–24.4
Thyroid – anaplastic	22	0.0	0.1	0.1–0.2	10	0.0%	0.1	0.1–0.3	12	0.0%	0.1	0.1–0.2
Thyroid – follicular	83	0.1	0.6	0.4–0.7	24	0.1%	0.3	0.2–0.5	59	0.1%	0.8	0.6–1.0
Thyroid – medullary	25	0.0	0.2	0.1–0.2	16	0.0%	0.2	0.1–0.3	9	0.0%	0.1	0.1–0.2
Thyroid – papillary	2,200	2.8	14.9	14.3–15.6	574	1.5%	7.9	7.3–8.6	1,626	4.1%	21.7	20.7–22.8
Leukemia	2,336	3.0	14.3	13.7–14.9	1,411	3.6%	18.6	17.6–19.6	925	2.3%	10.8	10.1–11.5

Cancer type	Males and females combined – new cases	Males and females combined – % of cases	Males and females combined – ASIR	Males and females combined – 95% CI	Males – new cases	Males – % of cases	Males – ASIR	Males – 95% CI	Females – new cases	Females – % of cases	Females – ASIR	Females – 95% CI
Acute lymphocytic leukemia	232	0.3	1.6	1.4–1.8	113	0.3%	1.6	1.3–1.9	119	0.3%	1.7	1.4–2.0
Acute monocytic leukemia	19	0.0	0.1	0.1–0.2	10	0.0%	0.1	0.1–0.2	9	0.0%	0.1	0.0–0.2
Acute myeloid leukemia	760	1.0	4.6	4.3–5.0	431	1.1	5.6	5.1–6.2	329	0.8	3.8	3.4–4.2
Chronic lymphocytic leukemia	780	1.0	4.7	4.3–5.0	512	1.3	6.7	6.1–7.3	268	0.7	3.0	2.6–3.4
Chronic myeloid leukemia	340	0.4	2.1	1.9–2.3	218	0.6	2.9	2.5–3.3	122	0.3	1.4	1.1–1.7
Lymphoma	4,460	5.7	27.4	26.6–28.2	2,503	6.4	32.9	31.6–34.2	1,957	4.9	22.8	21.8–23.8
Hodgkin lymphoma	439	0.6	2.9	2.7–3.2	236	0.6	3.2	2.8–3.6	203	0.5	2.7	2.3–3.1
Non-Hodgkin lymphoma	4,021	5.1	24.5	23.7–25.3	2,267	5.8	29.7	28.5–31.0	1,754	4.4	20.1	19.1–21.1
Non-Hodgkin lymphoma – extranodal	2,070	2.6	12.6	12.0–13.1	1,183	3.0	15.6	14.7–16.5	887	2.2	10.1	9.4–10.8
Non-Hodgkin lymphoma – nodal	1,951	2.5	11.9	11.4–12.4	1,084	2.8	14.1	13.3–15.0	867	2.2	10.0	9.3–10.7
Myeloma	1,356	1.7	8.1	7.7–8.5	738	1.9	9.6	9.0–10.4	618	1.6	6.8	6.3–7.4
Melanoma of the skin	3,445	4.4	21.1	20.4–21.9	2,009	5.1	26.5	25.3–27.7	1,436	3.6	16.8	16.0–17.7
Melanoma (non-cutaneous)	184	0.2	1.2	1.0–1.3	90	0.2	1.2	1.0–1.5	94	0.2	1.1	0.9–1.4
Melanoma – mucosal	58	0.1	0.4	0.3–0.5	22	0.1	0.3	0.2–0.5	36	0.1	0.4	0.3–0.6
Melanoma – ocular	126	0.2	0.8	0.7–1.0	68	0.2	0.9	0.7–1.2	58	0.1	0.7	0.5–0.9
Lung	10,051	12.8	58.6	57.5–59.8	5,003	12.8	63.4	61.6–65.2	5,048	12.8	55.3	53.7–56.8
Lung – adenocarcinoma	3,584	4.5	21.1	20.4–21.8	1,683	4.3	21.3	20.3–22.3	1,901	4.8	21.2	20.2–22.2
Lung – large cell	123	0.2	0.7	0.6–0.9	61	0.2	0.7	0.6–1.0	62	0.2	0.7	0.5–0.9
Lung – small cell	915	1.2	5.3	5.0–5.7	463	1.2	5.8	5.3–6.3	452	1.1	5.0	4.6–5.5
Lung – squamous cell	1,605	2.0	9.2	8.8–9.7	992	2.5	12.3	11.6–13.1	613	1.6	6.6	6.1–7.1

Cancer type	Males and females combined – new cases	Males and females combined – % of cases	Males and females combined – ASIR	Males and females combined – 95% CI	Males – new cases	Males – % of cases	Males – ASIR	Males – 95% CI	Females – new cases	Females – % of cases	Females – ASIR	Females – 95% CI
Bladder	3,872	4.9	22.8	22.0–23.5	2,913	7.4	37.8	36.4–39.2	959	2.4	10.5	9.8–11.1
Kidney	2,387	3.0	14.9	14.3–15.5	1,617	4.1	21.3	20.3–22.4	770	1.9	9.1	8.5–9.8

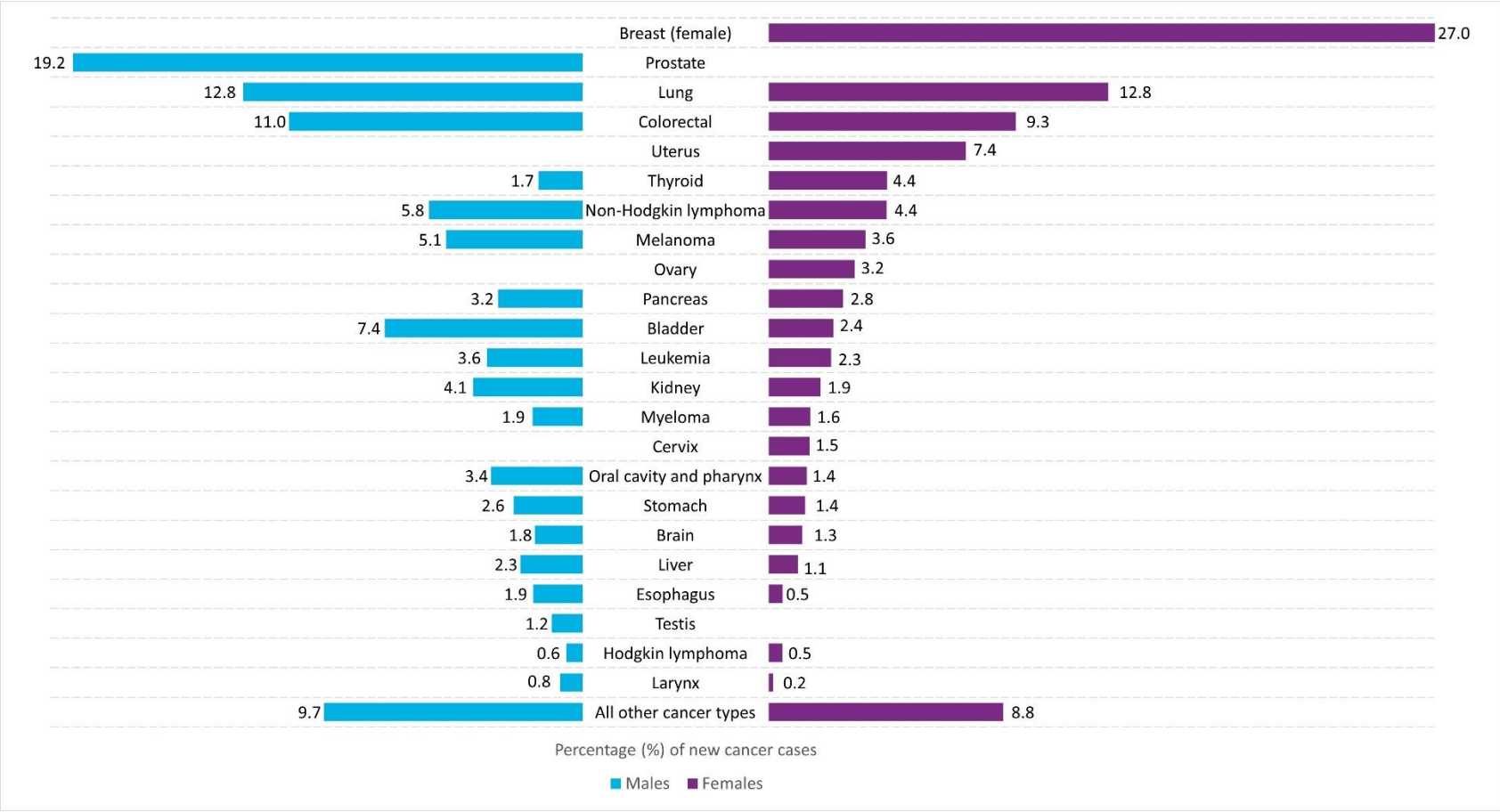
Abbreviations:
ASIR means age-standardized incidence rate
CI means confidence interval; n/a means not applicable

Notes:

- Rates are per 100,000 and standardized to the age distribution of the 2011 Canadian Standard population.
- Only selected anatomical subsites and histological subtypes of major cancers are shown. As a result, counts for the subsites and subtypes shown may not add up to the total for each cancer.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (December 2022), Ontario Health (Cancer Care Ontario)

Figure 2.4 Percentage of new cases by cancer type and binary sex, Ontario, 2020



Note:

- Incidence counts are based on International Agency for Research on Cancer/International Association of Cancer Registries multiple primary rules.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (December 2022), Ontario Health (Cancer Care Ontario)

Incidence by age and cancer type

From 2018 to 2020, the median age at cancer diagnosis was 69 for males and 67 for females (**Table 2.5**). The median age at diagnosis for most cancer types was above age 60, with a few exceptions. Of the 23 cancer types, cancers with the lowest median age (all under age 50) were testicular cancer, Hodgkin lymphoma and cervical cancer.

Among children, the cancer types with the lowest median age at diagnosis from 2018 to 2022 were retinoblastoma, hepatic tumours and neuroblastoma. In addition, during this time period, neuroblastoma, leukemias and central nervous system tumours were the most common types of cancer in children under one year of age.[3]

[3] Analysis by Health Analytics, Pediatric Oncology Group of Ontario. Data Source: POGONIS (May 11, 2023), Pediatric Oncology Group of Ontario

Table 2.5 Median age at diagnosis by cancer type and binary sex, Ontario, 2018 to 2020

Cancer type	Males and females combined – age (years)	Males – age (years)	Females – age (years)
All cancers	**68**	**69**	**67**
Bladder	73	73	73
Brain	62	61	63
Breast (female)	n/a	n/a	64
Cervix	n/a	n/a	48
Colorectal	70	69	72
Esophagus	69	68	73
Hodgkin lymphoma	38	40	35
Kidney	65	65	66
Larynx	68	68	66
Leukemia	68	68	69
Liver	70	69	72
Lung	72	72	71
Melanoma	68	69	66
Myeloma	72	72	73
Non-Hodgkin lymphoma	69	68	69
Oral cavity and pharynx	65	64	67
Ovary	64	n/a	64
Pancreas	72	71	73
Prostate	n/a	69	n/a
Stomach	71	71	71
Testis	n/a	34	n/a
Thyroid	52	55	51
Uterus	n/a	n/a	64

Abbreviation: n/a means not applicable

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (December 2022), Ontario Health (Cancer Care Ontario)

In 2020, more than half of all newly diagnosed cancer cases were in people ages 60 to 79 (**Table 2.6**). The distribution of cancer types by age group varied widely.

Ages zero to 39

Of all new cases, 5% occurred in people under age 40, with thyroid and female breast being the leading cancers.

The under-40 age group accounted for the majority of new cases of testicular cancer (68.8%), acute lymphocytic leukemia (65.1%) and Hodgkin lymphoma (50.8%).

From 2018 to 2022, about 0.4% of all new cancers occurred in children ages zero to 14 years (**Figure 2.2**, **Table 2.S1**). Childhood cancers are, in general, distinct from adult cancers, with differences in cancer types, biology, treatments and response to treatment. The most common types of childhood cancer are leukemias (32.4%), central nervous system tumours (24.4%) and lymphomas (12.5%) (see **Spotlight: Childhood Cancer Incidence, Table 2.S1**).

For more details on childhood cancer incidence, read the Pediatric Oncology Group of Ontario surveillance report.

Spotlight: Childhood Cancer Incidence

Table 2.S1 Childhood cancer incidence counts and rates, by cancer type, ages zero to 14 years, Ontario, 2018 to 2022

Cancer type	New cases	% of cases	Age-specific rate	ASIR	ASIR 95% CI
All cancers	**1,928**	**100.0**	**169.4**	**172.0**	**161.5–183.2**
Leukemias, myeloproliferative diseases, and myelodysplastic diseases	625	32.4	54.9	56.2	50.4–62.8
Lymphomas and reticuloendothelial neoplasms	241	12.5	21.2	21.1	17.7–25.3
CNS and miscellaneous intracranial and intraspinal neoplasms	470	24.4	41.3	41.5	36.5–47.1
Neuroblastoma and other peripheral nervous system tumours	118	6.1	10.4	10.9	8.5–14.0
Retinoblastoma	40	2.1	3.5	3.7	2.4–5.7
Renal tumours	88	4.6	7.7	8.0	6.0–10.7
Hepatic tumours	46	2.4	4.0	4.2	2.8–6.3
Malignant bone tumours	70	3.6	6.2	6.1	4.3–8.5
Soft tissue and other extraosseous sarcomas	104	5.4	9.1	9.2	7.0–12.1
Germ cell tumours, trophoblastic tumours, and neoplasms of gonads	68	3.5	6.0	6.0	4.3–8.4
Other and unspecified malignant neoplasms	58	3.0	5.1	5.0	3.5–7.3

Abbreviations:
ASIR means age-standardized incidence rate
CI means confidence interval
CNS means central nervous system

Notes:

- Rates are per 1,000,000.
- The Pediatric Oncology Group of Ontario Networked Information System (POGONIS) classifies childhood cancer according to the International Classification of Childhood Cancer, third edition, which has 12 main diagnostic groups.
- Childhood cancer incidence is reported over a five-year period due to variations in annual incidence and potential for small cell disclosure.

Analysis by: Health Analytics, Pediatric Oncology Group of Ontario
Data source: POGONIS (May 11, 2023), Pediatric Oncology Group of Ontario

Ages 40 to 59

Of all new cancer cases, 21.8% occurred in people ages 40 to 59, with colorectal and female breast being the leading cancers.

Nearly half of all new cases of cervical cancer occurred in people ages 40 to 59 and 43.2% of new thyroid cancer cases occurred in females in this age group.

Ages 60 to 79

Of all new cancer cases, 53.9% occurred in people ages 60 to 79.

This age group was more likely than other age groups to be diagnosed with the most common cancers:

- 47.2% of new cases of female breast cancer
- 50.2% of new cases of colorectal cancer
- 66.4% of new cases of lung cancer
- 70.1% of new cases of prostate cancer

Age 80 and older

Of all new cancer cases, 19.3% occurred in people age 80 or older, with lung and colorectal being the leading cancers.

Incidence of all cancers combined increased with age, to a rate of 2,305.60 per 100,000 in people diagnosed at age 80 or older from 53.7 per 100,000 in people diagnosed at age 39 or younger. Rates varied by cancer type. Incidence rates for the following cancer types increased significantly with age:

- malignant and non-malignant cancers of the brain and other nervous system
- colorectal, and its subsite of colon cancer, especially right-sided colon
- leukemia, and its subtypes of acute and chronic myeloid leukemias
- lymphoma, and its subtypes of extranodal non-Hodgkin lymphoma

Testicular cancer and acute lymphocytic leukemia showed non-significant decreases with age, while all other cancer types increased non-significantly, remained stable with age, or peaked in the 40-59 age group (e.g., thyroid cancer).

Table 2.6 Incidence counts and rates by cancer type and age group, Ontario, 2020

Cancer type	Ages 0 to 39 – new cases	Ages 0 to 39 – age-specific rate	Ages 0 to 39 – 95% CI	Ages 40 to 59 – new cases	Ages 40 to 59 – age-specific rate	Ages 40 to 59 – 95% CI	Ages 60 to 79 – new cases	Ages 60 to 79 – age-specific rate	Ages 60 to 79 – 95% CI	Age 80 and older – new cases	Age 80 and older – age-specific rate	Age 80 and older – 95% CI
All cancers	**3,905**	**53.7**	**52–55.4**	**17,205**	**441.8**	**435.2–448.4**	**42,438**	**1,462.4**	**1,448.5–1,476.4**	**15,224**	**2,305.6**	**2,269.1–2,342.5**
Brain and other nervous system – malignant*	219	3.0	2.6–3.4	288	7.4	6.6–8.3	534	18.4	16.9–20.0	160	24.2	20.6–28.3
Glioblastoma	36	0.5	0.3–0.7	173	4.4	3.8–5.2	384	13.2	11.9–14.6	67	10.1	7.9–12.9
All other gliomas	123	1.7	1.4–2.0	71	1.8	1.4–2.3	69	2.4	1.9–3.0	9	1.4	0.6–2.6
Brain and other nervous system – non-malignant*	302	4.2	3.7–4.7	602	15.5	14.2–16.7	862	29.7	27.8–31.8	357	54.1	48.6–60
Meningiomas	35	0.5	0.3–0.7	200	5.1	4.4–5.9	279	9.6	8.5–10.8	59	8.9	6.8–11.5
Pituitary, pineal and craniopharyngeal duct	104	1.4	1.2–1.7	166	4.3	3.6–5.0	167	5.8	4.9–6.7	49	7.4	5.5–9.8
Breast (female)	509	14.3	13.1–15.6	3,692	186.3	180.3–192.4	5,048	332.4	323.3–341.7	1,439	364.9	346.3–384.3
Cervix	158	4.4	3.8–5.2	272	13.7	12.1–15.5	147	9.7	8.2–11.4	27	6.8	4.5–10.0
Ovary	102	2.9	2.3–3.5	410	20.7	18.7–22.8	582	38.3	35.3–41.6	182	46.2	39.7–53.4
Prostate	**	**	**	1,075†	56.2	52.9–59.7	5,268	380.8	370.6–391.2	1,171	440.3	415.4 - 466.2
Testis	308	8.3	7.4–9.3	120	6.3	5.2–7.5	20†	1.4	0.9–2.2	**	**	** - **
Uterus	77	2.2	1.7–2.7	925	46.7	43.7–49.8	1,684	110.9	105.7–116.3	243	61.6	54.1–69.9
Uterus – endometrial	55	1.5	1.2–2.0	826	41.7	38.9–44.6	1,545	101.7	96.7–106.9	208	52.7	45.8–60.4
Uterus – uterine sarcoma	12	0.3	0.2–0.6	39	2.0	1.4–2.7	30†	2	1.3–2.8	**	**	**

Cancer type	Ages 0 to 39 – new cases	Ages 0 to 39 – age-specific rate	Ages 0 to 39 – 95% CI	Ages 40 to 59 – new cases	Ages 40 to 59 – age-specific rate	Ages 40 to 59 – 95% CI	Ages 60 to 79 – new cases	Ages 60 to 79 – age-specific rate	Ages 60 to 79 – 95% CI	Age 80 and older – new cases	Age 80 and older – age-specific rate	Age 80 and older – 95% CI
Colorectal*	198	2.7	2.4–3.1	1,666	42.8	40.7–44.9	4,015	138.4	134.1–142.7	2,125	321.8	308.3–335.8
Colon excluding rectum*	106	1.5	1.2–1.8	953	24.5	22.9–26.1	2,707	93.3	89.8–96.9	1,598	242.0	230.3–254.2
Colon – left sided	57	0.8	0.6–1.0	487	12.5	11.4–13.7	993	34.2	32.1–36.4	422	63.9	58.0–70.3
Colon – right sided*	44	0.6	0.4–0.8	421	10.8	9.8–11.9	1,603	55.2	52.6–58	1,010	153.0	143.7–162.7
Rectum and rectosigmoid junction	92	1.3	1.0–1.6	712	18.3	17.0–19.7	1,303	44.9	42.5–47.4	517	78.3	71.7–85.3
Rectosigmoid junction	18	0.2	0.1–0.4	170	4.4	3.7–5.1	352	12.1	10.9–13.5	150	22.7	19.2–26.7
Rectum	74	1.0	0.8–1.3	542	13.9	12.8–15.1	951	32.8	30.7–34.9	367	55.6	50.0–61.6
Esophagus	9	0.1	0.1–0.2	156	4.0	3.4–4.7	576	19.8	18.3–21.5	192	29.1	25.1–33.5
Esophagus – adenocarcinoma	**	**	**	95†	2.4	2.0–3.0	327	11.3	10.1–12.6	101	15.3	12.5–18.6
Esophagus – squamous cell carcinoma	**	**	**	45†	1.2	0.8–1.5	179	6.2	5.3–7.1	57	8.6	6.5–11.2
Liver	22	0.3	0.2–0.5	211	5.4	4.7–6.2	816	28.1	26.2–30.1	297	45.0	40.5–50.4
Pancreas	24	0.3	0.2–0.5	413	10.6	9.6–11.7	1,331	45.9	43.4–48.4	579	87.7	80.7–95.1
Stomach	28	0.4	0.3–0.6	313	8.0	7.2–9.0	810	27.9	26–29.9	405	61.3	55.5–67.6
Larynx	**	**	**	80†	2.1	1.6–2.6	249	8.6	7.5–9.7	61	9.2	7.1–11.9
Oral cavity and pharynx	55	0.8	0.6–1.0	541	13.9	12.7–15.1	1,073	37	34.8–39.3	245	37.1	32.6–42.1
Hypopharynx	**	**	**	20†	0.5	0.3–0.8	72	2.5	1.9–3.1	11	1.7	0.8–3.0
Lip and oral cavity	31	0.4	0.3–0.6	202	5.2	4.5–6	481	16.6	15.1–18.1	162	24.5	20.9–28.6
Nasopharynx	16	0.2	0.1–0.4	51	1.3	1–1.7	42	1.4	1.0–2.0	7	1.1	0.4–2.2
Oropharynx	**	**	**	250†	6.4	5.6–7.3	439	15.1	13.7–16.6	54	8.2	6.1–10.7
Thyroid	571	7.9	7.2–8.5	1,040	26.7	25.1–28.4	707	24.4	22.6–26.2	88	13.3	10.7–16.4

Cancer type	Ages 0 to 39 – new cases	Ages 0 to 39 – age-specific rate	Ages 0 to 39 – 95% CI	Ages 40 to 59 – new cases	Ages 40 to 59 – age-specific rate	Ages 40 to 59 – 95% CI	Ages 60 to 79 – new cases	Ages 60 to 79 – age-specific rate	Ages 60 to 79 – 95% CI	Age 80 and older – new cases	Age 80 and older – age-specific rate	Age 80 and older – 95% CI
Thyroid – anaplastic	**	**	**	10	0.3	0.1–0.5	**	**	**	7	1.1	0.4–2.2
Thyroid – follicular	11	0.2	0.1–0.3	37	1.0	0.7–1.3	27	0.9	0.6–1.4	8	1.2	0.5–2.4
Thyroid – medullary	**	**	**	11	0.3	0.1–0.5	11	0.4	0.2–0.7	**	**	**
Thyroid – papillary	542	7.5	6.8–8.1	965	24.8	23.2–26.4	638	22	20.3–23.8	55	8.3	6.3–10.8
Leukemia*	272	3.7	3.3–4.2	406	10.4	9.4–11.5	1,106	38.1	35.9–40.4	552	83.6	76.8–90.9
Acute lymphocytic leukemia	151	2.1	1.8–2.4	31	0.8	0.5–1.1	42	1.4	1.0–2.0	8	1.2	0.5–2.4
Acute monocytic leukemia	**	**	**	**	**	**	8	0.3	0.1–0.5	9	1.4	0.6–2.6
Acute myeloid leukemia*	59	0.8	0.6–1.0	132	3.4	2.8–4	381	13.1	11.8–14.5	188	28.5	24.5–32.8
Chronic lymphocytic leukemia	8	0.1	0.0–0.2	128	3.3	2.7–3.9	447	15.4	14.0–16.9	197	29.8	25.8–34.3
Chronic myeloid leukemia*	34	0.5	0.3–0.7	66	1.7	1.3–2.2	159	5.5	4.7–6.4	81	12.3	9.7–15.2
Lymphoma*	459	6.3	5.7–6.9	923	23.7	22.2–25.3	2,196	75.7	72.5–78.9	882	133.6	124.9–142.7
Hodgkin lymphoma	223	3.1	2.7–3.5	99	2.5	2.1–3.1	96	3.3	2.7–4.0	21	3.2	2–4.9
Non-Hodgkin lymphoma*	236	3.2	2.8–3.7	824	21.2	19.7–22.7	2,100	72.4	69.3–75.5	861	130.4	121.8–139.4
Non-Hodgkin lymphoma – extranodal*	144	2.0	1.7–2.3	397	10.2	9.2–11.2	1,024	35.3	33.2–37.5	505	76.5	70–83.5
Non-Hodgkin lymphoma – nodal	92	1.3	1.0–1.6	427	11.0	9.9–12.1	1,076	37.1	34.9–39.4	356	53.9	48.5–59.8
Myeloma	14	0.2	0.1–0.3	199	5.1	4.4–5.9	782	26.9	25.1–28.9	361	54.7	49.2–60.6
Melanoma of the skin*	186	2.6	2.2–3	774	19.9	18.5–21.3	1,734	59.8	57.0–62.6	751	113.7	105.7–122.2
Melanoma (non-cutaneous)	10	0.1	0.1–0.3	62	1.6	1.2–2	79	2.7	2.2–3.4	33	5.0	3.4–7
Melanoma – mucosal	**	**	**	15†	0.4	0.2–0.6	26	0.9	0.6–1.3	12	1.8	0.9–3.2

Cancer type	Ages 0 to 39 – new cases	Ages 0 to 39 – age-specific rate	Ages 0 to 39 – 95% CI	Ages 40 to 59 – new cases	Ages 40 to 59 – age-specific rate	Ages 40 to 59 – 95% CI	Ages 60 to 79 – new cases	Ages 60 to 79 – age-specific rate	Ages 60 to 79 – 95% CI	Age 80 and older – new cases	Age 80 and older – age-specific rate	Age 80 and older – 95% CI
Melanoma – ocular	6	0.1	0–0.2	46	1.2	0.9–1.6	53	1.8	1.4–2.4	21	3.2	2–4.9
Lung	43	0.6	0.4–0.8	1,126	28.9	27.2–30.7	6,675	230	224.5–235.6	2,207	334.2	320.4–348.5
Lung – adenocarcinoma	18	0.2	0.1–0.4	499	12.8	11.7–14	2,415	83.2	79.9–86.6	652	98.7	91.3–106.6
Lung – large cell	**	**	**	10†	0.3	0.1–0.5	96	3.3	2.7–4.0	14	2.1	1.2–3.6
Lung – small cell	**	**	**	115†	3.0	2.4–3.5	677	23.3	21.6–25.2	120	18.2	15.1–21.7
Lung – squamous cell	**	**	**	115†	3.0	2.4–3.5	1,195	41.2	38.9–43.6	291	44.1	39.2–49.4
Bladder	33	0.5	0.3–0.6	480	12.3	11.2–13.5	2,189	75.4	72.3–78.7	1,170	177.2	167.2–187.6
Kidney	97	1.3	1.1–1.6	679	17.4	16.1–18.8	1,317	45.4	43.0–47.9	294	44.5	39.6–49.9

Abbreviation: CI means confidence interval

Symbols:
*Statistically significant trend. Significant increasing trend in age-specific rate with increasing age was determined using annual per cent change (see Appendix 2: Analysis)
**Suppressed due to small case count of less than six
†Count has been rounded to ensure confidentiality, and associated rate and confidence interval have been adjusted to reflect rounded count

Notes:

- Rates are per 100,000.
- Excludes cases with no age information.
- Only selected subsites and histological subtypes of major cancers are shown. As a result, counts for the subsites and subtypes may not add up to the total for each major cancer type.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (December 2022), Ontario Health (Cancer Care Ontario)

Incidence trends by sex and cancer type

This section describes the age-standardized incidence rates over time for select cancers (**Figure 2.5**), annual per cent changes and average annual per cent changes in the age-standardized incidence rates (**Table 2.7, Figure 2.6**). An annual per cent change is a measure that characterizes the change over time of a rate. It represents the percentage increase or decrease per year in blocks of time over a specified time period. This measure is used to examine short-term changes in the trend in rates. An average annual per cent change is a summary measure that allows the use of a single number to describe the *average* of the annual per cent changes over a specified time period.

Because 2020 was an anomalous year that can bias the estimates, incidence data for 2020 were excluded from the incidence trends analysis in this chapter. However, age-standardized incidence rates for 2020 are still provided in **Figure 2.5**.

Short-term changes in incidence trends by cancer type

Following a long period (1986 to 2006) of steadily increasing rates, the age-standardized incidence rate for all cancers combined decreased by 0.8% per year from 2006 to 2019 (**Table 2.7**).

Among males, the incidence rate remained stable from 1986 to 2007, decreased by 3.1% per year until 2013 and was stable from 2013 to 2019. Although the cancer incidence rate among females did not see a similar decrease, it stabilized from 2013 to 2019 following a steady increase of 0.4% per year from 1986 to 2013. A notable exception is uterine cancer incidence, which has increased since 1995: the incidence rate increased at 1.1% per year from 1995 to 2007, 4.8% per year from 2007 to 2011 1.1% per year from 2011 to 2019.

Recent incidence trends for the four most commonly diagnosed cancers

BREAST CANCER

The age-standardized incidence rate for female breast cancer in Ontario increased by 2.4% per year until 1991 (not statistically significant) (**Table 2.7, Figure 2.5A**). It then stabilized from 1991 to 1999 before steadily decreasing at 0.8% per year until 2008 (not statistically significant). The rate remained stable in recent years. This stabilization of rates in recent years is likely due to the decreasing number of females with undetected cancer. This kind of rise and fall in incidence rate since the 1990s is typical when an organized screening program, such as the Ontario Breast Cancer Screening program, is launched (1990).(101)

The decrease in breast cancer incidence rate may also have been due to the reduced use of hormone replacement therapy starting in the early 2000s. Hormone replacement therapy is associated with an increased risk of breast cancer among post-menopausal women.(102,103)

COLORECTAL CANCER

Among males and females combined, the age-standardized incidence rate for colorectal cancer in Ontario decreased since 1986, with more rapid decreases at 2.5% per year occurring from 2009 to 2019 (**Table 2.7, Figure 2.5A**). The age-standardized incidence rate for colorectal cancer among males decreased by 2.7% per year from 2008 to 2019 (**Table 2.7**). Incidence rates for colon and rectal subsite cancers dropped in males during this period.

Among females, the colorectal cancer incidence rate was stable from 1996 to 2000. After 2000 it decreased, first at a rate of 1.3% per year until 2010 and then more rapidly by 2.4% per year until 2019. These patterns may reflect the following opposing trends for colorectal cancer subsites in females:

- an increase in cancer of the rectosigmoid junction from 1996 to 2000 (not statistically significant)
- an overall decrease in colon cancer from 1986 to 2019

LUNG CANCER

The overall age-standardized incidence rates for lung cancer in males and females combined had two periods of significant decrease in Ontario (at 0.9% per year from 1991 to 2008 and at 2.0% per year from 2012 to 2019) interspersed with two periods of stable rates (1986 to 1991 and 2008 to 2012) (**Table 2.7, Figure 2.5A**). However, the trends over time differed between males and females. In males, the age-standardized incidence rate for lung cancer experienced two periods of significant decrease – the first from 1986 to 2008 at a rate of 2.0% per year and then again more recently from 2012 to 2019 at a rate of 3.0% per year (**Table 2.7**). Among females, the incidence rate increased significantly from 1986 to 1998 at 2.0% per year, remained stable until 2012 and began to decrease by 1.2% per year from 2012 to 2019.

The differences in timing for these decreases in lung cancer incidence rates in males and females over the last two decades reflect historical differences in male and female smoking rates.(104,105) While tobacco use is the primary cause of lung cancer, other causes include exposure to radon, asbestos, second-hand smoke and air pollution.(106,107)

PROSTATE CANCER

The age-standardized incidence rate for prostate cancer increased steeply by 7.3% per year from 1986 to 1994 and then by 1.2% per year from 1992 to 2007. The rate fell by 6.3% per year from 2007 to 2014 and eventually stabilized in recent years (**Table 2.7, Figure 2.5A**). An abrupt rise and fall in incidence rate is common when a new method of early diagnosis is introduced or its frequency of use is influenced by clinical guidance. For example, the widespread use of the prostate-specific antigen test led to the early detection of prostate cancer. However, a decrease in the use of the test coincided with recommendations from the U.S. Preventive Services Task Force (in 2012) and the Canadian Task Force on Preventive Health Care (in 2014) against screening for prostate cancer with the prostate-specific antigen test.(58)

Notable changes in trends for other cancers

Cancers highlighted in this section had the largest, significant annual per cent changes (increasing or decreasing) in the most recent time period (see Appendix 2: Analysis for more details; **Table 2.7**, **Figure 2.5B**) or noteworthy trends in annual per cent changes in the most recent time period**.**

CERVICAL CANCER (Increasing trend)

After nearly three decades of decreasing or stable rates, the cervical cancer age-standardized incidence rate increased by 3.2% per year from 2014 to 2019 (**Table 2.7, Figure 2.5B**). Although the reason for this upward trend in Ontario is not clear, other jurisdictions have noted recent increases in the incidence of stage 4 cervical cancer and in cervical adenocarcinomas, cancers that are not typically detected by screening.(108)

KIDNEY CANCER (Increasing trend)

The age-standardized incidence rate for kidney cancer increased at 1.6% per year among males and females combined from 1995 to 2019 (**Table 2.7, Figure 2.5B**). In males, an initial period of significant increase (5.0% per year from 1986 to 1990) was punctuated by a short period of stable rates from 1990 to 1999, following which the upward trend continued at 2.0% per year from 1999 to 2019. In females, the age-standardized incidence rate for kidney cancer increased steadily by 1.0% per year from 1986 to 2019.

Rising incidence in kidney cancer is likely tied to better diagnostics as well as the increasing prevalence of excess body weight in the Ontarian population.(109) Despite the rise in incidence, mortality from kidney cancer continued to decrease over the same time period (see Chapter 3: Cancer Mortality).

LARYNGEAL CANCER (Decreasing trend)

The age-standardized incidence rates of laryngeal cancer decreased from 1986 to 2019 by 2.4% per year among males and females combined **(Table 2.7, Figure 2.5B**) as well as among males, and by 2.8% per year among females. Incidence rates of laryngeal cancer showed similar decreases in other jurisdictions, a phenomenon at least partially attributable to decreasing rates of smoking in the population.(110,111)

LEUKEMIA (Decreasing trend)

Following an increasing incidence trend that began in the late 1990s, age-standardized incidence rates for leukemia among males and females combined began decreasing in 2010 by 2.0% per year (**Table 2.7, Figure 2.5B**). In particular, the incidence rate for chronic lymphocytic leukemia decreased, while the rates for other leukemia types increased. The decreasing trend in chronic lymphocytic leukemia mirrors recent observations in other countries (112) and likely reflects the more restricted diagnostic criteria for chronic lymphocytic leukemia that were introduced in 2008.(113)

LIVER CANCER (Noteworthy trend)

The age-standardized incidence rate for liver cancer increased steeply (4.0% per year or higher) from 1986 to 2012, although the rates decreased at 1.3% per year in recent years (**Table 2.7, Figure 2.5B**). Among males, the age-standardized incidence rate increased at a rate of 4.6% per year from 1986 to 2013 and was stable from 2013 to 2019. The trend was more pronounced among females, with the age-standardized incidence rate increasing by 3.3% per year from 1986 to 2008, increasing by 14.1% per year from 2008 to 2012, and finally stabilizing from 2012 to 2019.

The abrupt stabilization of the upward incidence trend in liver cancer could be due to the recent introduction of direct-acting antiviral treatment for viral hepatitis C and suggests that the risk of liver cancer among people treated for hepatitis may be lower in the medium to long term.(114)

ORAL CAVITY AND PHARYNX CANCER (Increasing trend)

The age-standardized incidence rate for oral cavity and pharynx cancer among males and females combined decreased at 1.9% per year from 1986 to 2003 and then increased at 1.3% per year since (**Table 2.7, Figure 2.5B**). For males, the rates increased by 1.4% per year from 2003 to 2019 while a smaller yet significant increase of 0.8% per year occurred among females for the same time period (**Table 2.7**). A similar global trend in oral cavity and pharynx cancer incidence has been observed, predominantly in developed countries, and human papillomavirus (HPV) infections have been linked to the incidence of cancers in the pharynx.(115)

TESTICULAR CANCER (Increasing trend)

Testicular cancer incidence rate increased steadily from 1986 to 2019 at 1.3% per year (**Table 2.7, Figure 2.5B**). Many other jurisdictions have experienced a similar increase in testicular cancer incidence, at least since the mid-20th century.(116) While reasons behind this continued upward trend remain unclear, testicular cancer has a favorable prognosis with high survival and low mortality rates.

THYROID CANCER (Noteworthy trend)

The age-standardized incidence rate for thyroid cancer among males and females combined decreased significantly from 2013 to 2019, following nearly three decades of increasing rates (**Table 2.7, Figure 2.5B**). The incidence rate decreased by 3.5% per year from 2013 to 2019, largely due to the decreasing trend in papillary thyroid cancer. This trend was most prominent in females, who experienced a decrease at 4.3% per year over the same period. This pattern in trends is consistent with thyroid cancer incidence trends in the US and likely reflect refinements applied to the diagnostic work up of thyroid nodules with criteria based on nodule size (greater than 1 cm) and sonographic characteristics to reduce overdiagnosis in the US and Ontario.(117–119)

UTERINE CANCER (Noteworthy trend)

The age-standardized incidence rate for uterine cancer increased by 4.8% per year from 2007 to 2011 and continued to increase at a slower rate of 1.1% per year from 2011 to 2019 (**Table 2.7, Figure 2.5B**). These increases were mainly due to rising incidence rates for the endometrial subsite (5.8% per year from 2007 to 2011).

Increasing incidence of endometrial cancer in other jurisdictions suggests a link to rising rates of overweight and obesity and decreasing rates of pregnancy, both of which increase exposure to estrogen, a key risk factor for endometrial cancer.(120) One estimate has projected the incidence of uterine cancer to surpass that of colorectal cancer by 2030 in the United States.(121)

Figure 2.5A Age-standardized incidence rates by cancer type for the four most common cancers, Ontario, 1986 to 2020

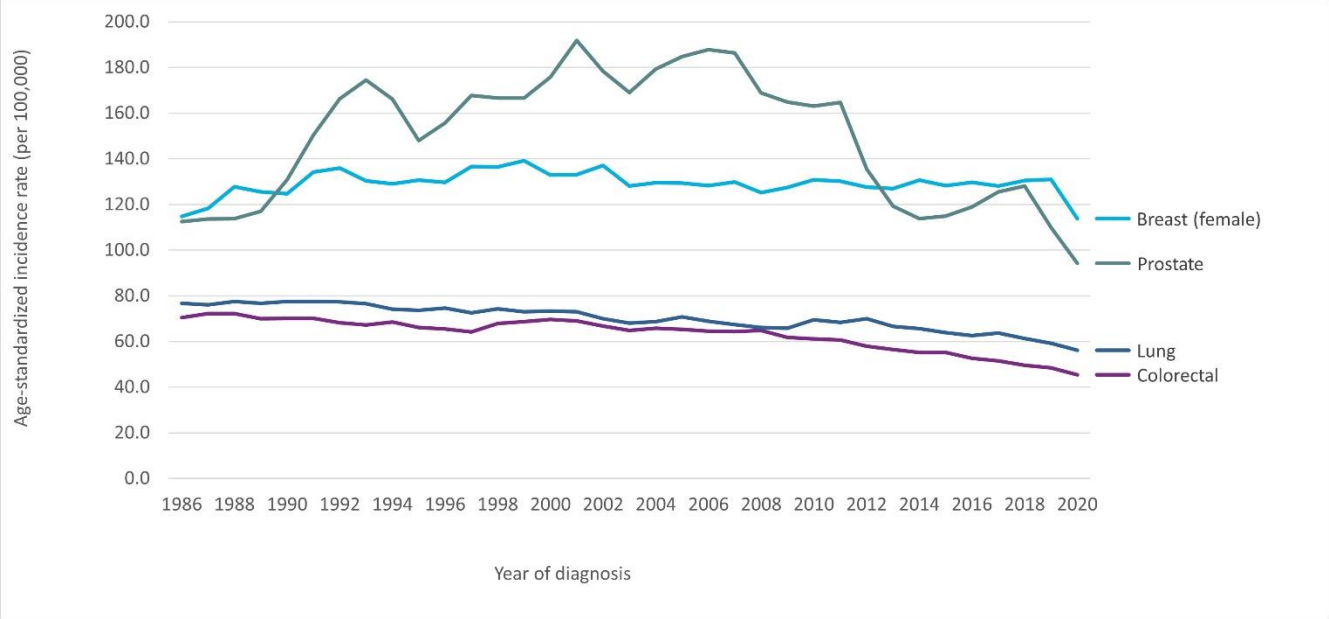
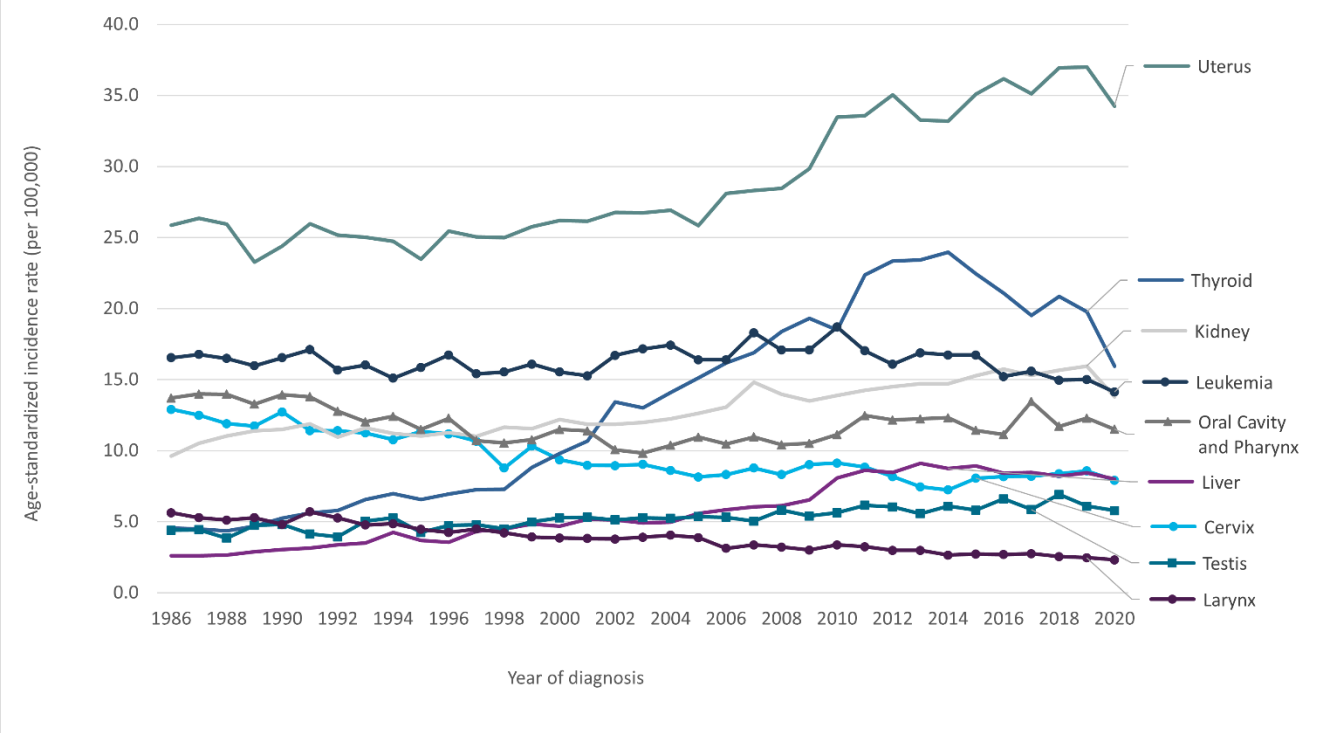


Figure 2.5B Age-standardized incidence rates by cancer type for cancers with notably increasing or decreasing recent trends, Ontario, 1986 to 2020



Notes:

- Rates are per 100,000 and standardized to the age distribution of the 2011 Canadian Standard population.
- International Agency for Research on Cancer/International Association of Cancer Registries multiple primary rules were used when presenting trends over time.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (December 2022), Ontario Health (Cancer Care Ontario)

Table 2.7 Annual per cent change in age-standardized incidence rates by cancer type and binary sex, Ontario, 1986 to 2019

Cancer type	Males and females combined – period	Males and females combined – APC	Males – period	Males – APC	Females – period	Females – APC
All cancers	**1986–2006**	**0.3***	**1986–2007**	**0.1**	**1986–2013**	**0.4***
	2006–2019	**-0.8***	**2007–2013**	**-3.1***	**2013–2019**	**-0.4**
	n/a	**n/a**	**2013–2019**	**-0.9**	**n/a**	**n/a**
Brain and other nervous system – malignant	1986–2008	-0.3*	1986–2019	-0.6*	1986–2000	0.0
	2008–2019	-1.5*	n/a	n/a	2000–2019	-1.2*
Glioblastoma	1986–2001	1.6*	1986–2019	0.6*	1986–2001	1.8*
	2001–2005	-6.1	n/a	n/a	2001–2005	-7.8
	2005–2009	6.6	n/a	n/a	2005–2012	5.5*
	2009–2019	0.1	n/a	n/a	2012–2019	-0.7
All other gliomas	1986–2004	-1.5*	1986–2004	-1.6*	1986–2019	-0.9*
	2004–2008	4.2	2004–2008	4.1	n/a	n/a
	2008–2019	-3.1*	2008–2019	-3.1*	n/a	n/a
Brain and other nervous system – non-malignant	n/a	**	n/a	**	n/a	**
Meningiomas	n/a	**	n/a	**	n/a	**
Pituitary, pineal and craniopharyngeal duct	n/a	**	n/a	**	n/a	**
Breast (female)	n/a	n/a	n/a	n/a	1986–1991	2.4
	n/a	n/a	n/a	n/a	1991–1999	0.4
	n/a	n/a	n/a	n/a	1999–2008	-0.8
	n/a	n/a	n/a	n/a	2008–2019	0.2
Cervix	n/a	n/a	n/a	n/a	1986–2006	-2.2*
	n/a	n/a	n/a	n/a	2006–2010	2.4
	n/a	n/a	n/a	n/a	2010–2014	-4.9
	n/a	n/a	n/a	n/a	2014–2019	3.2*
Ovary	n/a	n/a	n/a	n/a	1986–2001	0.5*
	n/a	n/a	n/a	n/a	2001–2019	-1.1*
Prostate	n/a	n/a	1986–1992	7.3*	n/a	n/a
	n/a	n/a	1992–2007	1.2*	n/a	n/a
	n/a	n/a	2007–2014	-6.3*	n/a	n/a
	n/a	n/a	2014–2019	0.0	n/a	n/a

Cancer type	Males and females combined – period	Males and females combined – APC	Males – period	Males – APC	Females – period	Females – APC
Testis	n/a	n/a	1986–2019	1.3*	n/a	n/a
Uterus	n/a	n/a	n/a	n/a	1986–1995	-0.5
	n/a	n/a	n/a	n/a	1995–2007	1.1*
	n/a	n/a	n/a	n/a	2007–2011	4.8*
	n/a	n/a	n/a	n/a	2011–2019	1.1*
Uterus – endometrial	n/a	n/a	n/a	n/a	1986–1995	-0.9
	n/a	n/a	n/a	n/a	1995–2007	1.3*
	n/a	n/a	n/a	n/a	2007–2011	5.8*
	n/a	n/a	n/a	n/a	2011–2019	1.1*
Uterus – uterine sarcoma	n/a	n/a	n/a	n/a	1986–2019	1.2*
Colorectal	1986–1996	-1.0*	1986–2008	-0.3*	1986–1996	-1.4*
	1996–2000	1.2	2008–2019	-2.7*	1996–2000	1.3
	2000–2009	-1.0*	n/a	n/a	2000–2010	-1.3*
	2009–2019	-2.5*	n/a	n/a	2010–2019	-2.4*
Colon excluding rectum	1986–2009	-0.6*	1986–2009	-0.5*	1986–2009	-0.8*
	2009–2019	-2.7*	2009–2019	-2.8*	2009–2019	-2.5*
Colon – left sided	1986–2004	-1.1*	1986–2004	-0.9*	1986–2009	-1.2*
	2004–2008	1.4	2004–2008	2.0	2009–2019	-3.2*
	2008–2019	-3.8*	2008–2019	-4.1*	n/a	n/a
Colon – right sided	1986–2010	0.1	1986–2011	0.1	1986–2010	0.0
	2010–2019	-2.2*	2011–2019	-2.5*	2010–2019	-2.3*
Rectum and rectosigmoid junction	1986–1997	-0.6*	1986–1997	-0.4	1986–1996	-1.5*
	1997–2001	3.7*	1997–2001	3.6	1996–2000	4.1
	2001–2019	-1.9*	2001–2019	-2.1*	2000–2019	-1.6*
Rectosigmoid junction	1986–2001	2.4*	1986–2001	2.4*	1986–1991	4.3
	2001–2019	-3.9*	2001–2019	-3.9*	1991–1996	-5.2
	n/a	n/a	n/a	n/a	1996–2000	11.8
	n/a	n/a	n/a	n/a	2000–2019	-4.2*
Rectum	1986–1992	-2.3*	1986–1995	-1.3*	1986–1991	-3.1
	1992–2008	0.4*	1995–2006	0.8*	1991–2019	-0.2
	2008–2015	-1.9*	2006–2019	-1.7*	n/a	n/a

Cancer type	Males and females combined – period	Males and females combined – APC	Males – period	Males – APC	Females – period	Females – APC
	2015–2019	-0.1	n/a	n/a	n/a	n/a
Esophagus	1986–2007	-0.1	1986–2006	0.1	1986–2019	-0.7*
	2007–2011	3.4	2006–2011	3.3	n/a	n/a
	2011–2015	-5.1	2011–2015	-5.6*	n/a	n/a
	2015–2019	2.4	2015–2019	2.5	n/a	n/a
Esophagus – adenocarcinoma	1986–2010	3.3*	1986–2010	3.2*	1986–2019	2.4*
	2010–2019	-0.7	2010–2019	-0.9	n/a	n/a
Esophagus – squamous cell carcinoma	1986–2019	-2.1*	1986–2019	-2.3*	1986–2015	-2.3*
	n/a	n/a	n/a	n/a	2015–2019	4.9
Liver	1986–2008	4.0*	1986–2013	4.6*	1986–2008	3.3*
	2008–2012	9.4*	2013–2019	-1.3	2008–2012	14.1*
	2012–2019	-1.3*	n/a	n/a	2012–2019	-1.2
Pancreas	1986–2006	-0.7*	1986–2003	-1.1*	1986–2006	-0.4*
	2006–2012	3.2*	2003–2019	1.6*	2006–2012	2.8*
	2012–2019	-0.4	n/a	n/a	2012–2019	-1.0
Stomach	1986–1993	-3.0*	1986–2007	-2.0*	1986–1998	-2.7*
	1993–2009	-1.4*	2007–2019	0.0	1998–2019	-0.3
	2009–2013	1.9	n/a	n/a	n/a	n/a
	2013–2019	-1.3	n/a	n/a	n/a	n/a
Larynx	1986–2019	-2.4*	1986–2019	-2.4*	1986–2019	-2.8*
Oral cavity and pharynx	1986–2003	-1.9*	1986–2003	-2.4*	1986–2003	-1.2*
	2003–2019	1.3*	2003–2019	1.4*	2003–2019	0.8*
Hypopharynx	1986–2019	-2.5*	1986–2019	-2.2*	1986–2019	-3.6*
Lip and oral cavity	1986–2002	-3.2*	1986–2002	-4.2*	1986–2003	-1.3*
	2002–2019	1.0*	2002–2019	0.7	2003–2019	1.5*
Nasopharynx	1986–2019	-0.2	1986–2019	-0.1	1986–2019	-0.3
Oropharynx	1986–1998	-1.0	1986–1997	-1.6	1986–2019	0.3
	1998–2019	2.5*	1997–2019	3.0*	n/a	n/a
Thyroid	1986–1998	4.8*	1986–2014	6.5*	1986–1998	5.0*
	1998–2002	13.4*	2014–2019	-2.1	1998–2002	15.2*
	2002–2013	6.0*	n/a	n/a	2002–2013	5.6*
	2013–2019	-3.5*	n/a	n/a	2013–2019	-4.3*
Thyroid – anaplastic	1986–2019	0.1	1986–2019	1.7*	1986–2019	-0.7
Thyroid – follicular	1986–2019	-0.7*	1986–2019	-0.8*	1986–2019	-0.6*

Cancer type	Males and females combined – period	Males and females combined – APC	Males – period	Males – APC	Females – period	Females – APC
Thyroid – medullary	1986–2015	2.3*	1986–2015	2.7*	1986–2019	1.6*
	2015–2019	-8.5	2015–2019	-17.2	n/a	n/a
Thyroid – papillary	1986–2012	9.0*	1986–2013	8.5*	1986–1998	7.2*
	2012–2019	-3.0*	2013–2019	-1.1	1998–2002	15.9*
	n/a	n/a	n/a	n/a	2002–2013	7.0*
	n/a	n/a	n/a	n/a	2013–2019	-4.9*
Leukemia	1986–1998	-0.5	1986–1997	-0.7	1986–2001	-0.5
	1998–2010	1.1*	1997–2010	0.9*	2001–2010	1.7*
	2010–2019	-2.0*	2010–2019	-2.1*	2010–2019	-2.3*
Acute lymphocytic leukemia	1986–2019	0.8*	1986–2019	0.8*	1986–2019	0.8*
Acute monocytic leukemia	1986–2019	2.4*	1986–2019	1.9*	1986–2019	2.8*
Acute myeloid leukemia	1986–2019	0.7*	1986–2019	0.6*	1986–2019	0.6*
Chronic lymphocytic leukemia	1986–2009	1.3*	1986–2009	1.3*	1986–2009	1.1*
	2009–2019	-3.5*	2009–2019	-3.6*	2009–2019	-3.7*
Chronic myeloid leukemia	1986–2004	-1.2*	1986–2004	-1.5*	1986–2019	0.3
	2004–2019	1.7*	2004–2019	1.6*	n/a	n/a
Lymphoma	1986–1998	1.5*	1986–2009	1.0*	1986–1998	1.8*
	1998–2009	0.6*	2009–2013	4.7*	1998–2008	0.2
	2009–2013	4.5*	2013–2019	-1.1*	2008–2013	3.2*
	2013–2019	-1.0*	n/a	n/a	2013–2019	-0.8
Hodgkin lymphoma	1986–2019	-0.3*	1986–2019	-0.4*	1986–2019	-0.2
Non-Hodgkin lymphoma	1986–1998	1.8*	1986–2009	1.3*	1986–1998	2.1*
	1998–2009	0.8*	2009–2013	5.1*	1998–2008	0.3
	2009–2013	4.8*	2013–2019	-1.3*	2008–2013	3.5*
	2013–2019	-1.1*	n/a	n/a	2013–2019	-0.9
Non-Hodgkin lymphoma – extranodal	1986–2007	8.5*	1986–2007	8.2*	1986–2007	8.2*
	2007–2012	35.7*	2007–2012	37.5*	2007–2011	42.1*
	2012–2019	-0.2	2012–2019	-0.8	2011–2019	2.2

Cancer type	Males and females combined – period	Males and females combined – APC	Males – period	Males – APC	Females – period	Females – APC
Non-Hodgkin lymphoma – nodal	1986–2007	0.9*	1986–2007	1.0*	1986–1994	2.3*
	2007–2011	-8.3*	2007–2011	-8.3	1994–2007	0.2
	2011–2019	-2.3*	2011–2019	-1.9	2007–2013	-6.7*
	n/a	n/a	n/a	n/a	2013–2019	-1.9
Myeloma	1986–2004	0.8*	1986–2003	0.8*	1986–2019	0.8*
	2004–2008	-2.8	2003–2007	-3.9	n/a	n/a
	2008–2012	6.3	2007–2011	7.5	n/a	n/a
	2012–2019	0.3	2011–2019	0.3	n/a	n/a
Melanoma of the skin	1986–1993	-0.5	1986–2015	2.0*	1986–1992	-1.4
	1993–2014	2.3*	2015–2019	-0.9	1992–2019	2.0*
	2014–2019	0.1	n/a	n/a	n/a	n/a
Melanoma (non-cutaneous)	1986–2019	0.8*	1986–2019	0.6*	1986–2019	0.9*
Melanoma – mucosal	1986–2006	0.4	n/a	**	n/a	**
	2006–2010	39.6	n/a	**	n/a	**
	2010–2019	-1.9	n/a	**	n/a	**
Melanoma – ocular	1986–1996	-3.5*	1986–2019	0.0	1986–2019	-0.3
	1996–2000	9.6	n/a	n/a	n/a	n/a
	2000–2007	-4.4	n/a	n/a	n/a	n/a
	2007–2019	1.5	n/a	n/a	n/a	n/a
Lung	1986–1991	0.3	1986–2008	-2.0*	1986–1998	2.0*
	1991–2008	-0.9*	2008–2012	0.1	1998–2008	0.2
	2008–2012	0.7	2012–2019	-3.0*	2008–2012	1.4
	2012–2019	-2.0*	n/a	n/a	2012–2019	-1.2*
Lung – adenocarcinoma	1986–1992	4.6*	1986–2000	0.5	1986–1992	6.6*
	1992–2008	-0.4	2000–2007	-3.6*	1992–2008	0.8*
	2008–2013	7.7*	2007–2012	8.2*	2008–2014	6.9*
	2013–2019	-3.0*	2012–2019	-2.3*	2014–2019	-4.3*
Lung – large cell	1986–2001	-0.5	1986–2000	-1.2	1986–1999	2.1*
	2001–2005	-16.6*	2000–2004	-17.5*	1999–2019	-8.4*
	2005–2019	-6.5*	2004–2019	-6.6*	n/a	n/a
Lung – small cell	1986–1993	1.5	1986–1990	2.3	1986–2000	2.1*
	1993–2012	-0.7*	1990–2011	-1.4*	2000–2019	-0.8*

Cancer type	Males and females combined – period	Males and females combined – APC	Males – period	Males – APC	Females – period	Females – APC
	2012–2019	-2.8*	2011–2019	-3.0*	n/a	n/a
Lung – squamous cell	1986–1995	-2.6*	1986–2008	-4.3*	1986–1998	0.2
	1995–2008	-3.8*	2008–2012	3.3	1998–2007	-3.1*
	2008–2012	4.8	2012–2019	-2.8*	2007–2012	5.3*
	2012–2019	-2.4*	n/a	n/a	2012–2019	-1.8*
Bladder[†]	1989–2019	-1.3*	1989–2019	-1.4*	1989–2019	-1.4*
Kidney	1986–1990	4.4*	1986–1990	5.0*	1986–2019	1.0*
	1990–1995	-1.4	1990–1999	-0.6	n/a	n/a
	1995–2019	1.6*	1999–2019	2.0*	n/a	n/a

Abbreviations:
APC means annual per cent change
n/a means not applicable

Symbols:
*Statistically significant trend
**Too few cases to calculate
[†]Bladder cancer trend begins at 1989 due to classification changes

Notes:

- Rates are standardized to the age distribution of the 2011 Canadian Standard population.
- Only selected anatomical subsites and histological subtypes of major cancers are shown.
- For all cancers combined, breast cancer, melanoma of the skin and bladder cancer, the National Cancer Institute's Surveillance, Epidemiology and End Results Program standards for counting multiple primary cancers were used for selecting cases. For all other cancer types, the International Agency for Research on Cancer/International Association of Cancer Registries multiple primary rules were used.
- The jump model in the Joinpoint software was applied in trend analyses for all cancers combined, breast cancer, melanoma of the skin and bladder cancer (see Appendix 2: Analysis).

Analysis by: Surveillance, Ontario Heath (Cancer Care Ontario)
Data source: Ontario Cancer Registry (December 2022), Ontario Heath (Cancer Care Ontario)

Thirty-four-year trend in incidence by cancer type

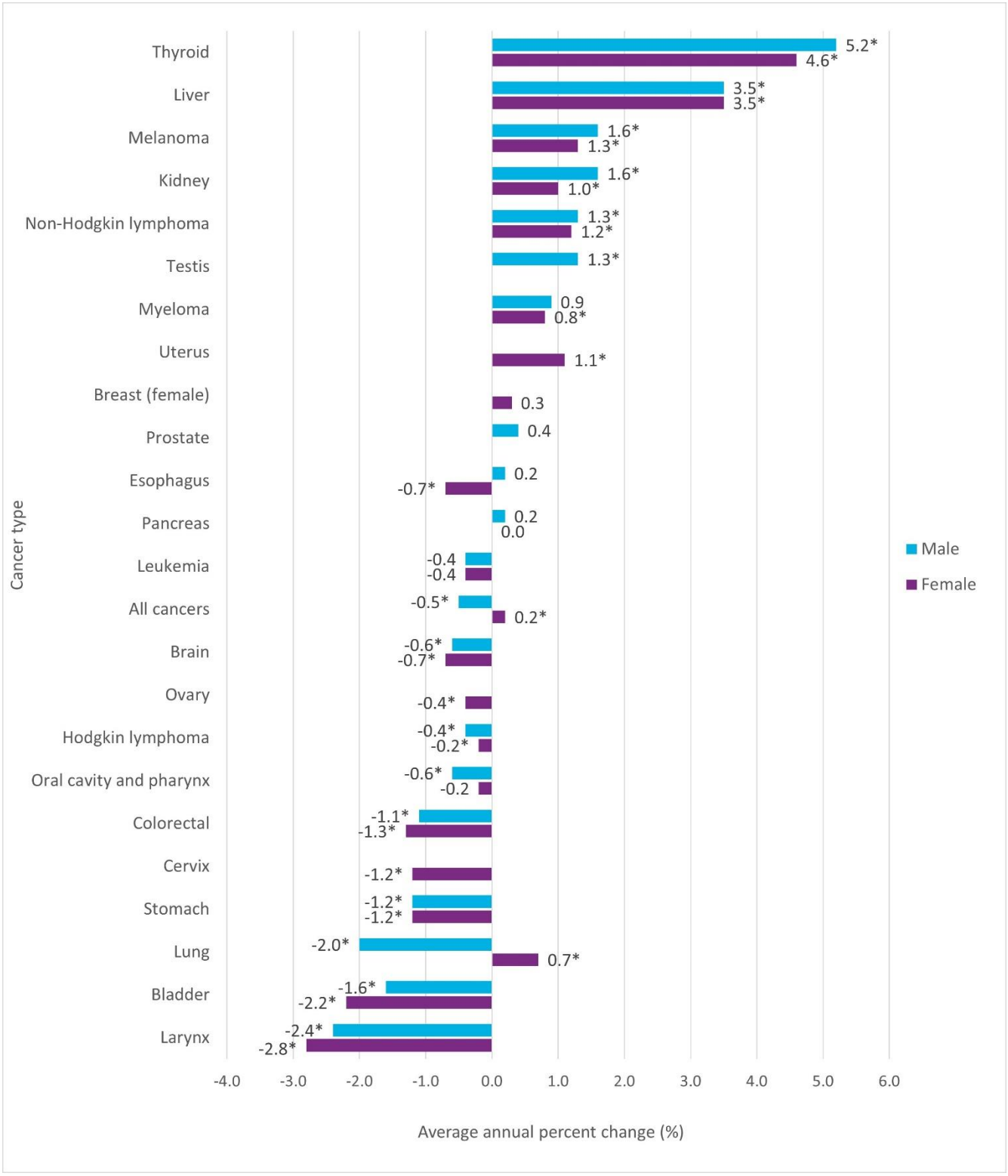
From 1986 to 2019, the average annual per cent change in age-standardized incidence rate for males (**Figure 2.6**):

- increased most for thyroid cancer (5.2%), liver cancer (3.5%), melanoma (1.6%), kidney cancer (1.6%) and testicular cancer (1.3%)
- remained stable for esophageal, pancreatic and prostate cancers, leukemia and myeloma
- decreased most for laryngeal (2.4%), lung (2.0%), bladder (1.6%), stomach (1.2%) and colorectal (1.1%) cancers

Over the same period, the average annual per cent change for females:

- increased most for thyroid cancer (4.6%), liver cancer (3.5%), melanoma (1.3%), non-Hodgkin lymphoma (1.2%) and uterine cancer (1.1%)
- remained stable for breast, oral cavity and pharynx and pancreatic cancers, as well as for Hodgkin lymphoma and leukemia
- decreased most for laryngeal (2.8%), bladder (2.2%), colorectal (1.3%), cervical (1.2%) and stomach (1.2%) cancers

Figure 2.6 Average annual per cent change in age-standardized incidence rates by cancer type and binary sex, Ontario, 1986 to 2019



Symbol: *Statistically significant trend

Notes:

- Rates are standardized to the age distribution of the 2011 Canadian Standard population.
- The bladder cancer trend begins in 1989 due to classification changes; the average annual per cent change is for 1989 to 2019.
- Average annual per cent change was calculated for trends that were based on counts using the International Agency for Research on Cancer/International Association of Cancer Registries multiple primary rules.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (December 2022), Ontario Health (Cancer Care Ontario)

Incidence trends by age

This section describes annual per cent changes in the age-standardized incidence rates for all cancers combined by age group in Ontario (**Figure 2.7**). An annual per cent change is a measure that assesses the change over time of a rate. It represents the percentage increase or decrease per year in a specified time period. This measure is used to examine short-term changes in the trend in rates over time. Because 2020 was an anomalous year that can bias the estimates, incidence data for 2020 were excluded from the incidence trends analysis in this chapter. However, age-standardized incidence rates for 2020 are still provided in **Figure 2.7**.

Over the past 34 years (1986 to 2019), the annual per cent change in age-standardized cancer incidence rate has been generally decreasing among people under age 60 and stable in people age 60 and older, although these trends differ by sex (**Figure 2.7**).

Ages zero to 39

Among people under age 40, the cancer incidence rate increased by 0.4% per year from 1986 to 2001 and then by 1.5% per year from 2001 to 2015. From 2015 to 2019, however, the cancer incidence rate decreased among people under age 40 overall (**Figure 2.7**).

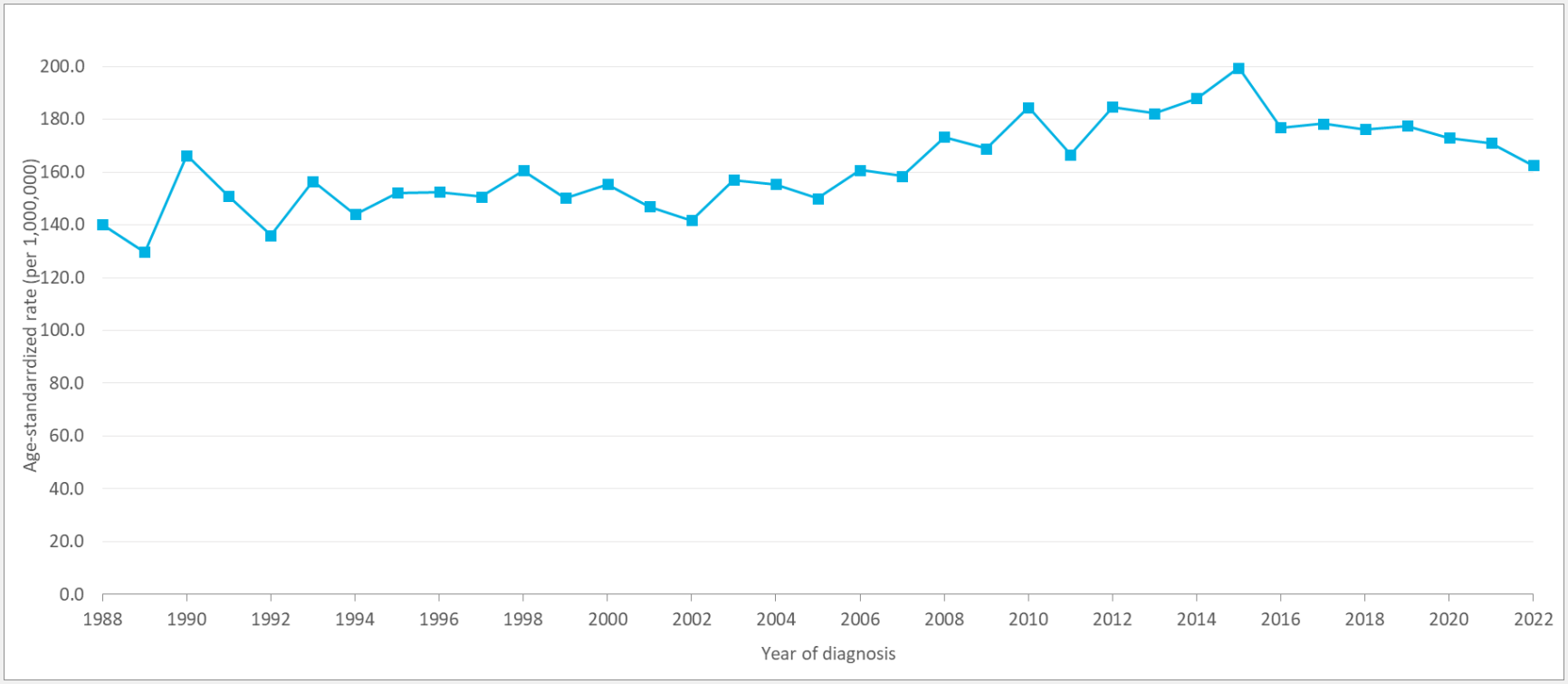
Different trends in rates occurred in males and females. Among males, the rate was stable from 1986 to 2019. For females, the rate was stable from 1986 to 1992, increased by 1.6% per year until 2014 and then decreased by 0.8% per year from 2014 to 2019, although this decrease was not statistically significant.

Among children ages zero to 14 years, the overall average annual per cent change in age-standardized incidence rate was stable from 1988 to 2022 (0.4% per year, not significant), but increased by 2.1% per year from 2005 to 2015 before decreasing by 2.2% per year from 2015 to 2022 (see **Spotlight: Childhood Cancer Incidence Trend, Figure 2.S1**).

For more details on childhood cancer incidence trends, read the Pediatric Oncology Group of Ontario surveillance report.

Spotlight: Childhood Cancer Incidence Trend

Figure 2.S1 Age-standardized incidence rates of cancer in children, all cancers combined, ages zero to 14 years, Ontario, 1988 to 2022



Time period	APC (%)
1988–2005	0.4
2005–2015	2.1*
2015–2022	-2.2*

Abbreviation: APC means annual per cent change
Symbol: *Statistically significant trend

Notes:

- Rates are per 1,000,000.
- For childhood cancers, the International Agency for Research on Cancer/International Association of Cancer Registries multiple primary rules were used.

Analysis by: Health Analytics, Pediatric Oncology Group of Ontario
Data source: POGONIS (May 11, 2023), Pediatric Oncology Group of Ontario

Ages 40 to 59

Among people ages 40 to 59, the cancer incidence rate increased by 0.5% per year from 1986 to 2007 and then decreased by 0.6% per year from 2007 to 2019 (**Figure 2.7**). While the male rate decreased by 1.3% per year from 2007 to 2019 following a steady increase, the female rate stabilized from 2015 to 2019 following an increase of 0.4% per year from 1986 to 2015.

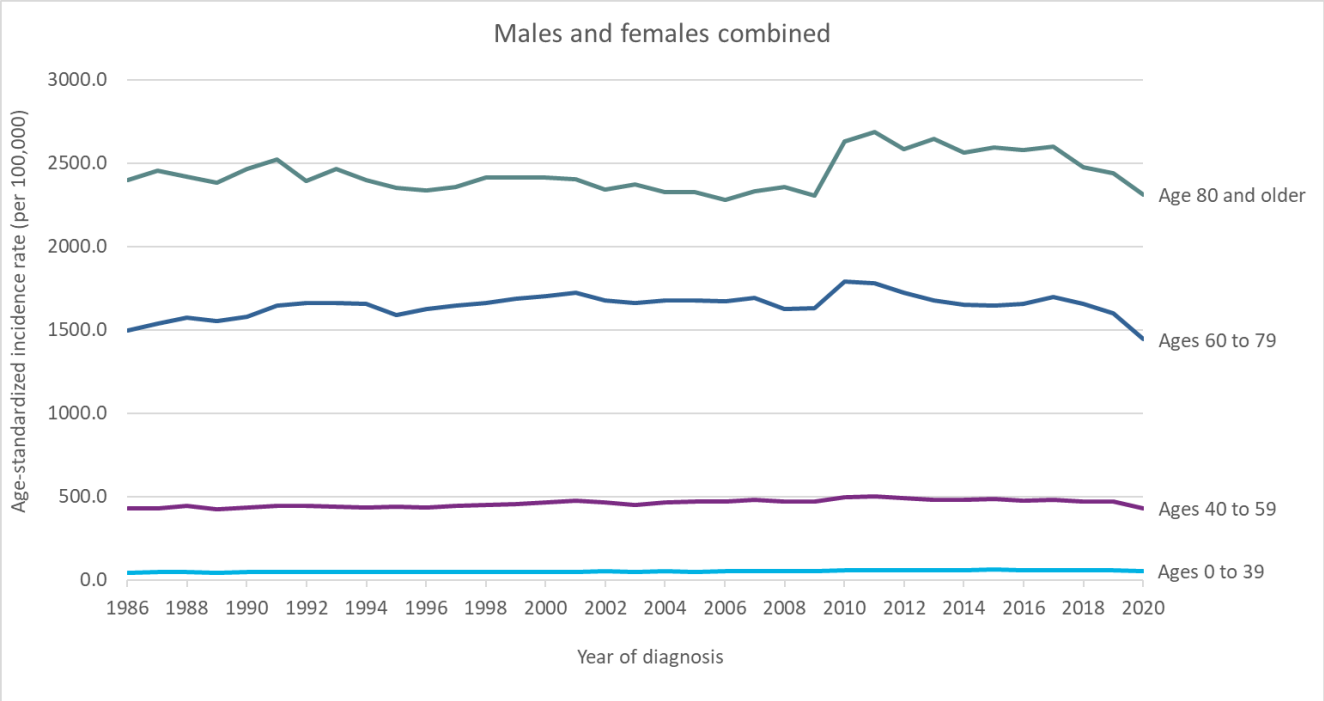
Ages 60 to 79

For people ages 60 to 79, the cancer incidence rate increased by 1.5% per year from 1986 to 1992, remained stable until 2007, decreased by 2.3% per year from 2007 to 2013, and was stable from 2013 to 2019 (**Figure 2.7**). The trend among males was similar to the overall trend, although the rate of decrease from 2007 to 2013 was greater, at 3.9% per year. Females in this age group had no significant increase or decrease in incidence rate, remaining stable from 1986 to 2019.

Age 80 and older

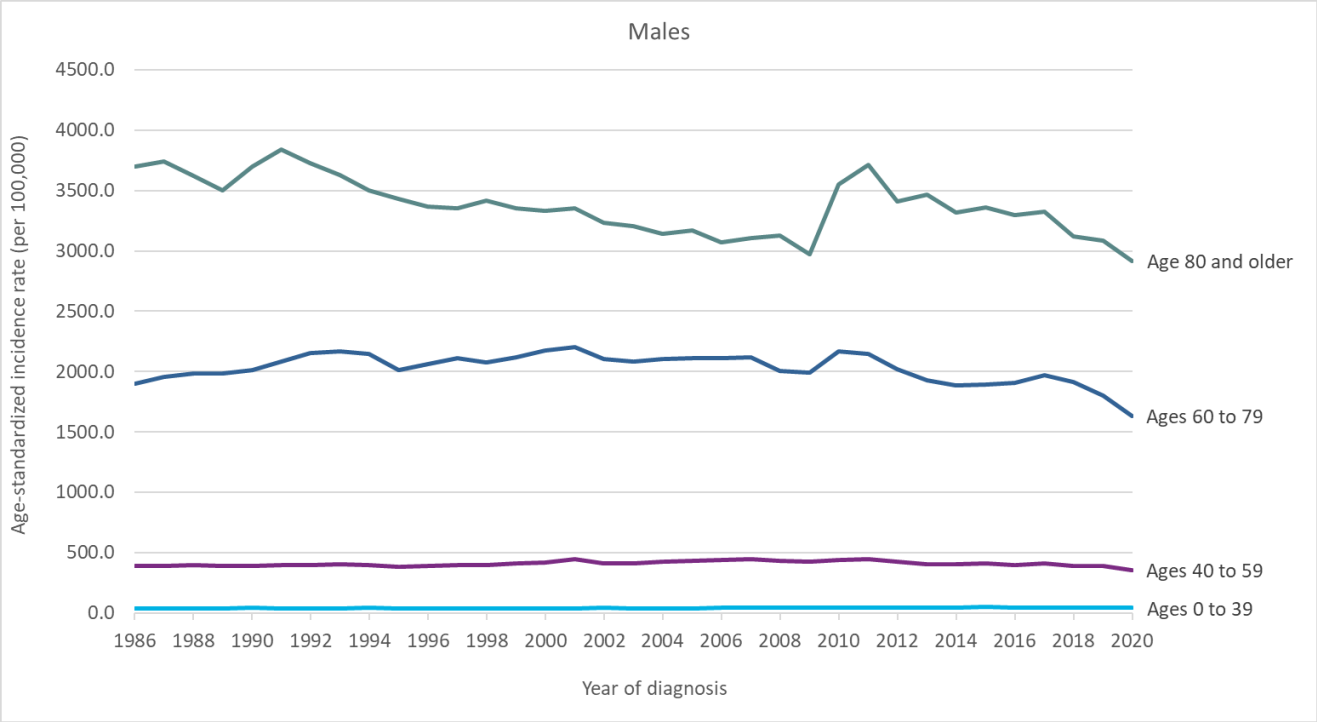
In people age 80 and older, the cancer incidence rate decreased steadily from 1986 to 2015 by 0.2% per year and stabilized from 2015 to 2019 (**Figure 2.7**). Different trends were seen in males and females. Among males, the rate decreased by 1.0% per year from 1986 to 2011 and then more rapidly by 1.7% per year until 2019. Among females, the rate increased steadily by 0.2% per year from 1986 to 2015 and then stabilized from 2015 to 2019.

Figure 2.7 Age-standardized incidence rates (1986 to 2020) and annual per cent change in age-standardized incidence rates (1986 to 2019) by binary sex and age group, Ontario



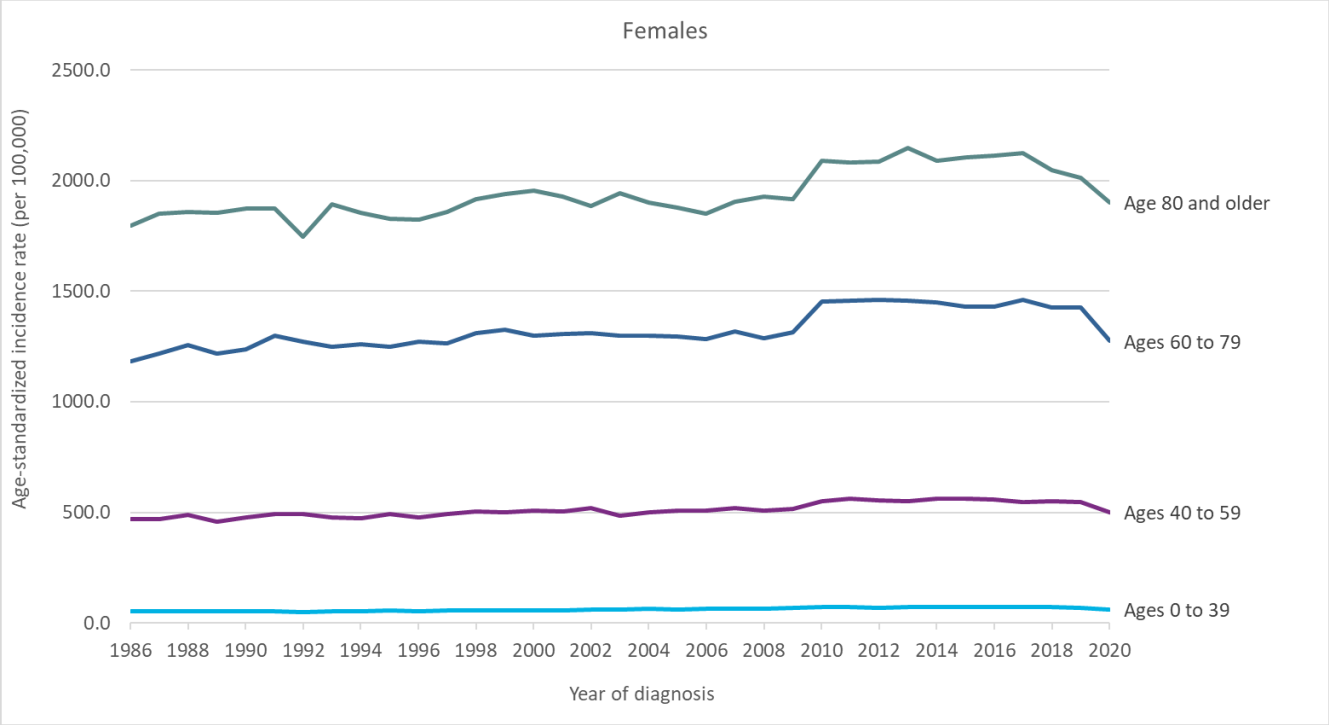
Males and Females Combined APC

Ages 0 to 39		Ages 40 to 59		Ages 60 to 79		Age 80 and older	
PERIOD	**APC**	**PERIOD**	**APC**	**PERIOD**	**APC**	**PERIOD**	**APC**
1986–2001	0.4*	1986–2007	0.5*	1986–1992	1.5*	1986–2015	-0.2*
2001–2015	1.5*	2007–2019	-0.6*	1992–2007	0.2	2015–2019	-1.4
2015–2019	-1.7*			2007–2013	-2.3*		
				2013–2019	-0.5		



Males APC

Ages 0 to 39		Ages 40 to 59		Ages 60 to 79		Age 80 and older	
PERIOD	**APC**	**PERIOD**	**APC**	**PERIOD**	**APC**	**PERIOD**	**APC**
1986–2019	0.1	1986–2007	0.6*	1986–1992	1.8*	1986–2011	-1.0*
		2007–2019	-1.3*	1992–2007	0.0	2011–2019	-1.7*
				2007–2013	-3.9*		
				2013–2019	-0.6		



Females APC

Ages 0 to 39		Ages 40 to 59		Ages 60 to 79		Age 80 and older	
PERIOD	**APC**	**PERIOD**	**APC**	**PERIOD**	**APC**	**PERIOD**	**APC**
1986–1992	-0.7	1986–2015	0.4*	1986–1991	1.3	1986–2015	0.2*
1992–2014	1.6*	2015–2019	-0.8	1991–1995	-0.6	2015–2019	-1.0
2014–2019	-0.8			1995–1999	1.3		
				1999–2019	-0.2		

Abbreviation: APC means annual per cent change

Symbol: *Statistically significant trend

Notes:

- Counts are based on the National Cancer Institute's Surveillance, Epidemiology and End Results Program standards for counting multiple primary cancers.
- Rates are per 100,000 and standardized to the age distribution of the 2011 Canadian Standard population.
- Because 2020 was an anomalous year that can bias the APC estimates, incidence data for 2020 were excluded from the incidence trends analysis.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (December 2022), Ontario Health (Cancer Care Ontario)

Incidence by cancer stage

"Cancer staging" refers to classifying people with cancer into groups according to the extent of their disease. "Stage at diagnosis" is the extent of the disease at the time of initial diagnosis.

A stage group (i.e., stage 0, 1, 2, 3 or 4) is based on distinct characteristics of a tumour that describe how much a cancer has spread in the body. Knowing the stage of the disease helps physicians plan appropriate treatment and determine the likely outcome or course of the disease. Information about stage at diagnosis is one of the most important factors in predicting the outcome for someone with cancer.(122)

A cancer diagnosed at an early stage is more likely to be treated successfully. If the cancer has spread, treatment becomes more difficult and someone's chances of survival are generally much lower.

Stage group is useful as a comparator within and across different cancer types, as well as for comparing trends over time. High-quality stage information at the population level can help health care providers, administrators, researchers and decision-makers plan, evaluate and enhance quality of care and ultimately improve treatment outcomes.

Population-level stage at diagnosis data with high completeness are available in Ontario for five cancers: female breast, prostate, colorectal, lung and cervical. In 2018, a new staging classification scheme was adopted by the Ontario Cancer Registry, which affects the stage distribution of many cancers for cases diagnosed from 2018 onward (see Appendix 1: Data Sources).

Recent distribution of stage at diagnosis data (2018 to 2020) and changes are described in Chapter 1: COVID-19 and Cancer in Ontario.

Ch 3: Cancer Mortality

Cancer mortality refers to the number of deaths caused by cancer in a specific timeframe. This chapter reports projections for 2021 to 2024, as well as actual (non-projected) cancer mortality rates and trends for 1986 to 2020.

Mortality overview

Although the number of deaths (mortality) from all cancers combined in Ontario increased over the past three decades, the mortality rate has decreased for much of this period. In general, cancer mortality is affected by:

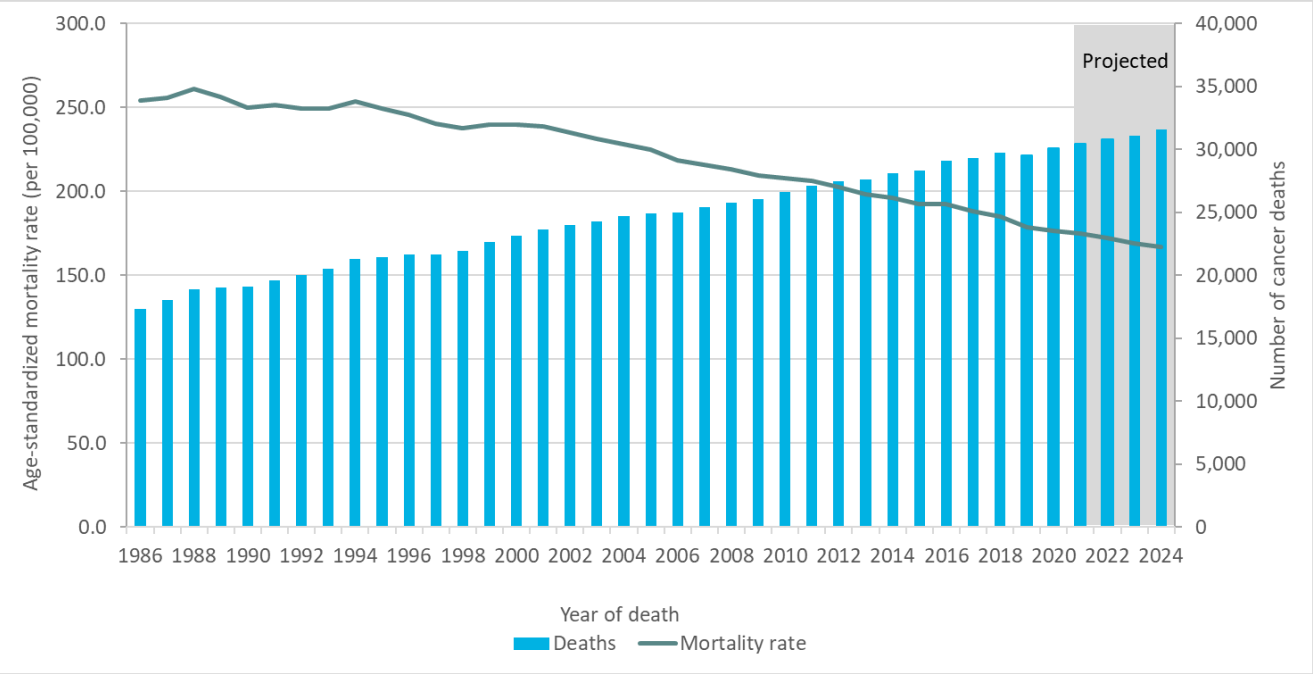
- cancer incidence
- cancer survival
- socio-demographic factors
- the availability of access to and effectiveness of early detection and screening for cancer
- the availability of and access to effective treatment for cancer

Statistics by sex in this chapter refer to sex data that are binary and assigned at birth. For more information, refer to About This Report: Statistics by sex.

Estimated cancer mortality in 2024

In 2024, an estimated 31,575 people in Ontario are expected to die from cancer (excluding non-melanoma skin cancer). This estimate represents an age-standardized mortality rate of 167.0 per 100,000 people (**Figure 3.1**). While the number of cancer deaths increased each year since 1986, the age-standardized mortality rate peaked in 1988 and has decreased every year since 1999.

Figure 3.1 Mortality counts and age-standardized rates for all cancers combined, Ontario, 1986 to 2024



Notes:

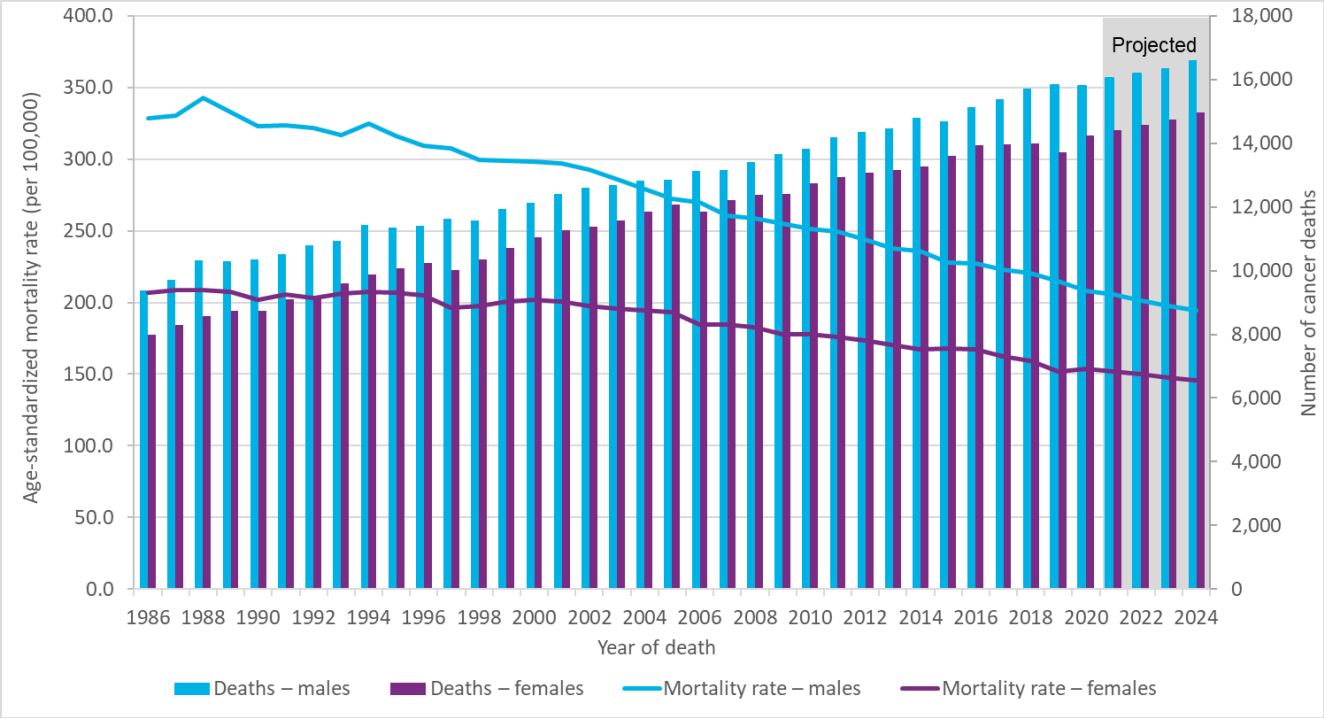
- Rates are per 100,000 and standardized to the age distribution of the 2011 Canadian Standard population.
- The shaded area indicates projected data for the years 2021 onward.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (February 2023), Ontario Health (Cancer Care Ontario)

Projected mortality by sex

Among males, cancer is expected to cause 16,619 deaths in 2024, which will result in an age-standardized mortality rate of 194.6 per 100,000 (**Figure 3.2**). The numbers are expected to be lower for females, with 14,959 expected deaths and an age-standardized mortality rate of 145.9 per 100,000. Males are projected to account for 52.6% of all cancer deaths in 2024. This percentage has decreased slightly over time, with males accounting for 54.0% of all cancer deaths in 1986. While the numbers of cancer deaths have increased for males and females from 1986 to 2024, the age-standardized mortality rates are expected to continue their decrease from prior years to 2024 (**Figure 3.2**).

Figure 3.2 Mortality counts and age-standardized rates by binary sex for all cancers combined, Ontario, 1986 to 2024



Notes:

- Rates are per 100,000 and standardized to the age distribution of the 2011 Canadian Standard population.
- The shaded area indicates projected data for the years 2021 onward.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (February 2023), Ontario Health (Cancer Care Ontario)

Projected mortality by sex and cancer type

In 2024, the leading cause of cancer death is expected to be lung cancer, which is projected to account for 21.7% (6,852) of all cancer deaths (**Table 3.1**). Colorectal cancer is expected to result in the second highest number of cancer deaths (3,200 or 10.1%), followed by pancreatic cancer. Despite having a much lower incidence, pancreatic cancer is projected to cause roughly the same number of deaths (2,207 or 7.0%) as female breast cancer (2,135 or 6.8%). Together, these four cancers will represent almost half of all cancer deaths.

The age-standardized mortality rate of lung cancer is projected to be significantly higher in males (40.3 per 100,000) than in females (31.5 per 100,000).

For every cancer listed in **Table 3.1**, except thyroid cancer, the age-standardized mortality rate is expected to be higher in males than in females (see Chapter 2: Incidence by Sex and Cancer Type for more details on thyroid cancer sex disparities). The higher male mortality rates are due to generally

higher incidence rates among males for every cancer that occurs in both males and females. The higher incidence and mortality rates in males are due to:

- a higher prevalence of risk factors, such as overweight and obesity, alcohol and tobacco use (78)
- greater occupational exposure to carcinogens (68,69)
- less use of medical services (63,64,123)
- the influence of different sex hormones (124)

The biggest differences in cancer mortality between males and females in 2024 are expected to be for:

- laryngeal, esophageal and bladder cancers, which will have a male age-standardized mortality rate that is at least three times higher than the female rate
- melanoma, as well as kidney, liver and stomach cancers, which will have a male age-standardized mortality rate that is about twice as high as the female rate

Table 3.1 Projected mortality counts and age-standardized rates by cancer type and binary sex, Ontario, 2024

Cancer type	Males and females combined – deaths	Males and females combined – ASMR	Males – deaths	Males – ASMR	Females – deaths	Females – ASMR
All cancers	**31,575**	**167.0**	**16,619**	**194.6**	**14,959**	**145.9**
Bladder	1,005	5.1	725	8.6	280	2.5
Brain	905	5.1	545	6.6	360	3.8
Breast (female)	n/a	n/a	n/a	n/a	2,135	22.2
Cervix	n/a	n/a	n/a	n/a	159	1.9
Colorectal	3,200	17.1	1,764	21.0	1,436	13.8
Esophagus	952	5.1	736	8.6	217	2.1
Hodgkin lymphoma	40	0.2	26	0.3	17	0.2
Kidney	638	3.4	417	4.9	221	2.1
Larynx	133	0.7	115	1.3	20	0.2
Leukemia	1,254	6.5	736	8.6	517	4.9
Liver	1,534	8.0	983	11.2	553	5.3
Lung	6,852	35.4	3,534	40.3	3,321	31.5
Melanoma	552	3.0	352	4.2	198	2.0
Myeloma	626	3.2	368	4.3	259	2.4
Non-Hodgkin lymphoma	1,161	6.1	661	7.8	502	4.7
Oral cavity and pharynx	585	3.2	413	4.9	173	1.7
Ovary	n/a	n/a	n/a	n/a	746	7.6
Pancreas	2,207	11.6	1,191	13.8	1,015	9.6
Prostate	n/a	n/a	1,876	22.1	n/a	n/a
Stomach	836	4.5	533	6.3	305	3.1
Testis	n/a	n/a	18	0.2	n/a	n/a
Thyroid	108	0.6	47	0.6	60	0.6
Uterus	n/a	n/a	n/a	n/a	646	6.3

Abbreviations:
ASMR means age-standardized mortality rate
n/a means not applicable

Note:

- Rates are per 100,000 and standardized to the age distribution of the 2011 Canadian Standard population.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (February 2023), Ontario Health (Cancer Care Ontario)

Projected mortality by sex and age

In 2024, the highest cancer mortality rate is expected to be in the 80 and older age group, followed by the 60 to 79 age group. The 60 to 79 age group, however, will account for an estimated 52% of all deaths, compared with 36% for the 80 and older age group (**Table 3.2**).

Deaths from cancer before age 40 will continue to be uncommon in 2024, with only 436 deaths expected. These deaths represent 1.4% of all cancer deaths and a rate of 5.6 deaths per 100,000 people.

Although projected mortality rates increase substantially for ages 60 to 79 for most cancer types, exceptions exist for breast and lung cancers. The rates for these cancers begin instead to increase rapidly in the 40 to 59 age group.

Table 3.2 Projected mortality counts and age-specific rates by cancer type and age group, Ontario, 2024

Cancer type	Ages 0 to 39 – deaths	Ages 0 to 39 – age-specific rate	Ages 40 to 59 – deaths	Ages 40 to 59 – age-specific rate	Ages 60 to 79 – deaths	Ages 60 to 79 – age-specific rate	Age 80 and older – deaths	Age 80 and older – age-specific rate
All cancers	**436**	**5.6**	**3,320**	**86.1**	**16,452**	**503.4**	**11,367**	**1,523.9**
Bladder	**	**	35†	0.9	409	12.5	554	74.3
Brain	66	0.9	180	4.7	504	15.4	155	20.8
Breast (female)	59	1.6	449	22.8	942	55.1	685	155.6
Cervix	13	0.3	56	2.8	65	3.8	25	5.7
Colorectal	37	0.5	385	10.0	1,480	45.3	1,298	174.0
Esophagus	**	**	125†	3.2	576	17.6	247	33.1
Hodgkin lymphoma	6	0.1	**	**	15†	0.5	9	1.2
Kidney	6	0.1	67	1.7	327	10.0	238	31.9
Larynx	**	**	20†	0.5	75	2.3	41	5.5
Leukemia	44	0.6	86	2.2	595	18.2	529	70.9
Liver	14	0.2	144	3.7	929	28.4	447	59.9
Lung	14	0.2	484	12.6	4,200	128.5	2,154	288.8
Melanoma	17	0.2	70	1.8	269	8.2	196	26.3
Myeloma	**	**	40†	1.1	327	10.0	258	34.6
Non-Hodgkin lymphoma	16	0.2	104	2.7	574	17.6	467	62.6
Oral cavity and pharynx	7	0.1	91	2.4	336	10.3	151	20.2
Ovary	14	0.4	122	6.2	409	23.9	200	45.4
Pancreas	9	0.1	217	5.6	1,254	38.4	727	97.5
Prostate	**	**	55†	2.9	801	51.4	1,023	334.5
Stomach	15	0.2	123	3.2	429	13.1	269	36.1
Testis	10†	0.3	**	**	**	**	**	**
Thyroid	**	**	15†	0.4	58	1.8	38	5.1

Symbols:
**Suppressed due to small case count of less than six
†Count has been rounded to ensure confidentiality, and associated rate and confidence interval have been adjusted to reflect rounded count

Note:

- Rates are per 100,000.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (February 2023), Ontario Health (Cancer Care Ontario)

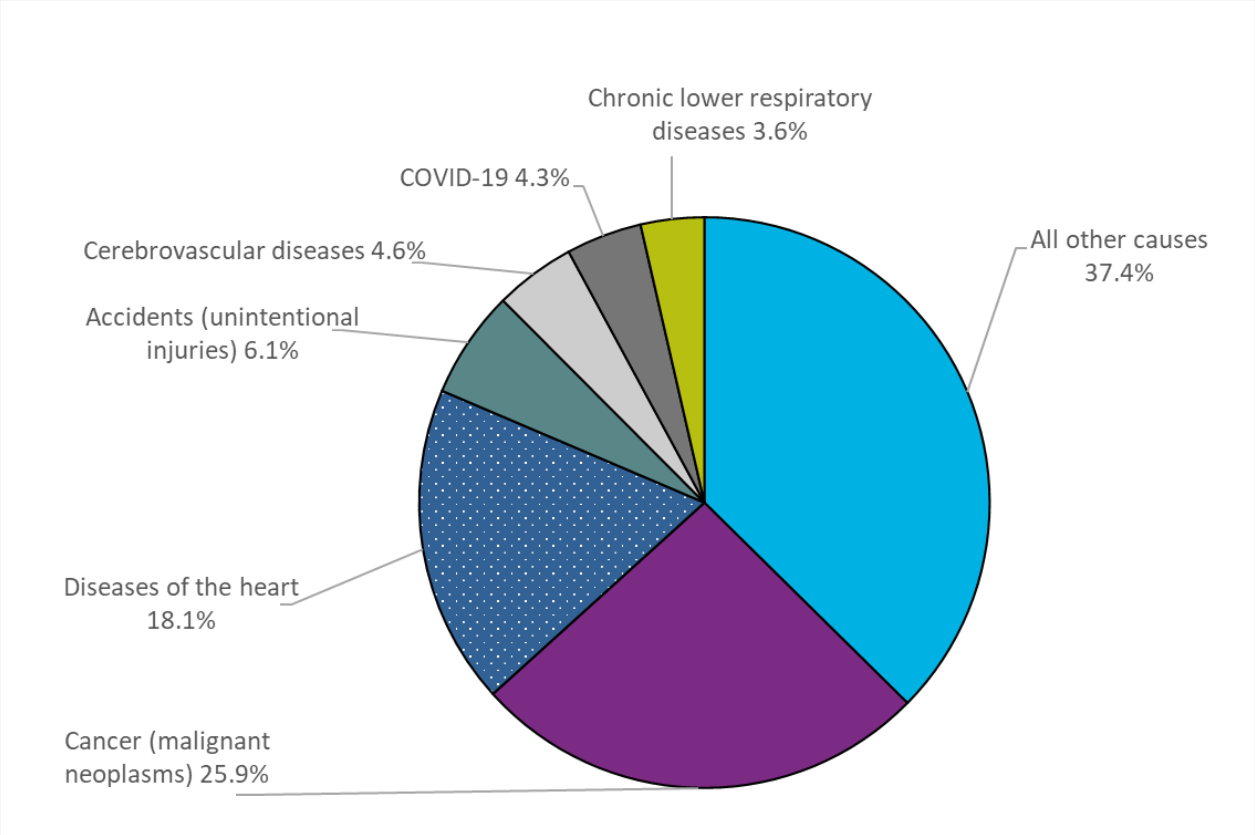
Cancer mortality 1986 to 2020

Cancer deaths in Ontario in 2020 were higher than expected due to the COVID-19 pandemic. Please refer to Chapter 1: COVID-19 and Cancer in Ontario for more information on the impact of the pandemic on cancer mortality in Ontario.

Cancer as a leading cause of death

In 2020, cancer caused 25.9% of all deaths in Ontario, making it the province's leading cause of death (**Figure 3.3**).(125) Cancer caused almost as many deaths as the next three leading causes of death combined: diseases of the heart, accidents and cerebrovascular diseases.

Figure 3.3 Leading causes of death, Ontario, 2020



Note:

- ICD-10 codes for causes of death: chronic lower respiratory diseases [J40–J47]; COVID-19 [U07.1, U07.2]; cerebrovascular diseases [I60–I69]; accidents (unintentional injuries) [V01–X59, Y85–Y86]; diseases of heart [I00–I09, I11, I13, I20–I51]; cancer (malignant neoplasms) [C00–C97].

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Statistics Canada. Table 13-10-0801-01 Leading causes of death, total population (age standardization using 2011 population)

Probability of dying from cancer

The probability of dying from cancer represents the average chance of death due to cancer. This probability depends on many factors:

- population characteristics
- prevalence of risk factors
- availability of, access to and effectiveness of early detection and screening for cancer
- availability of and access to effective treatment for cancer

These probabilities also reflect the average risks for the overall population and do not take into account personal risk. In other words, an individual's risk may be higher or lower than the numbers reported here.

In Ontario, 1 in 4 (24.4%) people, will die from cancer (**Table 3.3**). Males have a greater chance of dying from cancer at slightly more than 1 in 4 (26.5%), compared with females whose chance is slightly less than 1 in 4 (22.5%).

As with the chance of developing cancer, the probability of dying from cancer varies based on cancer type and sex:

- Among males, the probability is highest for lung (1 in 17), prostate (1 in 29) and colorectal (1 in 35) cancers.
- Among females, the probability is highest for lung (1 in 20), breast (1 in 32) and colorectal (1 in 40) cancers.

Table 3.3 Lifetime probability of dying of cancer, by cancer type and binary sex, Ontario, 2016 to 2020

Cancer type	Males and females combined – %	Males and females combined – 1 in	Males – %	Males – 1 in	Females – %	Females – 1 in
All cancers	**24.4**	**4**	**26.5**	**4**	**22.5**	**5**
Bladder	0.8	123	1.2	82	0.4	223
Brain	0.6	173	0.7	152	0.5	201
Breast (female)	n/a	n/a	n/a	n/a	3.1	32
Cervix	n/a	n/a	n/a	n/a	0.2	490
Colorectal	2.7	37	2.9	35	2.5	40
Esophagus	0.6	160	0.9	105	0.3	315
Hodgkin lymphoma	0.0	3,115	0.0	2,347	0.0	4,545
Kidney	0.5	202	0.6	159	0.4	272
Larynx	0.1	891	0.2	513	0.0	2,890
Leukemia	0.9	106	1.1	90	0.8	126
Liver	0.9	105	1.2	83	0.7	141
Lung	5.4	19	5.8	17	5.0	20
Melanoma	0.4	249	0.5	184	0.3	366
Myeloma	0.5	200	0.6	173	0.4	232
Non-Hodgkin lymphoma	0.9	106	1.1	93	0.8	120
Oral cavity and pharynx	0.4	246	0.5	183	0.3	368
Ovary	n/a	n/a	n/a	n/a	1.0	100
Pancreas	1.5	65	1.6	63	1.5	67
Prostate	n/a	n/a	3.4	29	n/a	n/a
Stomach	0.6	161	0.8	125	0.5	221
Testis	n/a	n/a	0.0	5,000	n/a	n/a
Thyroid	0.1	1,325	0.1	1,565	0.1	1,164
Uterus	n/a	n/a	n/a	n/a	0.8	131

Abbreviation: n/a means not applicable

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (February 2023), Ontario Health (Cancer Care Ontario). Statistics Canada, Table 13-10-0709-01 Mortality rates, by age group

Mortality by sex and cancer type

In 2020, 30,054 people died from cancer in Ontario. The age-standardized mortality rate was 176.7 per 100,000 (**Table 3.4**).

The four most commonly diagnosed cancers (breast, colorectal, lung and prostate) were responsible for 44.8% of all cancer deaths in 2020. Lung, colorectal and prostate cancers accounted for 43.0% of all male cancer deaths, while lung, breast and colorectal cancers accounted for 46.7% of all female cancer deaths (**Figure 3.4**).

Some of the less commonly diagnosed cancers made a relatively large contribution to mortality because of their poor prognosis. For example, pancreatic cancer accounted for 6.6% of all cancer deaths in 2020, making it the third highest contributor to cancer deaths after lung and colorectal cancers (**Table 3.4**). By contrast, pancreatic cancer accounted for only 2.4% of new cases in the same year (see Chapter 2: Cancer Incidence).

The highest age-standardized mortality rates for cancers occurring in males and females combined were for lung (38.8 per 100,000), colorectal (18.3 per 100,000) and pancreas (11.7 per 100,000).

The age-standardized mortality rate for all cancers combined was significantly higher for males (208.1 per 100,000) than for females (153.8 per 100,000). Among males, the highest age-standardized mortality rate was for lung (44.2 per 100,000), followed by prostate (23.3 per 100,000) and colorectal (22.0 per 100,000) cancers. For females, the highest age-standardized mortality rate was for lung (34.7 per 100,000), followed by breast (22.0 per 100,000) and colorectal (15.4 per 100,000) cancers.

Males had a consistently higher mortality rate than females for each type of cancer, except thyroid. Thyroid cancer mortality rates were similar for males and females.

The greatest differences between male and female cancer mortality rates were seen in:

- laryngeal cancer, which had a male rate that was more than 8 times higher than the female rate
- esophageal cancer, which had a male rate that was 4 times higher than the female rate
- bladder cancer, which had a male rate that was close to 4 times higher than the female rate
- oral cavity and pharynx cancer, which had a male rate that was more than 2 times higher than the female rate

Tobacco use is a major risk factor for these four cancer types. In large part, the higher mortality rates in males likely result from their historically higher rates of tobacco use.(104,105)

Table 3.4 Mortality counts and rates by cancer type and binary sex, Ontario, 2020

Cancer type	Males and females combined – deaths	Males and females combined – % of deaths	Males and females combined – ASMR	Males and females combined – 95% CI	Males – deaths	Males – % of deaths	Males – ASMR	Males – 95% CI	Females – deaths	Females – % of deaths	Females – ASMR	Females – 95% CI
All cancers	**30,054**	**100.0**	**176.7**	**174.7–178.7**	**15,811**	**100.0**	**208.1**	**204.8–211.4**	**14,243**	**100.0**	**153.8**	**151.2–156.3**
Bladder	825	2.7	4.7	4.4–5.1	602	3.8	8.2	7.5–8.9	223	1.6	2.2	1.9–2.6
Brain	917	3.1	5.6	5.3–6.0	534	3.4	7.0	6.4–7.6	383	2.7	4.4	4.0–4.9
Breast (female)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1,958	13.7	22.0	21.0–23.0
Cervix	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	155	1.1	1.9	1.6–2.2
Colorectal	3,101	10.3	18.3	17.7–19.0	1,649	10.4	22.0	20.9–23.1	1,452	10.2	15.4	14.6–16.2
Esophagus	845	2.8	5.0	4.7–5.3	653	4.1	8.4	7.8–9.1	192	1.3	2.1	1.8–2.4
Hodgkin lymphoma	45	0.1	0.3	0.2–0.4	32	0.2	0.4	0.3–0.6	13	0.1	0.1	0.1–0.3
Kidney	605	2.0	3.5	3.3–3.8	387	2.4	5.1	4.6–5.6	218	1.5	2.3	2.0–2.6
Larynx	157	0.5	0.9	0.8–1.1	134	0.8	1.7	1.4–2.1	23	0.2	0.2	0.2–0.4
Leukemia	1,125	3.7	6.6	6.2–7.0	638	4.0	8.5	7.8–9.2	487	3.4	5.1	4.7–5.6
Liver	1,312	4.4	7.7	7.3–8.2	812	5.1	10.5	9.8–11.3	500	3.5	5.4	5.0–5.9
Lung	6,692	22.3	38.8	37.9–39.7	3,445	21.8	44.2	42.7–45.7	3,247	22.8	34.7	33.5–36.0
Melanoma	523	1.7	3.1	2.8–3.4	350	2.2	4.6	4.1–5.1	173	1.2	1.9	1.6–2.2
Myeloma	561	1.9	3.2	3.0–3.5	327	2.1	4.3	3.9–4.8	234	1.6	2.4	2.1–2.8
Non-Hodgkin lymphoma	1,158	3.9	6.8	6.4–7.2	619	3.9	8.2	7.6–8.9	539	3.8	5.6	5.2–6.1
Oral cavity and pharynx	572	1.9	3.4	3.1–3.7	387	2.4	4.9	4.5–5.5	185	1.3	2.0	1.7–2.3
Ovary	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	695	4.9	7.8	7.2–8.4
Pancreas	1,998	6.6	11.7	11.2–12.3	1,047	6.6	13.6	12.8–14.4	951	6.7	10.1	9.5–10.8
Prostate	n/a	n/a	n/a	n/a	1,711	10.8	23.3	22.2–24.5	n/a	n/a	n/a	n/a
Stomach	790	2.6	4.7	4.4–5.0	510	3.2	6.8	6.2–7.4	280	2.0	3.0	2.7–3.4
Testis	n/a	n/a	n/a	n/a	24	0.2	0.4	0.2–0.5	n/a	n/a	n/a	n/a
Thyroid	82	0.3	0.5	0.4–0.6	42	0.3	0.6	0.4–0.8	40	0.3	0.4	0.3–0.6
Uterus	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	572	4.0	6.3	5.8–6.8

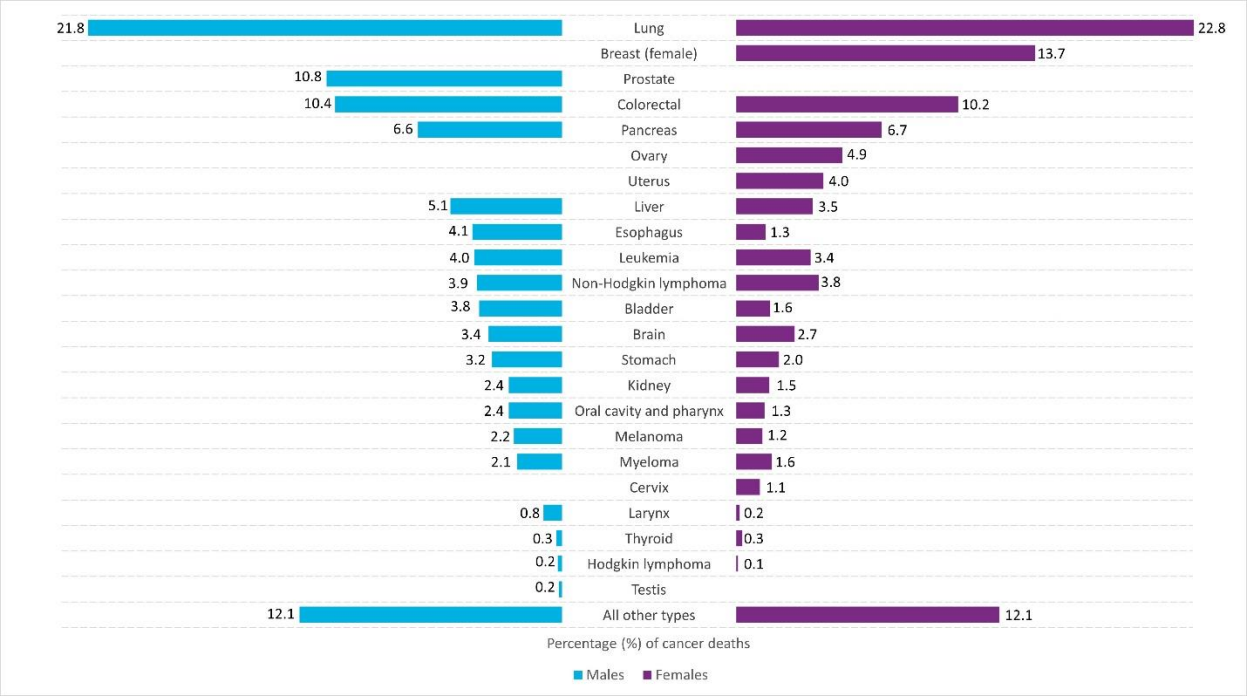
Abbreviations:
ASMR means age-standardized mortality rate
CI means confidence interval
n/a means not applicable

Note:

- Rates are per 100,000 and standardized to the age distribution of the 2011 Canadian Standard population.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (February 2023), Ontario Health (Cancer Care Ontario)

Figure 3.4 Percentage of cancer deaths by cancer type and binary sex, Ontario, 2020



Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (February 2023), Ontario Health (Cancer Care Ontario)

Mortality by age and cancer type

From 2018 to 2020, the median age at death for all cancers combined was 75 for males and females (**Table 3.5**). The median age at death varied by cancer type. Cancers with the lowest median age at death were testicular and cervical. The median age for most other cancer types was over 70.

Table 3.5 Median age at death by cancer type and binary sex, Ontario, 2018 to 2020

Cancer type	Males and females combined – age (years)	Males – age (years)	Females – age (years)
All cancers	**75**	**75**	**75**
Bladder	82	81	83
Brain	66	66	68
Breast (female)	n/a	n/a	72
Cervix	n/a	n/a	60
Colorectal	77	75	79
Esophagus	71	70	75
Hodgkin lymphoma	71	70	74
Kidney	74	73	77
Larynx	73	73	75
Leukemia	77	76	78
Liver	73	71	75
Lung	74	74	74
Melanoma	74	74	74
Myeloma	78	77	79
Non-Hodgkin lymphoma	76	76	77
Oral cavity and pharynx	70	69	73
Ovary	n/a	n/a	71
Pancreas	74	72	76
Prostate	n/a	82	n/a
Stomach	73	73	74
Testis	n/a	41	n/a
Thyroid	75	72	78
Uterus	n/a	n/a	72

Abbreviation: n/a means not applicable

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (February 2023), Ontario Health (Cancer Care Ontario)

In 2020, 87.0% of all people in Ontario who died of cancer were age 60 or older (**Table 3.6**). Mortality was distributed differently by age group.

Ages zero to 39

People younger than age 40 made up 1.3% of all cancer deaths (compared with 5.0% of all new cases), with brain and breast cancers being the leading causes.

In 2020, 0.2% of all cancer deaths occurred in children with cancer (ages zero to 14 years). From 2017 to 2021, the majority of deaths in children with cancer occurred in people with:

- central nervous system and miscellaneous intracranial and intraspinal neoplasms (39.0%)
- leukemias, myeloproliferative diseases and myelodysplastic diseases (23.6%)

For more information, please read the Pediatric Oncology Group of Ontario surveillance report.

Ages 40 to 59

People ages 40 to 59 made up 11.7% of all cancer deaths, compared with 21.8% of all new cases, with lung and breast cancers being the leading causes.

Ages 60 to 79

People ages 60 to 79 made up 50.7% of all cancer deaths, compared with 53.9% of all new cases.

This age group represented the greatest proportion of cancer deaths for 20 of the 23 types of cancer examined in this report. The greatest percentages of cancer deaths in this age group were from lung (27.0%) and colorectal (8.6%) cancers.

Age 80 and older

People age 80 and older made up 36.2% of all cancer deaths, compared with 19.3% of all new cases, with lung (18.4%) and colorectal (12.3%) cancers being the leading causes.

While prostate cancer was diagnosed most frequently in males ages 60 to 79, most deaths caused by prostate cancer were in males age 80 and older. The higher mortality rate in males age 80 and older reflects the often slow progression of the disease and the higher frequency of later stage cancers in older males.

Cancer mortality increased significantly with age, from a rate of 5.6 per 100,000 in people age 39 and younger, to a rate of 1,648.2 per 100,000 in people age 80 and older (**Table 3.6**). Mortality varied by cancer type:

- There were significant increases in mortality with age for cancers of the breast, colorectum, kidney and stomach, as well as leukemia, melanoma and non-Hodgkin lymphoma.
- Mortality increased with age, but not significantly, for cancers of the bladder, brain, cervix, esophagus, larynx, liver, lung, oral cavity and pharynx, ovary, pancreas, prostate, thyroid and uterus.
- Testicular cancer mortality was highest in people under age 60.

Table 3.6 Mortality counts and rates by cancer type and age group, Ontario, 2020

Cancer type	Ages 0 to 39 – deaths	Ages 0 to 39 – age-specific rate	Ages 0 to 39 – 95% CI	Ages 40 to 59 – deaths	Ages 40 to 59 – age-specific rate	Ages 40 to 59 – 95% CI	Ages 60 to 79 – deaths	Ages 60 to 79 – age-specific rate	Ages 60 to 79 – 95% CI	Age 80 and older – deaths	Age 80 and older – age-specific rate	Age 80 and older – 95% CI
All cancers*	**405**	**5.6**	**5.0–6.1**	**3,516**	**90.3**	**87.3–93.3**	**15,250**	**525.5**	**517.2–533.9**	**10,883**	**1,648.2**	**1,617.4–1,679.4**
Bladder	**	**	**	35†	0.9	0.6 – 1.2	321	11.1	9.9–12.3	473	71.6	65.3–78.4
Brain	60	0.8	0.6–1.1	196	5.0	4.4–5.8	506	17.4	16.0–19.0	155	23.5	19.9–27.5
Breast (female)*	36	1.0	0.7–1.4	458	23.1	21.0–25.3	832	54.8	51.1–58.6	632	160.3	148.0–173.3
Cervix	18	0.5	0.3–0.8	49	2.5	1.8–3.3	67	4.4	3.4–5.6	21	5.3	3.3–8.1
Colorectal*	47	0.6	0.5–0.9	402	10.3	9.3–11.4	1,314	45.3	42.9–47.8	1,338	202.6	191.9–213.8
Esophagus	7	0.1	0.0–0.2	119	3.1	2.5–3.7	500	17.2	15.8–18.8	219	33.2	28.9–37.9
Hodgkin lymphoma	**	**	**	10†	0.3	0.1 – 0.5	19	0.7	0.4–1.0	13	2.0	1.0–3.4
Kidney*	7	0.1	0.0–0.2	75	1.9	1.5–2.4	312	10.8	9.6–12.0	211	32.0	27.8–36.6
Larynx	**	**	**	10†	0.3	0.1 – 0.5	96	3.3	2.7–4.0	46	7.0	5.1–9.3
Leukemia*	42	0.6	0.4–0.8	97	2.5	2.0–3.0	493	17.0	15.5–18.6	493	74.7	68.2–81.6
Liver	9	0.1	0.1–0.2	156	4.0	3.4–4.7	766	26.4	24.6–28.3	381	57.7	52.1–63.8
Lung	13	0.2	0.1–0.3	561	14.4	13.2–15.6	4,120	142.0	137.7–146.4	1,998	302.6	289.5–316.2
Melanoma*	11	0.2	0.1–0.3	66	1.7	1.3–2.2	258	8.9	7.8–10.0	188	28.5	24.5–32.8
Myeloma	**	**	**	40†	1.0	0.7 – 1.4	281	9.7	8.6–10.9	241	36.5	32.0–41.4
Non-Hodgkin lymphoma*	12	0.2	0.1–0.3	115	3.0	2.4–3.5	560	19.3	17.7–21.0	471	71.3	65.0–78.1
Oral cavity and pharynx	7	0.1	0.0–0.2	94	2.4	2.0–3.0	335	11.5	10.3–12.8	136	20.6	17.3–24.4
Ovary	13	0.4	0.2–0.6	150	7.6	6.4–8.9	362	23.8	21.4–26.4	170	43.1	36.9–50.1
Pancreas	**	**	**	240†	6.2	5.4 – 7.0	1,109	38.2	36.0–40.5	644	97.5	90.1–105.4
Prostate	**	**	**	50†	2.6	1.9 – 3.4	653	47.2	43.7–51.0	1,004	377.5	354.5–401.6
Stomach*	10	0.1	0.1–0.3	123	3.2	2.6–3.8	377	13.0	11.7–14.4	280	42.4	37.6–47.7
Testis	10	0.3	0.1–0.5	11	0.6	0.3–1.0	**	**	**	**	**	**
Thyroid	**	**	**	15†	0.4	0.2 – 0.6	38	1.3	0.9–1.8	33	5.0	3.4–7.0
Uterus	**	**	**	90†	4.5	3.7 – 5.6	332	21.9	19.6–24.3	153	38.8	32.9–45.5

Abbreviation: CI means confidence interval

Symbols:
*Statistically significant trend. Significant increasing trend in age-specific rate with increasing age was determined using annual per cent change (see Appendix 2: Analysis)
**Suppressed due to small case count of less than six
†Count has been rounded to ensure confidentiality, and associated rate and confidence interval have been adjusted to reflect rounded count

Notes:

- Rates are per 100,000.
- Excludes cases with no age information.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (February 2023), Ontario Health (Cancer Care Ontario)

Mortality trends by sex and cancer type

This section describes the age-standardized mortality rates over time for select cancers (**Figure 3.5**), annual per cent changes and average annual per cent changes in the age-standardized mortality rates (**Table 3.7, Figure 3.6**). An annual per cent change is a measure that assesses the change over time of a rate. It represents the percentage increase or decrease per year in a specified time period over multiple years. This measure is used to examine short-term changes in the trend in rates over time. An average annual per cent change is a summary measure that allows the use of a single number to describe the *average* of the annual per cent changes over multiple years.

The age-standardized mortality rates from 1986 to 2020 for selected cancers are shown in **Figure 3.5**. These cancers represent the four most common cancers in Ontario (breast, prostate, lung and colorectal) (**Figure 3.5A**) and cancers with notably increasing or decreasing age-standardized mortality rates in recent years (**Figure 3.5B**).

Short-term changes in mortality trends by cancer type

The age-standardized mortality rate for all cancers combined in Ontario has been decreasing over the past few decades, with the drop in mortality accelerating in recent years (**Table 3.7**). From 1986 to 2001, the age-standardized mortality rate among males and females combined decreased by 0.6% per year and fell a further 1.5% per year from 2001 to 2020.

The decrease in mortality was greater for males than females. For males, the mortality rate decreased by 0.9% per year from 1986 to 2001 and then by 1.8% per year from 2001 to 2020. For females, the rate decreased by 0.3% per year from 1986 to 2002 and then by 1.4% per year from 2002 to 2020. This section examines some of the reasons for these changes in mortality trends.

Recent mortality trends for the four most commonly diagnosed cancers

BREAST CANCER

The age-standardized mortality rate for female breast cancer has been decreasing since the mid-1980s, first by 1.1% per year from 1986 to 1995, then by 2.5% per year from 1995 to 2012 and most recently by 1.5% per year from 2012 to 2020 (**Table 3.7, Figure 3.5A**). This decrease was likely due to:

- greater regular participation in mammography screening, especially after the introduction of Ontario's organized breast screening program in 1990 (126,127)
- improved treatment (128,129)
- the use of more effective systemic therapies after breast cancer surgery (130,131)

COLORECTAL CANCER

The colorectal cancer age-standardized mortality rate consistently decreased in males and females combined from 1986 to 2020, with the greatest decrease being in recent years (**Table 3.7, Figure 3.5A**). The mortality rate decreased by 3.1% per year from 2005 to 2020 among males and by 2.7% per year from 2004 to 2020 among females.

Reasons for this decrease in mortality may include changes in risk and protective factors, such as earlier diagnosis due to greater uptake of organized screening and follow-up of screened patients as well as improvements in treatment.(132,133)

LUNG CANCER

The age-standardized mortality rate for lung cancer among males and females combined has decreased over the past three decades in Ontario, at 1.1% per year from 1993 to 2012, then at 3.1% from 2012 to 2020 (**Table 3.7, Figure 3.5A**). In males, the age-standardized mortality rate for lung cancer decreased by 2.1% per year from 1986 to 2012, followed by a steeper decrease of 3.7% from 2012 to 2020 (**Table 3.7**). Among females, the mortality rate was stable from 1999 to 2008 and then began to decrease at 1.2% per year from 2008 to 2016, followed by a steeper decrease of 3.5% per year from 2016 to 2020.

The drop in lung cancer mortality is largely due to less tobacco use, which began to decrease in the late 1950s for males and in the mid-1970s for females.(104,134) This approximate 15-year gap in male and female peak smoking rates corresponds to the sex-based gap in the stabilization of lung cancer mortality rates.

PROSTATE CANCER

Following a period of significant increase by 1.4% per year from 1986 to 1994, the age-standardized mortality rate for prostate cancer decreased by 2.8% per year from 1994 to 2014 and then by 1.3% per year from 2014 to 2020 (**Table 3.7, Figure 3.5A**). This decrease was likely due to advances in diagnosis and improved treatments, which have increased prostate cancer survival.(135)

Notable changes in trends for other cancers

Cancers highlighted in this section had the largest, significant annual per cent changes (increasing or decreasing) in the most recent time period (see Appendix 2: Analysis for more details; **Table 3.7**, **Figure 3.5B**) or noteworthy trends in annual per cent changes in the most recent time period**.**

CERVICAL CANCER (Decreasing trend)

Despite the increasing incidence rates in recent years (see Chapter 2: Cancer Incidence), the age-standardized mortality rate for cervical cancer has continued to drop significantly over the past few decades at a rate of 2.4% per year from 1986 to 2020 (**Table 3.7, Figure 3.5B)**. Implementation of the Ontario Cervical Screening Program in 2000 likely contributed to the decreasing cervical cancer mortality in Ontario.(136) These decreasing mortality rates are consistent with other developed nations.(137)

HODGKIN LYMPHOMA (Decreasing trend)

The age-standardized mortality rate of Hodgkin lymphoma in males and females combined continued to decrease steadily over the past three decades at a rate of 3.2% per year from 1986 to 2020 (**Table 3.7, Figure 3.5B**), which is similar for males and for females. A similar decrease in mortality rates for Hodgkin lymphoma over the past decade occurred in other countries, more notably in high income countries, and is likely associated with advances and accessibility of treatment.(138)

LIVER CANCER (Noteworthy trend)

The liver cancer age-standardized mortality rate has been increasing in males and females combined from 1986 to 2012, and stabilized in the last decade (**Table 3.7, Figure 3.5B**). The male rate stabilized since 2007, following previous rapid upward trends in the mortality rate by 5.5% per year from 1986 to 1995 and by 1.5% per year from 1995 to 2007. The female mortality rate steadily increased by 2.5% per year from 1986 to 2020. This increase in mortality was probably at least partially due to a rise in incidence rate over the same period.

MELANOMA (Noteworthy trend)

Following a period of increase, the age-standardized mortality rate of melanoma decreased by 2.6% per year from 2013 to 2020 (**Table 3.7, Figure 3.5B**). This decrease was larger among females, with a rate of 3.5% per year from 2013 to 2020, while the male rates stabilized in recent years. This recent decrease in melanoma mortality rates is likely due to the availability of new, targeted immunotherapy treatments.(139)

PANCREATIC CANCER (Increasing trend)

In the most recent time period (1999 to 2020), the age-standardized mortality rate for pancreatic cancer increased significantly among males and females combined by 0.2% per year (**Table 3.7, Figure 3.5B**). This increase was largely driven by male rates where it increased by 0.6% per year from 2003 to 2020. In contrast, the female age-standardized mortality rate decreased by 1.0% per year from 2012 to 2020. This disparity is likely due to the higher incidence and increasing incidence rates of pancreatic cancer among males than females (see Chapter 2: Cancer Incidence).

UTERINE CANCER (Increasing trend)

The age-standardized mortality rate for uterine cancer increased by 1.3% per year from 1997 to 2020 (**Table 3.7, Figure 3.5B**). The incidence and mortality rates of uterine cancer have been on the rise in many jurisdictions, most notably in North America and Northern Europe.(140) The increase in uterine cancer mirrors the higher exposure to estrogen in women as a result of the increasing prevalence of overweight and obesity, which are risk factors for developing uterine cancer.(140)

Figure 3.5A Age-standardized mortality rates by cancer type for the four most common cancers, Ontario, 1986 to 2020

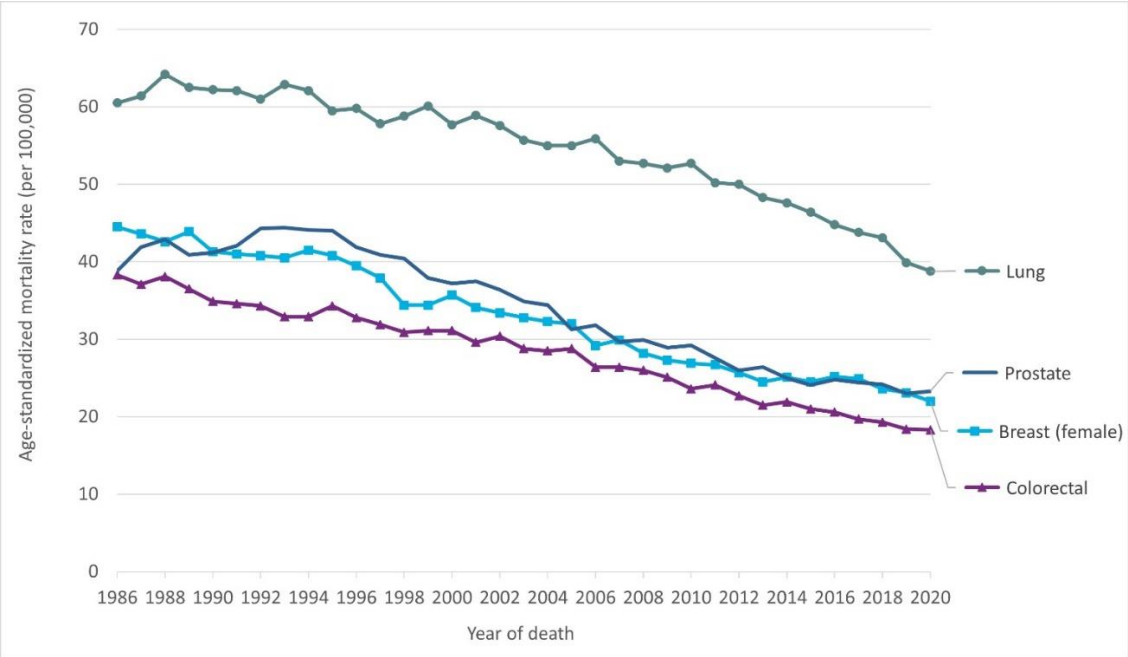
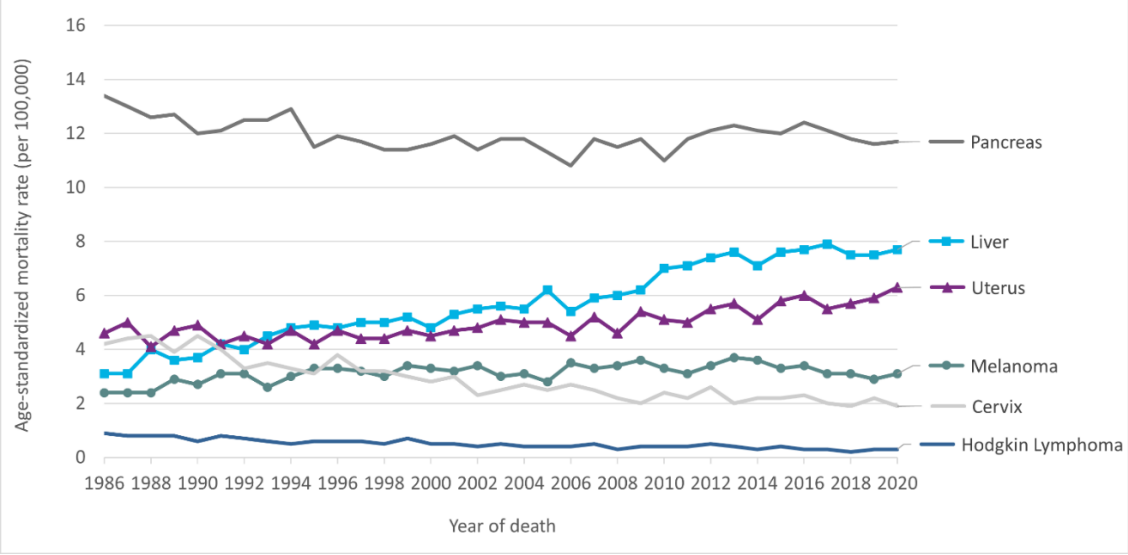


Figure 3.5B Age-standardized mortality rates by cancer type for cancers with notably increasing or decreasing recent trends, Ontario, 1986 to 2020



Notes:

- Rates are per 100,000 and standardized to the age distribution of the 2011 Canadian Standard population.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (February 2023), Ontario Health (Cancer Care Ontario)

Table 3.7 Annual per cent change in age-standardized mortality rates by cancer type and binary sex, Ontario, 1986 to 2020

Cancer type	Males and females combined – period	Males and females combined – APC	Males – period	Males – APC	Females – period	Females – APC
All cancers	**1986–2001**	**-0.6***	**1986–2001**	**-0.9***	**1986–2002**	**-0.3***
	2001–2020	**-1.5***	**2001–2020**	**-1.8***	**2002–2020**	**-1.4***
Bladder	1986–2016	-0.4*	1986–2016	-0.6*	1986–2006	0.3
	2016–2020	-4.5*	2016–2020	-4.2	2006–2020	-1.9*
Brain	1986–2006	-1.1*	1986–1995	-2.0*	1986–2006	-1.3*
	2006–2010	4.6	1995–2020	0.3*	2006–2011	4.5
	2010–2020	-0.8	n/a	n/a	2011–2020	-1.4*
Breast (female)	n/a	n/a	n/a	n/a	1986–1995	-1.1*
	n/a	n/a	n/a	n/a	1995–2012	-2.5*
	n/a	n/a	n/a	n/a	2012–2020	-1.5*
Cervix	n/a	n/a	n/a	n/a	1986–2020	-2.4*
Colorectal	1986–2004	-1.5*	1986–2005	-1.5*	1986–2004	-1.8*
	2004–2020	-2.8*	2005–2020	-3.1*	2004–2020	-2.7*
Esophagus	1986–2000	0.5	1986–2020	-0.1	1986–2020	-1.0*
	2000–2020	-0.6*	n/a	n/a	n/a	n/a
Hodgkin lymphoma	1986–2020	-3.2*	1986–2020	-3.1*	1986–2020	-3.3*
Kidney	1986–2008	-0.1	1986–2014	-0.4*	1986–2009	-0.2
	2008–2020	-1.9*	2014–2020	-3.5*	2009–2020	-2.6*
Larynx	1986–2009	-2.8*	1986–2009	-2.9*	1986–2020	-3.6*
	2009–2014	-8.0*	2009–2014	-8.6*	n/a	n/a
	2014–2020	1.5	2014–2020	2.5	n/a	n/a
Leukemia	1986–2013	-0.8*	1986–2013	-0.9*	1986–2020	-1.0*
	2013–2020	-2.1*	2013–2020	-2.6*	n/a	n/a
Liver	1986–1994	5.0*	1986–1995	5.5*	1986–2020	2.5*
	1994–2008	1.8*	1995–2007	1.5*	n/a	n/a
	2008–2012	5.7*	2007–2011	5.4	n/a	n/a
	2012–2020	0.3	2011–2020	0.2	n/a	n/a
Lung	1986–1993	0.1	1986–2012	-2.1*	1986–1999	2.0*
	1993–2012	-1.1*	2012–2020	-3.7*	1999–2008	0.1
	2012–2020	-3.1*	n/a	n/a	2008–2016	-1.2*
	n/a	n/a	n/a	n/a	2016–2020	-3.5*
Melanoma	1986–2013	1.0*	1986–2014	1.2*	1986–2013	0.6*
	2013–2020	-2.6*	2014–2020	-2.7	2013–2020	-3.5*

Cancer type	Males and females combined – period	Males and females combined – APC	Males – period	Males – APC	Females – period	Females – APC
Myeloma	1986–1999	0.3	1986–2020	-0.8*	1986–1999	0.6
	1999–2020	-1.3*	n/a	n/a	1999–2020	-1.8*
Non-Hodgkin lymphoma	1986–1999	1.8*	1986–1999	1.9*	1986–1998	1.9*
	1999–2020	-1.9*	1999–2020	-1.7*	1998–2020	-2.1*
Oral cavity and pharynx	1986–2008	-1.9*	1986–2006	-2.4*	1986–2020	-0.9*
	2008–2020	0.8	2006–2020	0.6	n/a	n/a
Ovary	n/a	n/a	n/a	n/a	1986–1999	-0.8*
	n/a	n/a	n/a	n/a	1999–2003	2.1
	n/a	n/a	n/a	n/a	2003–2007	-4.4
	n/a	n/a	n/a	n/a	2007–2020	-1.2*
Pancreas	1986–1999	-1.0*	1986–2003	-1.3*	1986–2008	-0.3*
	1999–2020	0.2*	2003–2020	0.6*	2008–2012	2.0
	n/a	n/a	n/a	n/a	2012–2020	-1.0*
Prostate	n/a	n/a	1986–1994	1.4*	n/a	n/a
	n/a	n/a	1994–2014	-2.8*	n/a	n/a
	n/a	n/a	2014–2020	-1.3*	n/a	n/a
Stomach	1986–1993	-4.4*	1986–2013	-2.9*	1986–1993	-4.6*
	1993–2020	-2.1*	2013–2020	-0.6	1993–2020	-2.0*
Testis	n/a	n/a	1986–2020	-1.3*	n/a	n/a
Thyroid	1986–2020	-0.1	1986–2020	0.7	1986–2020	-0.5
Uterus	n/a	n/a	n/a	n/a	1986–1997	-0.4
	n/a	n/a	n/a	n/a	1997–2020	1.3*

Abbreviations:
APC means annual per cent change
n/a means not applicable

Symbols:
*Statistically significant trend

Note:

- Rates are standardized to the age distribution of the 2011 Canadian Standard population.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (February 2023), Ontario Health (Cancer Care Ontario)

Thirty-five-year trend in mortality by cancer type

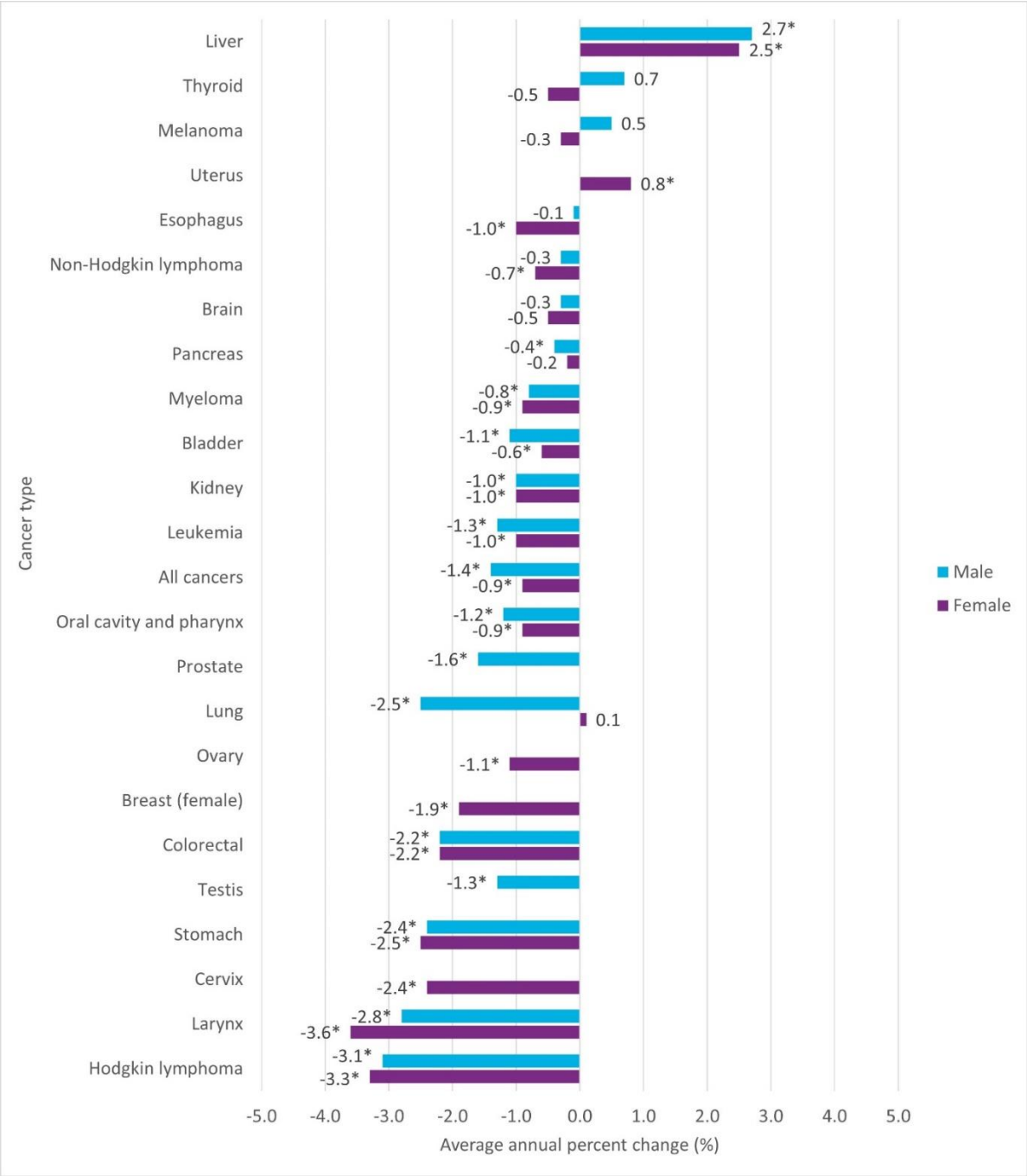
From 1986 to 2020, the average annual per cent change in the age-standardized mortality rate for males (**Figure 3.6**):

- increased for liver cancer (2.7% per year)
- was stable for brain, thyroid and esophageal cancers, as well as for non-Hodgkin lymphoma and melanoma
- decreased for most types of cancer, including Hodgkin lymphoma (3.1% per year), laryngeal cancer (2.8%), lung cancer (2.5%) and stomach cancer (2.4%)

Over the same period, the average annual per cent change for females:

- increased for liver (2.5% per year) and uterine (0.8%) cancers
- was stable for brain, lung, thyroid and pancreatic cancers, as well as for melanoma
- decreased for most types of cancer, including laryngeal (3.6% per year), stomach (2.5%) and cervical (2.4%) cancers, as well as for Hodgkin lymphoma (3.3%)

Figure 3.6 Average annual per cent change in age-standardized mortality rates by cancer type and binary sex, Ontario, 1986 to 2020



Symbol: *Statistically significant trend

Note:

- Rates are standardized to the age distribution of the 2011 Canadian Standard population.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (February 2023), Ontario Health (Cancer Care Ontario)

Mortality trends by age

This section describes annual per cent changes in the age-standardized mortality rates for all cancers combined by age group in Ontario (**Figure 3.7**). An annual per cent change is a measure that assesses the change over time of a rate. It represents the percentage increase or decrease per year in a specified time period over multiple years and is used to examine short-term changes in the trend in rates over time.

Mortality rates across all age groups have been generally decreasing in recent decades. In people over age 60, they have decreased fairly equally for males and females. However, among people under age 60, the decreases in mortality follow different trends for males and females (**Figure 3.7**).

Ages zero to 39

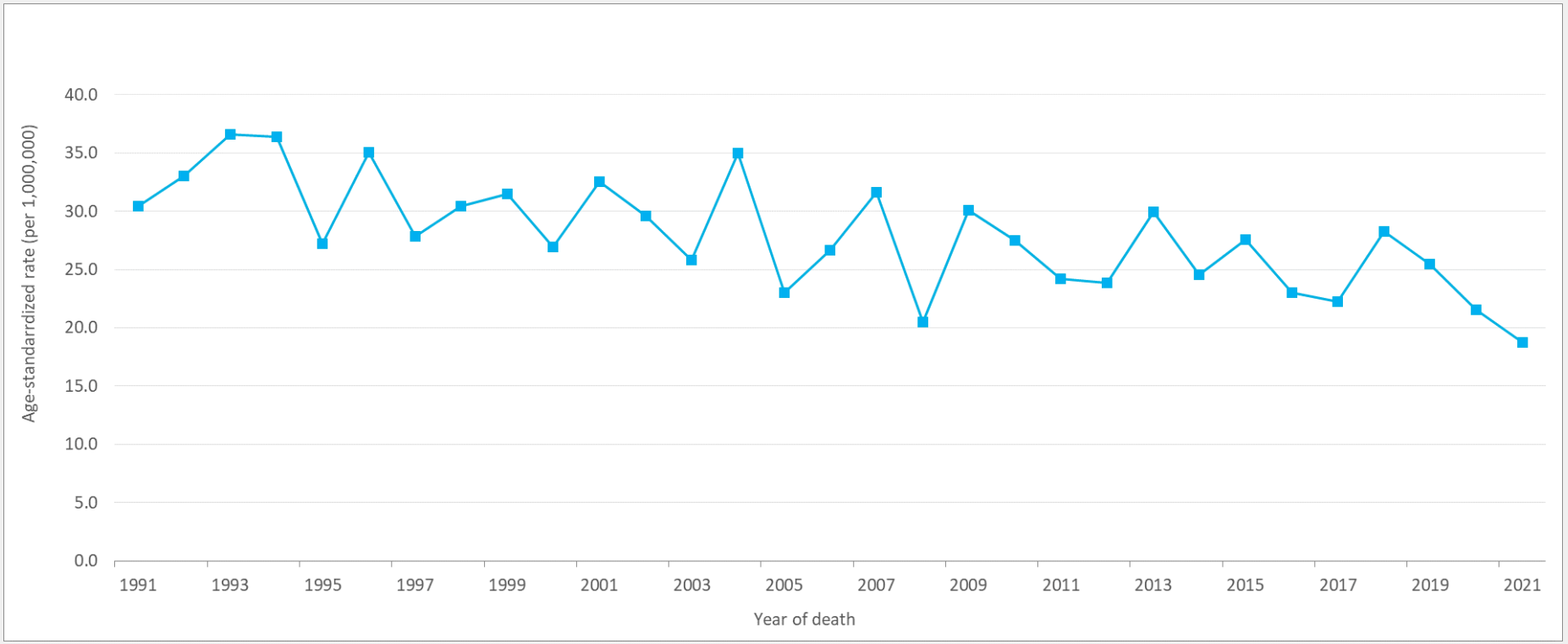
While incidence rates have been increasing among younger people, mortality rates are stable or decreasing. Among males under age 40, the mortality rate decreased by 1.6% per year from 1986 to 2020 (**Figure 3.7**). Among females in this age group, mortality rates decreased by 0.9% per year from 1986 to 2001 and were stable from 2001 to 2020.

Age-standardized mortality rates among children with cancer (ages zero to 14 years) decreased from 1991 to 2021 by an average of 1.3% per year (see **Spotlight: Childhood Cancer Mortality Trend, Figure 3.S1**).

For more details on childhood cancer mortality trends, read the Pediatric Oncology Group of Ontario surveillance report.

Spotlight: Childhood Cancer Mortality Trend

Figure 3.S1 Age-standardized mortality rates of cancer in children, all cancers combined, ages zero to 14 years, Ontario, 1991 to 2021



Time period	APC (%)
1991–2021	-1.3*

Abbreviation: APC means annual per cent change

Symbol: *Statistically significant trend

Note:

- Rates are per 1,000,000.
- Includes cases diagnosed since 1986 to align with Pediatric Oncology Group of Ontario Networked Information System (POGONIS) data capture.

Analysis by: Health Analytics, Pediatric Oncology Group of Ontario
Data source: POGONIS (May 11, 2023), Pediatric Oncology Group of Ontario

Ages 40 to 59

Among people ages 40 to 59, the cancer mortality rate decreased overall from 1986 to 2020, but the trends over this time period differed for males and for females (**Figure 3.7**). Among males, the mortality rate decreased by 1.2% per year from 1998 to 2016, followed by a steeper decrease of 3.0% per year from 2016 to 2020. In contrast, the mortality rate among females decreased steadily by 1.3% per year from 1997 to 2020.

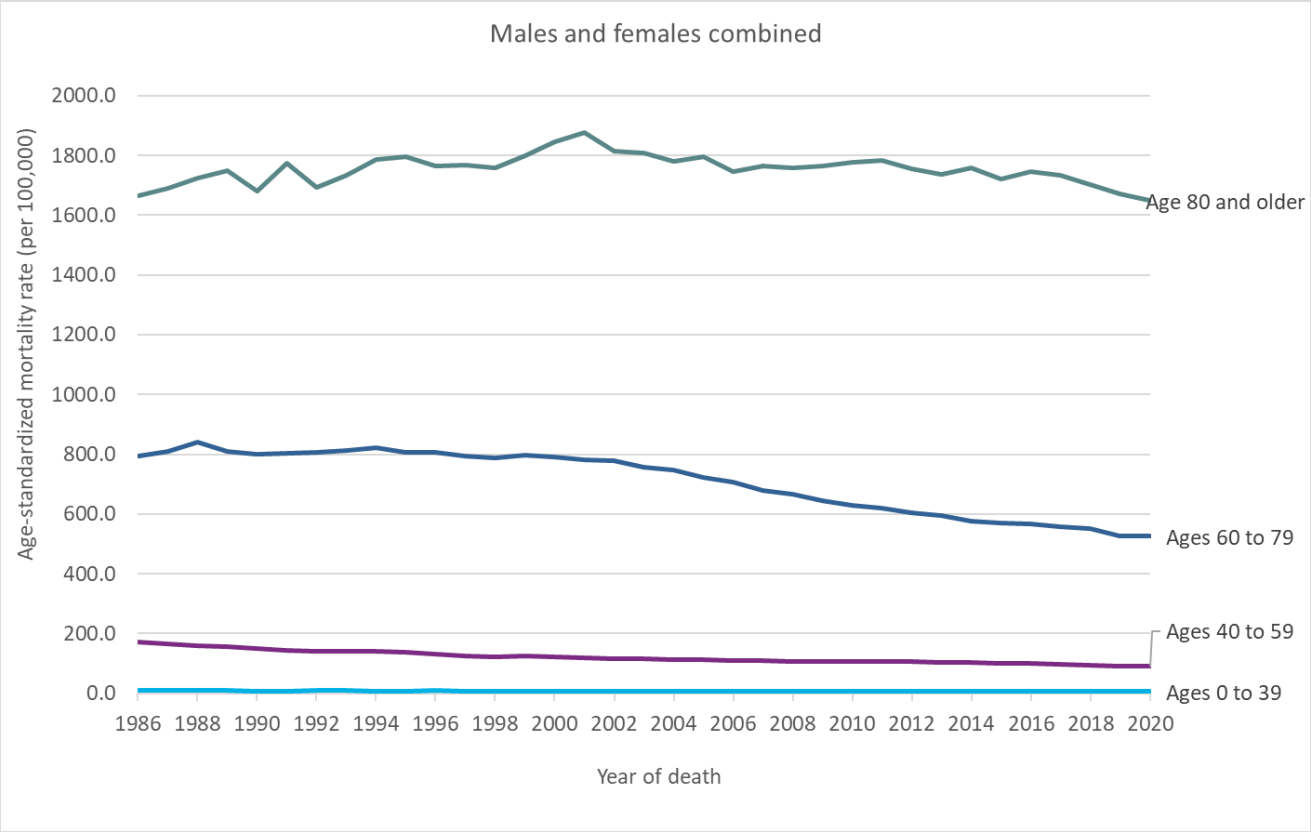
Ages 60 to 79

For people ages 60 to 79, the cancer mortality rate decreased by 0.2% per year from 1986 to 2002, then by 2.8% per year from 2002 to 2010 and finally by 1.8% per year from 2010 to 2020 (**Figure 3.7**). Similar trends were seen separately for males and for females over these time periods.

Age 80 and older

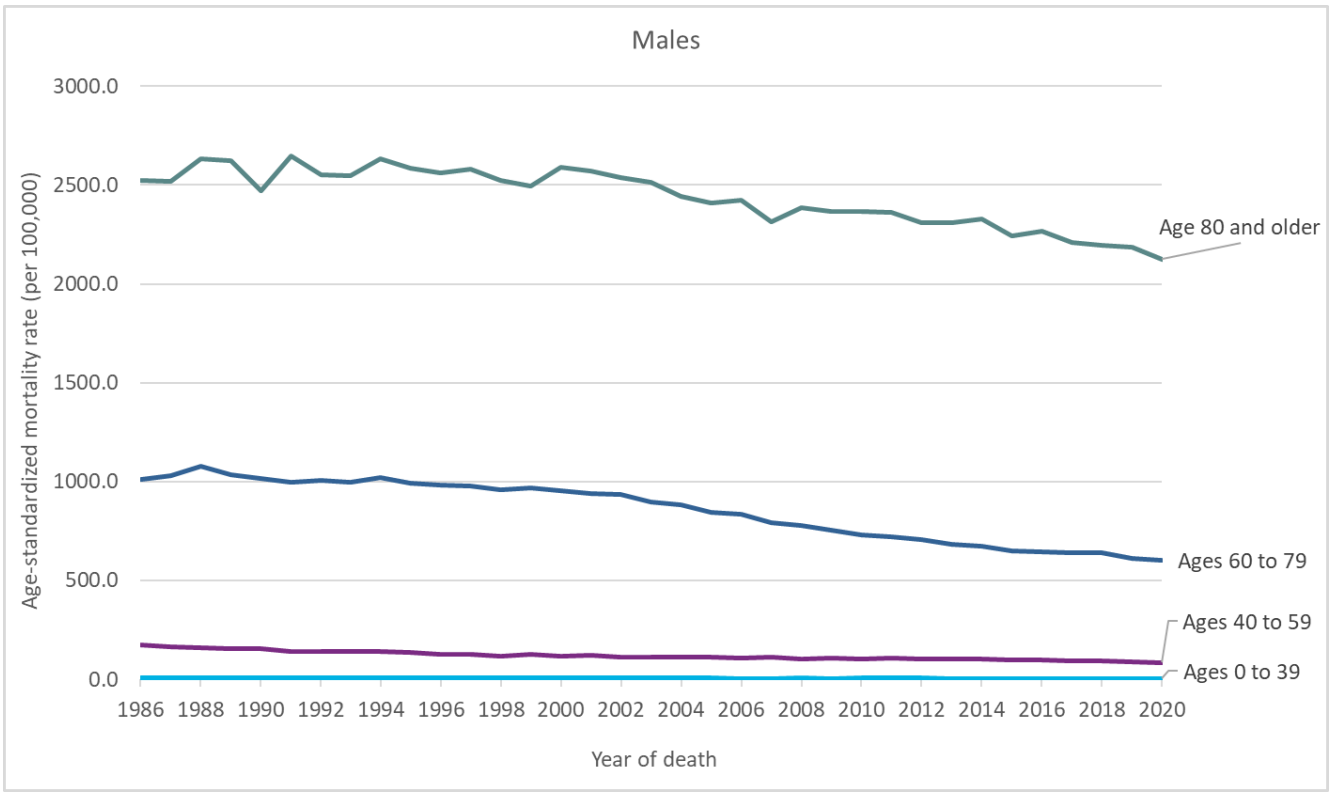
In people age 80 and older, the cancer mortality rate increased by 0.5% per year from 1986 to 2001 and then began decreasing, first by 0.3% per year from 2001 to 2016 and then by 1.2% per year from 2016 to 2020 (**Figure 3.7**). The decrease in mortality rate was greater in males than females, at 0.8% per year from 2000 to 2020 among males and 0.3% per year from 2001 to 2020 among females.

Figure 3.7 Age-standardized mortality rates and annual per cent change in age-standardized mortality rates by binary sex and age group, Ontario, 1986 to 2020



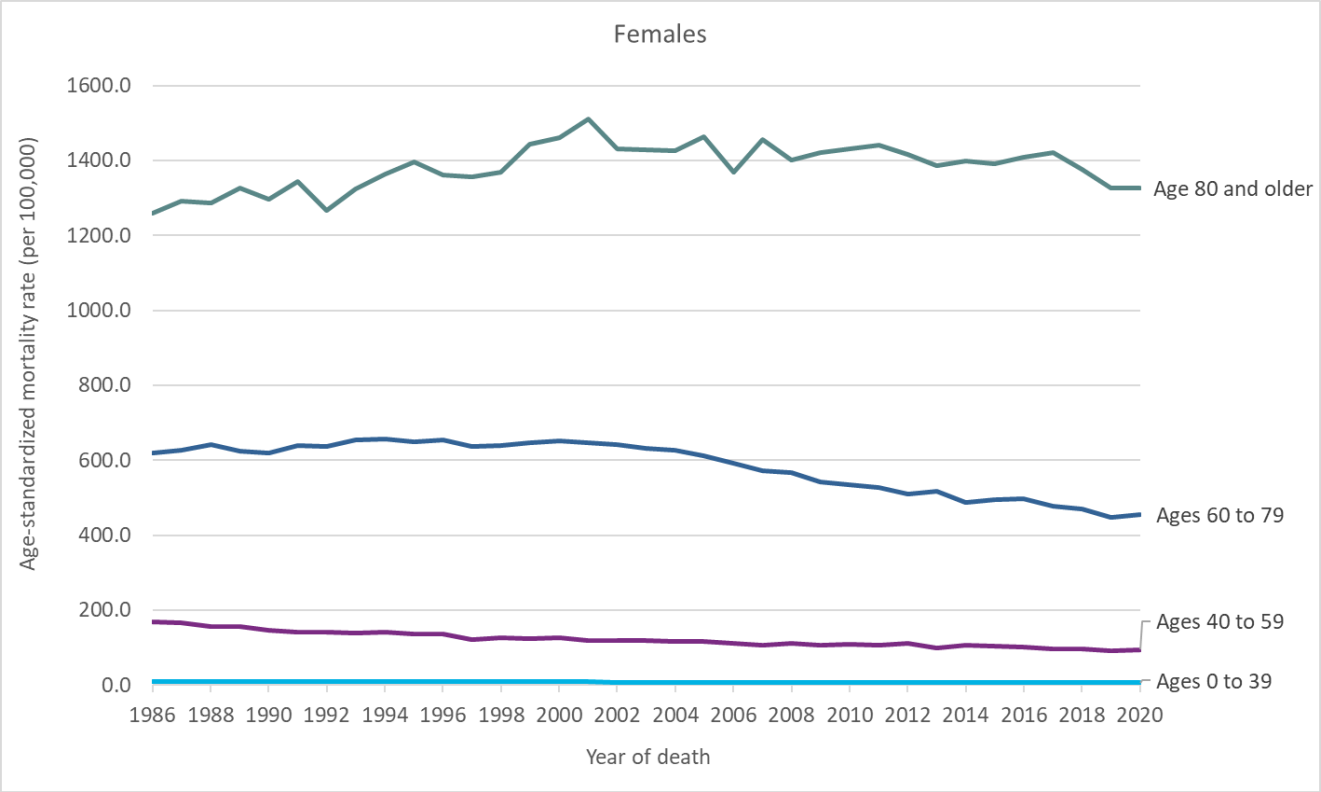
Males and Females Combined APC

Ages 0 to 39		Ages 40 to 59		Ages 60 to 79		Age 80 and older	
PERIOD	**APC**	**PERIOD**	**APC**	**PERIOD**	**APC**	**PERIOD**	**APC**
1986–2000	-1.1*	1986–1991	-3.4*	1986–2002	-0.2*	1986–2001	0.5*
2000–2006	-3.5*	1991–2006	-1.8*	2002–2010	-2.8*	2001–2016	-0.3*
2006–2020	-0.6	2006–2014	-0.7*	2010–2020	-1.8*	2016–2020	-1.2*
		2014–2020	-2.3*				



Males APC

Ages 0 to 39		Ages 40 to 59		Ages 60 to 79		Age 80 and older	
PERIOD	**APC**	**PERIOD**	**APC**	**PERIOD**	**APC**	**PERIOD**	**APC**
1986–2020	-1.6*	1986–1998	-2.8*	1986–2001	-0.6*	1986–2000	-0.1
		1998–2016	-1.2*	2001–2013	-2.8*	2000–2020	-0.8*
		2016–2020	-3.0*	2013–2020	-1.6*		



Females APC

Ages 0 to 39		Ages 40 to 59		Ages 60 to 79		Age 80 and older	
PERIOD	**APC**	**PERIOD**	**APC**	**PERIOD**	**APC**	**PERIOD**	**APC**
1986–2001	-0.9*	1986–1997	-2.4*	1986–2002	0.2*	1986–2001	1.0*
2001–2006	-4.9	1997–2020	-1.3*	2002–2010	-2.5*	2001–2020	-0.3*
2006–2015	0.8			2010–2020	-1.6*		
2015–2020	-3.6						

Abbreviation: APC means annual per cent change

Symbol: *Statistically significant trend

Note:

- Rates are per 100,000 and standardized to the age distribution of the 2011 Canadian Standard population.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (February 2023), Ontario Health (Cancer Care Ontario)

Ch 4: Cancer Survival

Relative cancer survival refers to the likelihood that someone diagnosed with cancer will survive for a certain amount of time compared with similar people in the general population. On the other hand, overall cancer survival refers to the percentage of people that survive their cancer for a certain amount of time among the total number of people diagnosed. This chapter focuses on five-year relative cancer survival for adults and five-year overall cancer survival for children in Ontario.

Survival overview

Survival statistics are a key indicator of population-level prognosis, as well as the effectiveness of cancer control programs.(141) Relative survival ratios compare the likelihood of surviving for a certain amount of time (e.g., one, three or five years) after a cancer diagnosis to the likelihood of survival in similar people (i.e., same age and sex) from the general population for the same amount of time.

The first five years after diagnosis are critical for examining survival because these years are when someone is most likely to access health care services, including primary treatment and clinical assessment for recurrence. After five years, use of the health care system and the chance of recurrence decrease.

Cancer survival depends on factors such as cancer type, sex, age at diagnosis, stage at diagnosis and type of treatment. Relative survival ratios represent the average survival expected for a group of people with a certain type of cancer, so these statistics will not reflect the prognosis of every individual. An individual's survival can also depend on their health status, the presence of comorbidities, and other personal and tumour-related factors. Survival estimates are based on data from people diagnosed in the past, which means the estimates may not reflect the impact of more recent advances in cancer detection and treatment. In addition, relative survival does not distinguish between people who no longer have evidence of cancer from those who have relapsed or are still under treatment. As a result, all of these groups of people contribute survival time to the same survival statistics.

Survival improves over time due to better methods for (and the greater use of) early detection, including screening, and more effective treatments. Even small improvements in survival rates can, at the population level, represent large numbers of people who avoid premature death.(142) Improvements in survival may also be the result of increased incidence through improved early detection. However, catching cancers earlier than they would normally be found may result in a lead time bias.(143) Lead time bias is a theoretical concept that refers to the time difference between

when a cancer is detected earlier by screening and when it would have been diagnosed by clinical (i.e., symptoms) presentation without affecting the course of the disease. This bias may cause an artificial improvement of cancer survival statistics (adjusting for lead time bias is considered during the evaluation of a new cancer screening method to ensure it is effective).

Statistics by sex in this chapter refer to sex data that are binary and assigned at birth. For more information, refer to About This Report: Statistics by sex.

Survival by sex and cancer type

From 2016 to 2020, the five-year relative survival ratio for all cancers combined was 67.3% (**Table 4.1**), which means people diagnosed with cancer during this period were 67.3% as likely to survive at least five years after diagnosis compared with similar people in the general population.

In males and females combined, five-year survival was:

- highest for thyroid cancer (97.9%), melanoma (88.3%) and Hodgkin lymphoma (87.7%)
- lowest for pancreatic (15.1%), esophageal (19.4%), liver (23.0%) and lung (28.7%) cancers, mainly because most of these cancers (with the exception of liver cancer) are diagnosed at an advanced stage (144)

For cancers with high mortality rates (particularly pancreatic cancer), relative survival estimates are generally higher in Ontario than in other provinces, possibly due to differences in survival methodology. Ontario's methodology assumes that people who are lost to follow-up are still alive at the cut-off date of five years after diagnosis, which can result in an overestimation of survival.(145) Work is underway to adjust Ontario data for cases lost to follow-up. For high-mortality cancers, being alive longer than five years is very unlikely. Therefore, survival estimates for pancreatic, esophageal, liver and lung cancers should be interpreted with caution, especially when comparing with other jurisdictions.

There was wide variation in the five-year relative survival ratio for the following groupings within cancer types (**Table 4.1**):

- malignant compared with non-malignant brain cancers
- different subtypes of leukemia
- cutaneous compared with non-cutaneous melanoma
- endometrial compared with uterine sarcoma
- small cell compared with other types of lung cancer
- anaplastic compared with other types of thyroid cancer

Male survival from 2016 to 2020 (64.9%) was significantly lower than female survival (69.7%), which is a gap that has been widening over time. This difference likely results from generally higher survival ratios in females than males for cancer types found in all people, particularly for lung cancer, which is the leading cause of cancer death in Ontario.

For males, five-year survival was:

- highest for thyroid (95.9%), testicular (95.9%) and prostate (92.6%) cancers
- lowest for pancreatic (14.5%), esophageal (19.9%) and liver (23.7%) cancers

For females, five-year survival was:

- highest for thyroid cancer (98.6%), melanoma (92.0%), breast cancer (89.6%) and Hodgkin lymphoma (89.6%)
- lowest for pancreatic (15.9%), esophageal (17.9%) and liver (21.6%) cancers

There were differences between males and females in five-year survival for multiple cancer types. Some notable ones (excluding subtypes) include:

- Lung cancer survival was significantly higher in females (33.5%) than males (23.8%). One reason for this difference may be that males are more likely to have more aggressive lung cancer types, which have lower survival and are more likely to be diagnosed at a later stage.(146,147)
- Survival for melanoma of the skin was significantly higher in females (92.0%) than males (85.4%). Lower survival among males is due to sex-specific differences that make this cancer more likely to spread in males.(148–150) Recent research also suggests that the expression of the PR70 protein, which is linked to the X-chromosome and expressed in higher amounts among females, may suppress melanoma tumours.(151)
- Bladder cancer survival in females is lower (75.4%) than in males (79.4%), possibly because:
    - females are typically diagnosed at a more advanced stage than males
    - there are differences in how males and females metabolize carcinogens
    - there is a greater presence of sex steroids in females that could affect the progression of this cancer (152,153)

Table 4.1 Five-year relative survival ratios by cancer type and binary sex, Ontario, 2016 to 2020

Cancer type	Males and females combined – RSR (%)	Males and females combined – 95% CI	Males – RSR (%)	Males – 95% CI	Females – RSR (%)	Females – 95% CI
All cancers	**67.3**	**67.1–67.5**	**64.9**	**64.5–65.2**	**69.7**	**69.4–70.0**
Brain and other nervous system – malignant	26.8	25.1–28.5	26.0	23.8–28.3	27.9	25.3–30.5
Glioblastoma	6.3	5.2–7.7	6.3	4.7–8.1	6.3	4.5–8.4
All other gliomas	58.4	54.6–62.0	56.6	51.4–61.4	60.7	55.0–65.9
Brain and other nervous system – non-malignant	85.9	84.7–87.0	82.6	80.6–84.5	88.1	86.6–89.4
Meningiomas	93.3	91.3–94.9	86.7	82.0–90.1	96.0	93.7–97.4
Pituitary, pineal and craniopharyngeal duct	91.6	89.3–93.4	90.1	86.3–92.8	93.1	90.1–95.2
Breast (female)	n/a	n/a	n/a	n/a	89.6	89.1–90.1
Cervix	n/a	n/a	n/a	n/a	74.7	72.3–76.9
Ovary	n/a	n/a	n/a	n/a	49.4	47.6–51.3
Prostate	n/a	n/a	92.6	92.0–93.2	n/a	n/a
Testis	n/a	n/a	95.9	94.4–97.1	n/a	n/a
Uterus	n/a	n/a	n/a	n/a	81.7	80.6–82.7
Uterus – endometrial	n/a	n/a	n/a	n/a	84.3	83.2–85.3
Uterus – uterine sarcoma	n/a	n/a	n/a	n/a	52.4	45.2–59.1
Colorectal	65.0	64.2–65.8	64.6	63.5–65.7	65.5	64.3–66.7
Colon excluding rectum	64.3	63.3–65.3	63.9	62.5–65.3	64.7	63.2–66.1
Colon – left sided	67.6	66.0–69.1	67.8	65.7–69.8	67.3	64.9–69.6
Colon – right sided	65.6	64.3–66.9	64.6	62.7–66.5	66.6	64.8–68.4
Rectum and rectosigmoid junction	65.8	64.5–67.1	65.1	63.4–66.8	66.9	64.8–68.9
Rectosigmoid junction	59.0	56.3–61.6	58.9	55.3–62.3	59.0	54.8–63.0
Rectum	67.9	66.4–69.4	66.9	64.9–68.7	69.6	67.2–71.9
Esophagus	19.4	17.7–21.3	19.9	17.8–22.1	17.9	14.5–21.6
Esophagus – adenocarcinoma	21.6	19.2–24.0	22.2	19.6–25.0	17.5	12.3–23.3
Esophagus – squamous cell carcinoma	16.9	13.7–20.2	15.5	11.7–19.7	18.7	13.6–24.3
Liver	23.0	21.4–24.6	23.7	21.8–25.7	21.6	18.9–24.5
Pancreas	15.1	14.1–16.2	14.5	13.0–16.0	15.9	14.3–17.5
Stomach	33.6	32.0–35.3	31.4	29.4–33.4	37.6	34.8–40.3

Cancer type	Males and females combined – RSR (%)	Males and females combined – 95% CI	Males – RSR (%)	Males – 95% CI	Females – RSR (%)	Females – 95% CI
Larynx	61.8	58.2–65.2	62.1	58.2–65.8	60.2	50.9–68.4
Oral cavity and pharynx	64.7	63.1–66.3	63.7	61.7–65.5	67.2	64.2–70.1
Hypopharynx	30.6	23.9–37.5	31.9	24.4–39.7	25.7	12.6–41.0
Lip and oral cavity	66.5	64.1–68.8	64.1	60.9–67.0	70.6	66.7–74.2
Nasopharynx	69.1	62.9–74.5	67.7	60.1–74.2	72.3	60.7–81.0
Oropharynx	66.1	63.6–68.5	67.0	64.1–69.6	62.7	57.0–67.9
Thyroid	97.9	97.3–98.4	95.9	94.4–97.0	98.6	97.9–99.0
Thyroid – anaplastic	22.1	11.7–34.4	11.8	3.0–27.3	†	†
Thyroid – follicular	96.9	91.2–99.0	94.7	76.1–98.9	97.2	91.3–99.1
Thyroid – medullary	83.7	73.4–90.3	70.4	50.9–83.3	91.6	78.8–96.8
Thyroid – papillary	99.7	98.9–99.9	99.0	97.2–99.6	99.8	97.6–100.0
Leukemia	62.4	61.0–63.8	63.1	61.2–64.9	61.3	59.0–63.4
Acute lymphocytic leukemia	73.8	69.9–77.2	76.0	70.9–80.4	71.1	65.0–76.4
Acute monocytic leukemia	21.2	12.9–30.9	12.1	4.8–23.0	33.4	18.0–49.5
Acute myeloid leukemia	26.9	24.7–29.2	25.5	22.5–28.7	28.4	25.1–31.8
Chronic lymphocytic leukemia	89.9	87.7–91.8	88.8	85.9–91.2	91.8	88.1–94.4
Chronic myeloid leukemia	64.2	60.2–67.9	60.2	54.9–65.1	69.8	63.5–75.2
Lymphoma	71.7	70.7–72.7	70.6	69.2–71.9	73.1	71.7–74.5
Hodgkin lymphoma	87.7	85.3–89.7	86.1	82.6–88.9	89.6	86.0–92.3
Non-Hodgkin lymphoma	70.1	69.0–71.1	69.0	67.6–70.4	71.4	69.8–72.9
Non-Hodgkin lymphoma – extranodal	68.6	67.1–70.0	67.7	65.6–69.6	69.6	67.4–71.8
Non-Hodgkin lymphoma – nodal	71.6	70.1–73.1	70.6	68.5–72.5	73.0	70.7–75.1
Myeloma	55.2	53.2–57.1	54.0	51.3–56.6	56.5	53.6–59.3
Melanoma of the skin	88.3	87.3–89.3	85.4	83.9–86.8	92.0	90.6–93.2
Melanoma (non-cutaneous)	70.8	65.4–75.5	74.1	65.8–80.7	67.3	59.9–73.7
Melanoma – mucosal	48.8	37.7–59.0	82.6	50.2–94.9	38.3	26.9–49.6
Melanoma – ocular	78.4	72.3–83.4	73.3	64.4–80.3	83.9	75.2–89.8
Lung	28.7	28.1–29.4	23.8	22.9–24.6	33.5	32.6–34.4
Lung – adenocarcinoma	32.4	31.4–33.4	26.8	25.4–28.2	36.9	35.6–38.3
Lung – large cell	27.6	22.5–32.9	26.8	19.8–34.2	27.9	20.6–35.6
Lung – small cell	9.9	8.7–11.3	8.0	6.4–9.8	11.9	10.0–14.0
Lung – squamous cell	26.0	24.5–27.5	24.2	22.3–26.1	28.8	26.3–31.3

Cancer type	Males and females combined – RSR (%)	Males and females combined – 95% CI	Males – RSR (%)	Males – 95% CI	Females – RSR (%)	Females – 95% CI
Bladder	78.5	77.4–79.6	79.4	78.1–80.7	75.4	73.2–77.5
Kidney	78.7	77.5–80.0	79.1	77.5–80.6	78.0	75.9–80.0

Abbreviations:
CI means confidence interval
RSR means relative survival ratio
n/a means not applicable

Symbol: †Estimate could not be calculated

Notes:

- The analysis was restricted to people ages 15 to 99.
- Bladder cancer includes carcinoma *in situ* cases.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (December 2022), Ontario Health (Cancer Care Ontario)

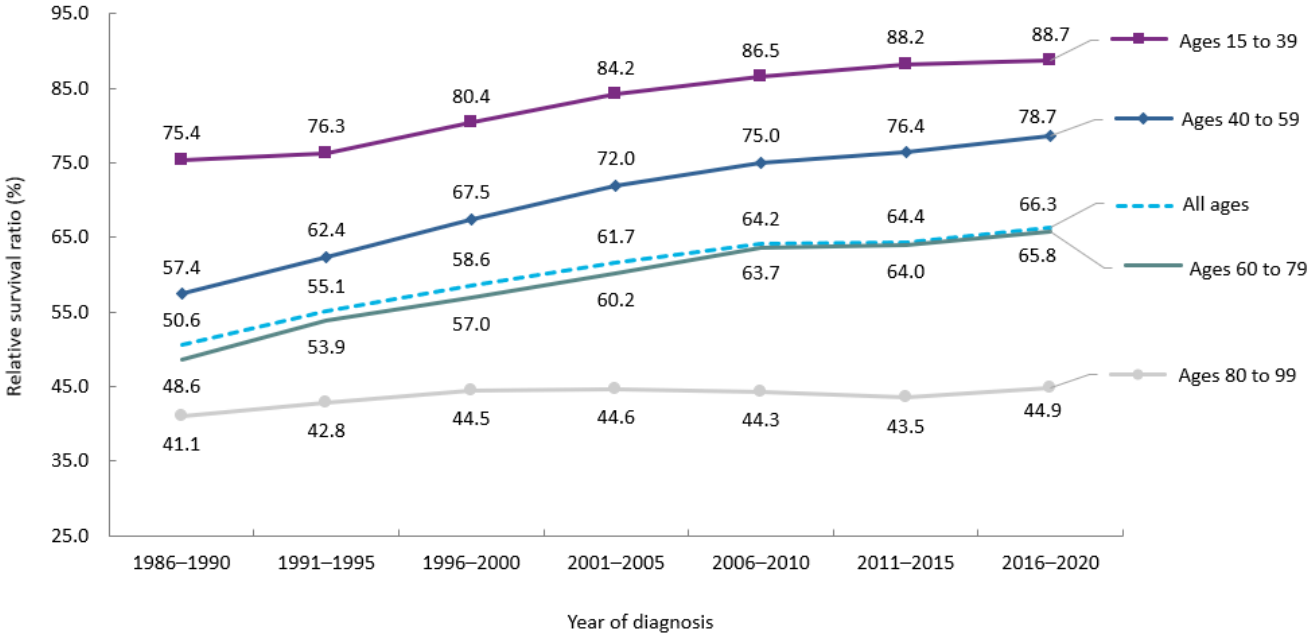
Survival by age

From the 1986–1990 period to the 2016–2020 period, the five-year age-standardized relative survival ratio for all ages and cancers combined rose from 50.6% to 66.3% (**Figure 4.1**).

As in previous periods, the five-year relative survival ratio for all cancers combined in the 2016–2020 period decreased with advancing age. For example, the relative survival ratio was 88.7% for people diagnosed at ages 15 to 39, but just 44.9% for those diagnosed at ages 80 to 99.

People diagnosed at ages 80 to 99 saw little improvement in five-year survival from the 1986–1990 period to the 2016–2020 period. This lack of improvement is mainly because people in this age group are more likely to have comorbidities and less likely to receive aggressive treatment for cancer. People diagnosed at ages 40 to 79 showed the greatest improvement in five-year relative survival. As a result, the gap in survival between the oldest age group and the younger age groups widened over time. A European study comparing people ages 55 to 69 with those ages 70 to 84 showed that the greater improvements in survival among people under age 80 may partly be due to the greater use of population-based screening programs for breast and colorectal cancers, and use of the prostate-specific antigen test for prostate cancer.(154)

Figure 4.1 Five-year relative survival ratios by age group and time period, Ontario, from the 1986–1990 period to the 2016–2020 period



Notes:

- The analysis was restricted to people ages 15 to 99.
- The International Agency for Research on Cancer/International Association of Cancer Registries multiple primary rules were used for selecting cases.
- This analysis includes carcinoma *in situ* cases for bladder cancer.
- The period method was used to derive relative survival ratios for the 2016–2020 period. The cohort method was used for all other periods.

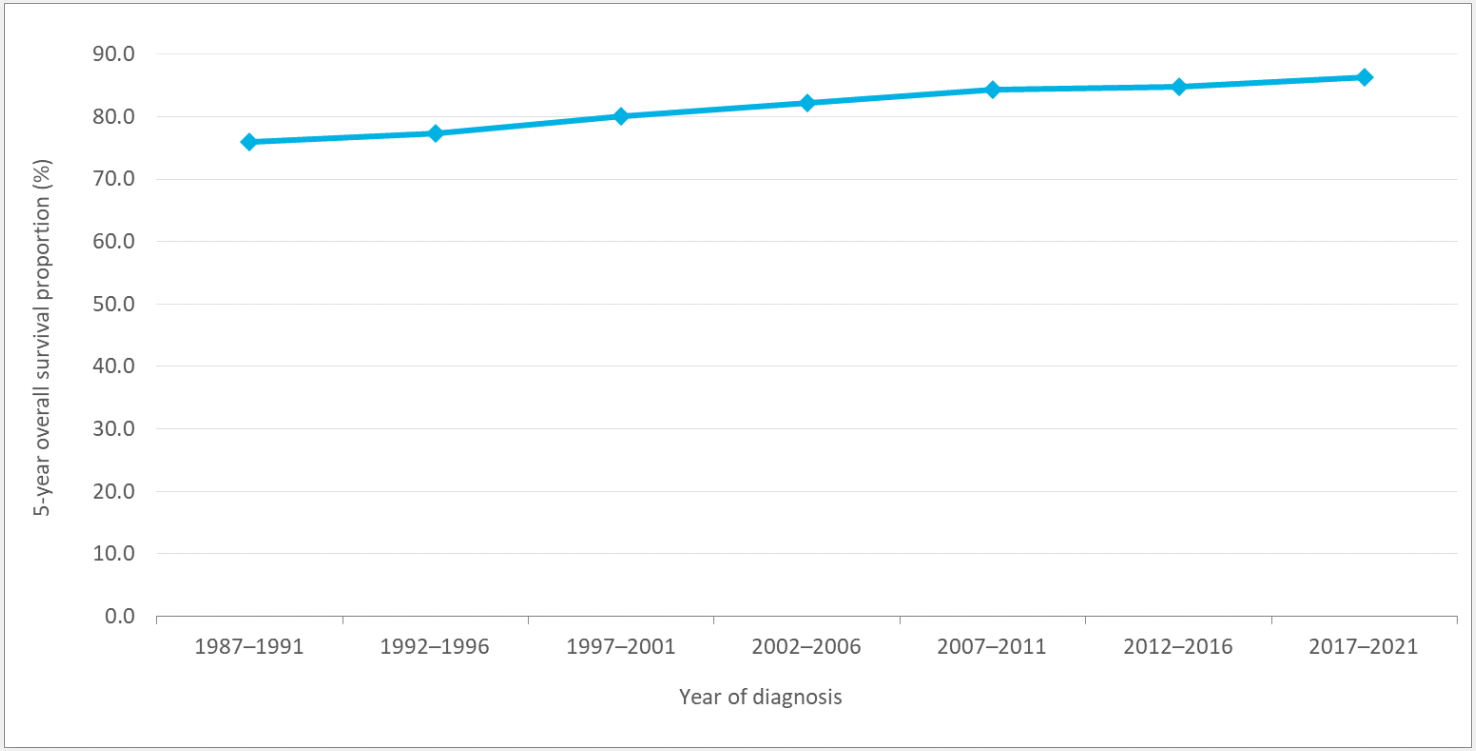
Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (December 2022), Ontario Health (Cancer Care Ontario)

In Ontario, 86.3% of children ages zero to 14 years diagnosed with cancer from 2017 to 2021 were estimated to survive five years (i.e., five-year overall survival proportion). Overall survival proportion is an estimate of the probability of surviving all causes of death. Children with cancer continued to experience gains in survival, with the five-year overall survival proportion increasing from 76.0% during the 1987–1991 period to 86.3% in the latest five-year period (2017–2021) (see **Spotlight: Childhood Cancer Survival Trend, Figure 4.S1**).

For more details on childhood cancer survival trends, read the Pediatric Oncology Group of Ontario surveillance report.

Spotlight: Childhood Cancer Survival Trends

Figure 4.S1 Five-year overall survival proportions of children with cancer, all cancers combined, ages zero to 14 years, Ontario, from the 1987–1991 period to the 2017–2021 period



Notes:

- The cohort method was used to derive five-year overall survival proportions for cases with a first primary cancer diagnosed from 1987 to 2016; the period method was used to derive five-year overall survival proportions for cases diagnosed in 2017–2021.
- Overall survival proportions do not adjust for the expected survival of the general population of children in Ontario who are the same age and sex during the same period.

Analysis by: Health Analytics, Pediatric Oncology Group of Ontario
Data source: POGONIS (May 11, 2023), Pediatric Oncology Group of Ontario

Survival trends by cancer type

The five-year relative survival ratio for all cancers combined in Ontario increased each decade from 1986 to 2020, but the magnitude of increase dropped from 2006–2010 to 2016–2020, compared with previous periods. More specifically, of the 15.7 percentage point increase from 1986 to 2020, the largest improvement in survival of 8.0 percentage points occurred from the 1986–1990 period to the 1996–2000 period, compared with only 2.1 percentage points from the 2006–2010 period to the 2016–2020 period (**Table 4.2**). From the 1986–1990 period to the 2016–2020 period, most cancers experienced increases in survival (**Table 4.2**, **Figure 4.2**).

There were notable gains in survival for many cancer types including the following (**Table 4.2**):

- myeloma (a 27.3 percentage point increase)
- kidney cancer (23.3)
- leukemia (21.9)
- lymphoma (21.7)
- nasopharynx (19.6) and oropharynx (28.4)
- prostate (18.4)
- rectum and rectosigmoid junction (17.6)
- lung (15.7)
- liver (14.2)
- colorectal (13.9)
- stomach (13.2)
- breast (12.3)
- thyroid (11.6)
- pancreas (10.6)

There were downward trends in survival for some cancers including the following:

- extranodal non-Hodgkin lymphoma (a 14.9 percentage point decrease)
- bladder (7.6, for malignant cases only)
- lip and oral cavity (1.6)
- uterus (1.4)

When comparing colorectal cancer subsites, the rectal cancer survival ratio was lower than the colon cancer survival ratio in the 1986–1990 period. Survival for both subsites increased over time, but the disparity in survival between the subsites decreased, with rectal cancer survival catching up to colon cancer survival by the 2016–2020 period.

Similarly, survival ratios for the oral cavity and pharynx cancer subsites became increasingly similar over time and were approximately the same by the 2016–2020 period, with the exception of hypopharynx.

In the 2016–2020 period, non-Hodgkin lymphoma survival also approached the survival of Hodgkin lymphoma, even though Hodgkin lymphoma still had a higher relative survival ratio.

Table 4.2 Age-standardized five-year relative survival ratios by cancer type and time period, Ontario, from the 1986–1990 period to the 2016–2020 period

Cancer type	1986–1990 – RSR (%)	1986–1990 – 95% CI	1996–2000 – RSR (%)	1996–2000 – 95% CI	2006–2010 – RSR (%)	2006–2010 – 95% CI	2016–2020 – RSR (%)	2016–2020 – 95% CI
All cancers	50.6	50.4–50.9	58.6	58.4–58.8	64.2	64.0–64.4	66.3	66.1–66.6
Brain and other nervous system – malignant	26.3	24.9–27.8	30.7	29.3–32.0	32.0	30.8–33.3	30.1	28.4–31.8
Glioblastoma	5.6	4.2–7.4	7.5	5.9–9.2	8.7	7.0–10.6	11.8	9.2–14.6
All other gliomas	27.8	25.4–30.2	35.4	32.6–38.1	40.2	37.9–42.5	46.1	42.2–49.8
Brain and other nervous system – non-malignant	†	†	†	†	†	†	†	†
Meningiomas	†	†	†	†	†	†	†	†
Pituitary, pineal and craniopharyngeal duct	†	†	†	†	†	†	†	†
Breast (female)	77.1	76.3–77.8	85.5	84.9–86.1	86.9	86.3–87.4	89.4	88.7–90.0
Cervix	63.6	61.6–65.6	69.2	67.1–71.2	66.9	64.8–68.9	68.8	66.1–71.4
Ovary	31.4	29.8–33.1	37.8	36.3–39.4	42.1	40.7–43.5	45.6	43.7–47.5
Prostate	73.6	72.4–74.8	91.5	90.9–92.1	94.4	93.9–94.8	92.0	91.3–92.6
Testis	87.9	83.3–91.4	87.0	81.8–90.8	91.7	88.1–94.3	92.6	88.0–95.4
Uterus	81.0	79.4–82.6	82.2	80.9–83.5	80.5	79.4–81.6	79.6	78.2–80.9
Uterus – endometrial	83.1	81.4–84.8	85.0	83.5–86.3	83.9	82.7–85.0	82.4	81.0–83.7
Uterus – uterine sarcoma	44.4	33.2–55.0	42.5	33.6–51.1	34.0	28.3–39.7	42.2	30.7–53.2
Colorectal	53.0	52.3–53.8	58.6	58.0–59.3	67.1	66.6–67.7	66.9	66.1–67.6
Colon excluding rectum	55.0	54.1–55.9	58.2	57.3–59.0	66.7	66.0–67.4	66.1	65.1–67.1
Colon – left sided	57.0	55.5–58.4	61.1	59.8–62.4	70.5	69.4–71.5	68.5	66.9–70.0
Colon – right sided	55.3	54.0–56.7	58.8	57.6–59.9	66.0	65.0–67.0	67.0	65.7–68.4
Rectum and rectosigmoid junction	49.1	47.8–50.5	59.9	58.7–61.1	67.2	66.2–68.2	66.7	65.3–68.0
Rectosigmoid junction	45.6	43.1–48.0	59.9	57.9–61.9	64.2	62.2–66.0	60.1	57.3–62.7

Cancer type	1986–1990 – RSR (%)	1986–1990 – 95% CI	1996–2000 – RSR (%)	1996–2000 – 95% CI	2006–2010 – RSR (%)	2006–2010 – 95% CI	2016–2020 – RSR (%)	2016–2020 – 95% CI
Rectum	50.6	49.0–52.1	59.8	58.3–61.2	68.3	67.1–69.4	68.7	67.1–70.2
Esophagus	13.9	12.1–15.9	15.0	13.5–16.6	16.4	15.0–17.8	20.3	18.3–22.4
Esophagus – adenocarcinoma	12.7	9.5–16.3	12.3	10.3–14.5	14.5	12.8–16.3	21.6	19.0–24.3
Esophagus – squamous cell carcinoma	12.5	10.2–15.0	15.6	13.1–18.2	19.6	16.8–22.6	18.6	14.8–22.7
Liver	9.8	7.9–12.0	16.6	14.9–18.4	23.3	21.8–24.7	24.0	22.3–25.7
Pancreas	7.8	7.0–8.8	9.3	8.5–10.3	11.9	11.1–12.8	18.4	17.1–19.7
Stomach	21.2	19.9–22.5	24.1	22.8–25.4	30.4	29.1–31.7	34.4	32.8–36.1
Larynx	63.6	60.4–66.5	63.6	60.8–66.3	63.9	61.3–66.4	63.2	59.5–66.7
Oral cavity and pharynx	55.4	53.5–57.2	56.7	55.0–58.4	59.8	58.3–61.3	63.9	62.0–65.6
Hypopharynx	18.0	13.8–22.8	26.1	20.8–31.7	30.4	25.5–35.5	29.8	22.2–37.8
Lip and oral cavity	68.5	66.1–70.8	67.8	65.4–70.1	65.4	63.3–67.4	66.9	64.2–69.3
Nasopharynx	49.9	43.9–55.6	59.3	54.2–64.0	67.6	62.8–71.9	69.5	62.9–75.2
Oropharynx	34.3	31.0–37.6	43.2	40.0–46.3	56.6	53.8–59.4	62.7	59.5–65.6
Thyroid	85.4	82.9–87.5	91.9	90.4–93.2	96.2	95.3–96.9	97.0	96.2–97.6
Thyroid – anaplastic	29.1	27.1–31.1	†	†	30.1	26.2–34.1	†	†
Thyroid – follicular	87.5	82.2–91.3	93.5	88.2–96.5	93.2	88.3–96.1	96.5	91.6–98.5
Thyroid – medullary	78.7	62.7–88.4	83.7	69.6–91.6	84.7	76.2–90.3	81.3	70.9–88.3
Thyroid – papillary	94.0	90.3–96.3	97.0	95.1–98.2	98.9	97.8–99.4	99.3	98.5–99.7
Leukemia	40.0	38.6–41.5	46.5	45.2–47.8	56.6	55.5–57.7	61.9	60.4–63.3
Acute lymphocytic leukemia	27.0	21.8–32.4	32.1	26.8–37.6	55.1	50.6–59.4	62.2	56.8–67.2
Acute monocytic leukemia	8.5	3.2–17.1	13.3	8.3–19.4	13.4	8.4–19.6	16.8	9.6–25.8
Acute myeloid leukemia	11.2	9.5–13.0	14.8	13.2–16.6	17.8	16.3–19.4	28.1	25.8–30.4
Chronic lymphocytic leukemia	68.3	65.7–70.6	74.4	72.3–76.3	81.3	79.8–82.7	90.3	88.2–92.1
Chronic myeloid leukemia	28.0	24.6–31.6	36.3	33.1–39.5	59.8	56.8–62.7	62.8	59.0–66.3

Cancer type	1986–1990 – RSR (%)	1986–1990 – 95% CI	1996–2000 – RSR (%)	1996–2000 – 95% CI	2006–2010 – RSR (%)	2006–2010 – 95% CI	2016–2020 – RSR (%)	2016–2020 – 95% CI
Lymphoma	49.5	48.1–50.8	54.2	53.1–55.3	66.3	65.4–67.2	71.2	70.2–72.2
Hodgkin lymphoma	73.1	70.7–75.3	81.6	79.4–83.7	83.0	81.1–84.7	86.7	84.4–88.7
Non-Hodgkin lymphoma	48.7	47.2–50.1	53.1	52.0–54.3	66.1	65.1–67.0	70.9	69.9–72.0
Non-Hodgkin lymphoma – extranodal	84.6	74.7–90.9	72.0	67.2–76.2	76.1	74.1–78.0	69.7	68.3–71.1
Non-Hodgkin lymphoma – nodal	47.4	46.0–48.8	51.6	50.4–52.7	63.4	62.4–64.4	72.2	70.7–73.7
Myeloma	32.3	30.1–34.4	38.5	36.7–40.3	46.2	44.5–47.8	59.6	57.7–61.5
Melanoma of the skin	83.7	82.3–84.9	85.3	84.3–86.3	87.7	87.0–88.4	91.3	90.5–92.1
Melanoma (non-cutaneous)	77.5	72.4–81.8	79.6	75.1–83.4	74.8	70.1–78.9	78.3	73.7–82.2
Melanoma – mucosal	63.8	45.9–77.1	54.5	36.7–69.2	32.7	24.3–41.4	†	†
Melanoma – ocular	78.4	72.9–82.8	82.4	77.7–86.2	81.2	76.7–84.8	83.6	78.5–87.6
Lung	14.9	14.4–15.4	16.7	16.3–17.2	19.8	19.3–20.3	30.6	29.8–31.4
Lung – adenocarcinoma	19.9	18.7–21.1	22.1	21.2–23.1	27.6	26.7–28.5	32.4	31.2–33.6
Lung – large cell	8.1	6.7–9.8	9.6	8.2–11.2	14.3	11.9–16.9	†	†
Lung – small cell	6.5	5.5–7.7	7.1	6.2–8.2	7.7	6.7–8.8	†	†
Lung – squamous cell	18.4	17.3–19.5	19.5	18.4–20.7	24.7	23.1–26.3	27.5	24.7–30.3
Bladder	73.8	72.5–75.0	71.2	70.0–72.5	68.0	66.8–69.1	66.2	64.4–67.9
Kidney	55.1	53.1–56.9	63.8	62.2–65.4	70.0	68.7–71.2	78.4	76.9–79.8

Abbreviations:
CI means confidence interval
RSR means relative survival ratio

Symbol: †Estimate could not be calculated

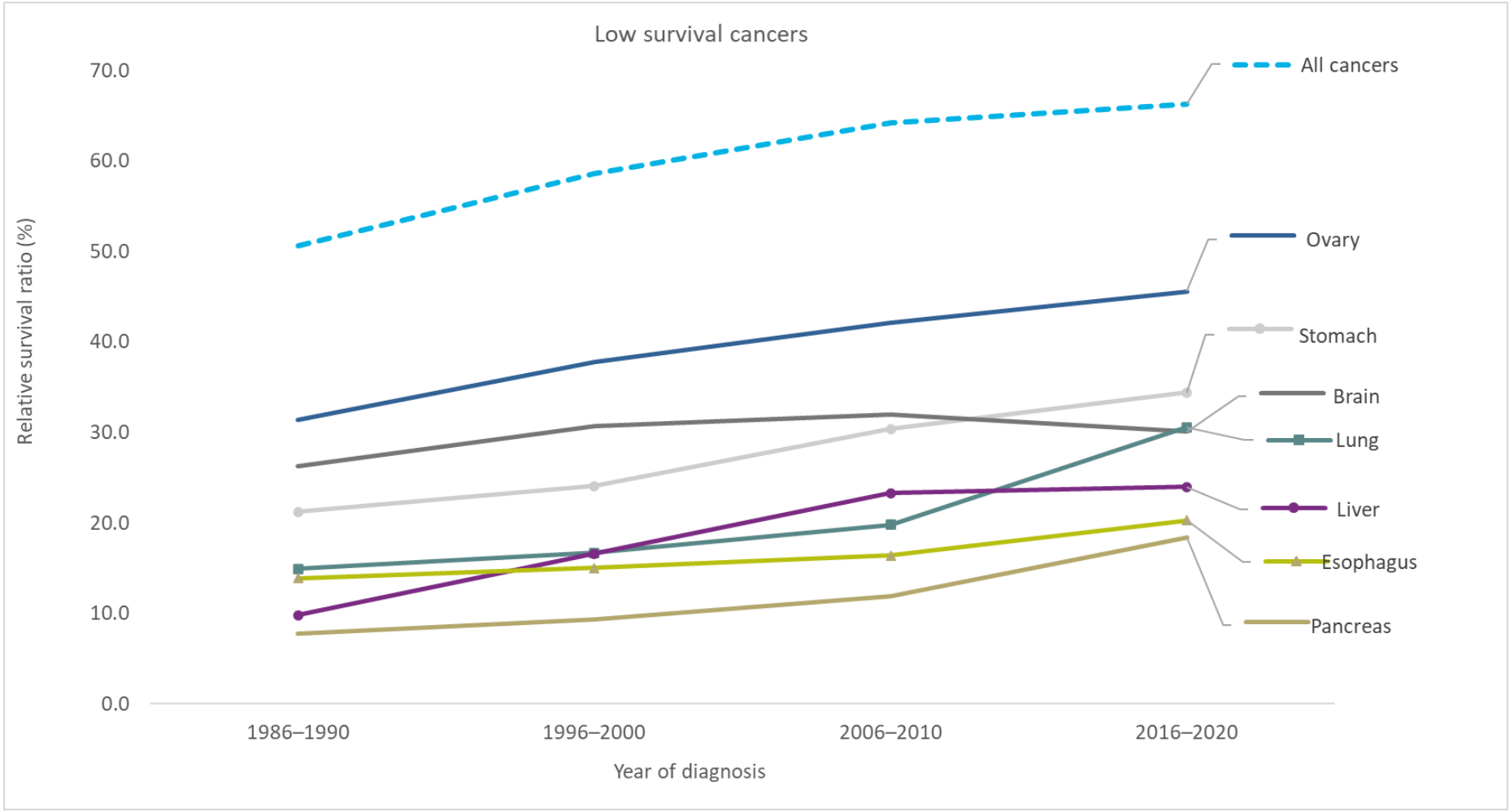
Notes:

- Analysis was restricted to ages 15 to 99.
- Bladder cancer includes malignant cases only (bladder carcinoma *in situ* cases are excluded).
- International Agency for Research on Cancer/International Association of Cancer Registries multiple primary rules were used for selecting cases.
- The period method was used to derive relative survival ratios for the 2016–2020 period. The cohort method was used for all other periods.
- Relative survival ratios were age-standardized using the International Cancer Survival Standards.

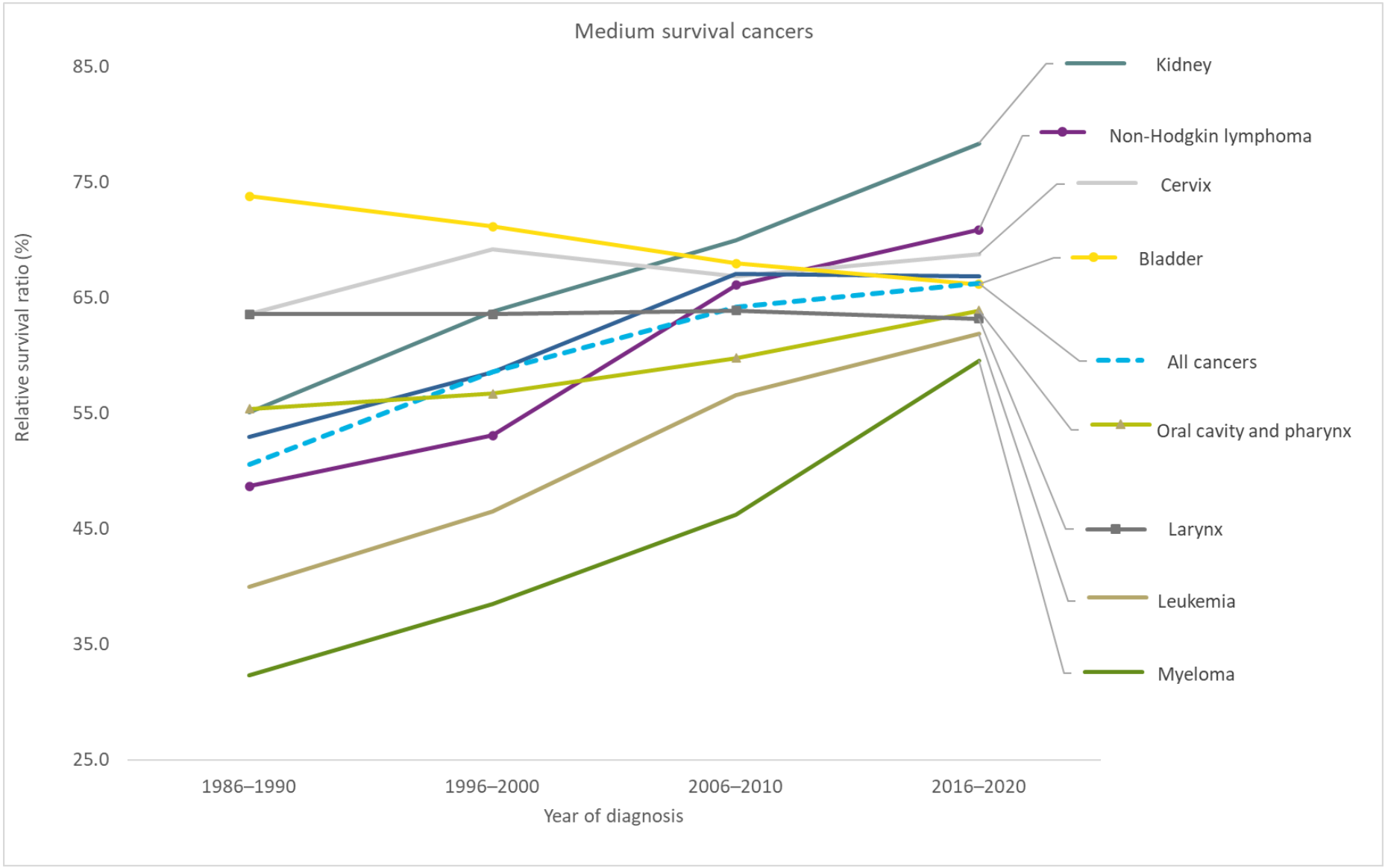
Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (December 2022), Ontario Health (Cancer Care Ontario)

Figure 4.2 Age-standardized five-year relative survival ratios for selected cancers, Ontario, 1986 to 2020

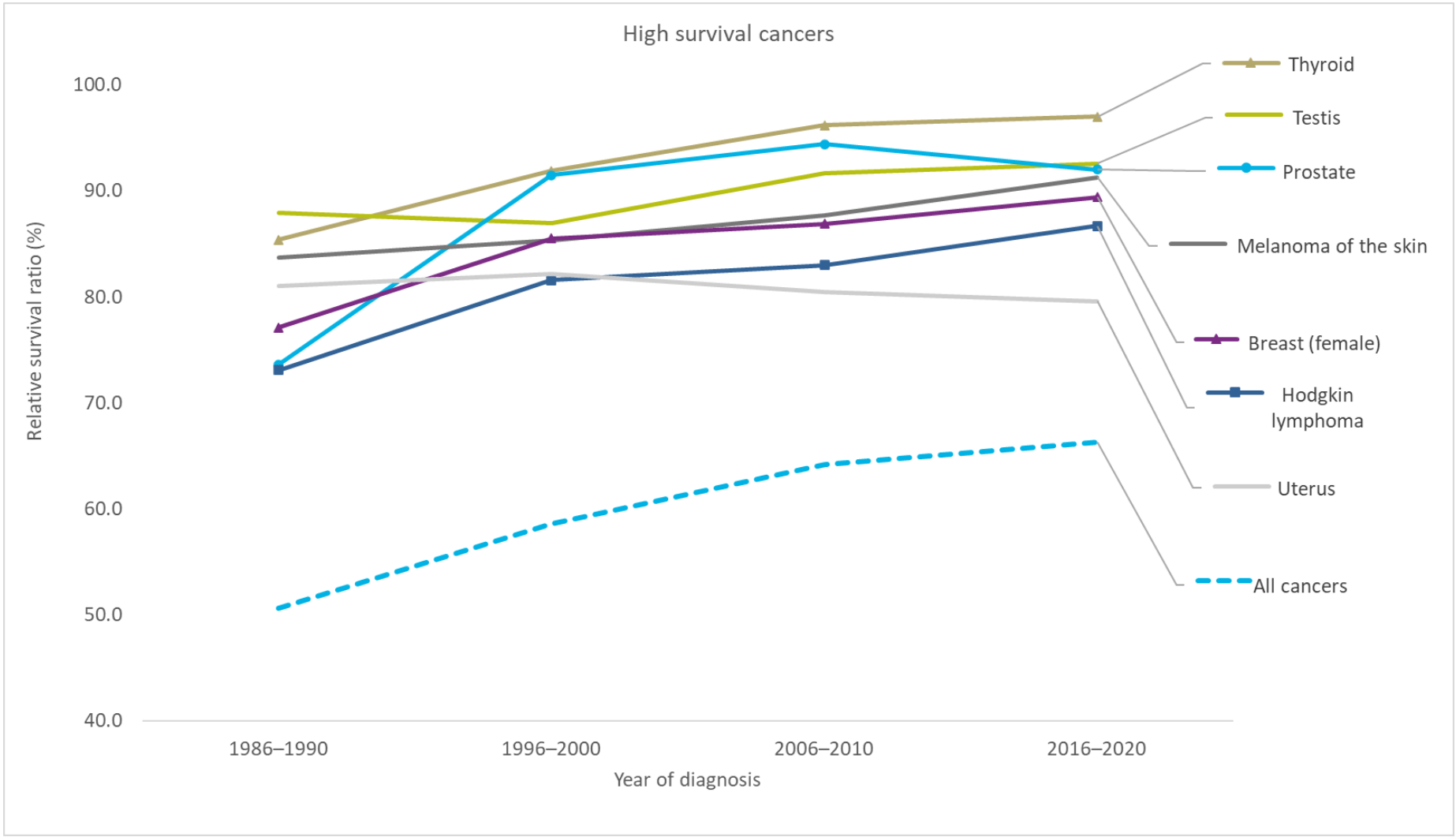
(A) Low survival cancers



(B) Medium survival cancers



(C) High survival cancers



Notes:

- Cancers are grouped into low, medium and high survival for visualization purposes.
- Analysis was restricted to ages 15 to 99.
- Bladder cancer includes malignant cases only (bladder carcinoma *in situ* cases are excluded).

- International Agency for Research on Cancer/International Association of Cancer Registries multiple primary rules were used for selecting cases.
- The period method was used to derive relative survival ratios for the 2016–2020 period. The cohort method was used for all other periods.
- Relative survival ratios were age-standardized using the International Cancer Survival Standards.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (December 2022), Ontario Health (Cancer Care Ontario)

Survival by duration and cancer type

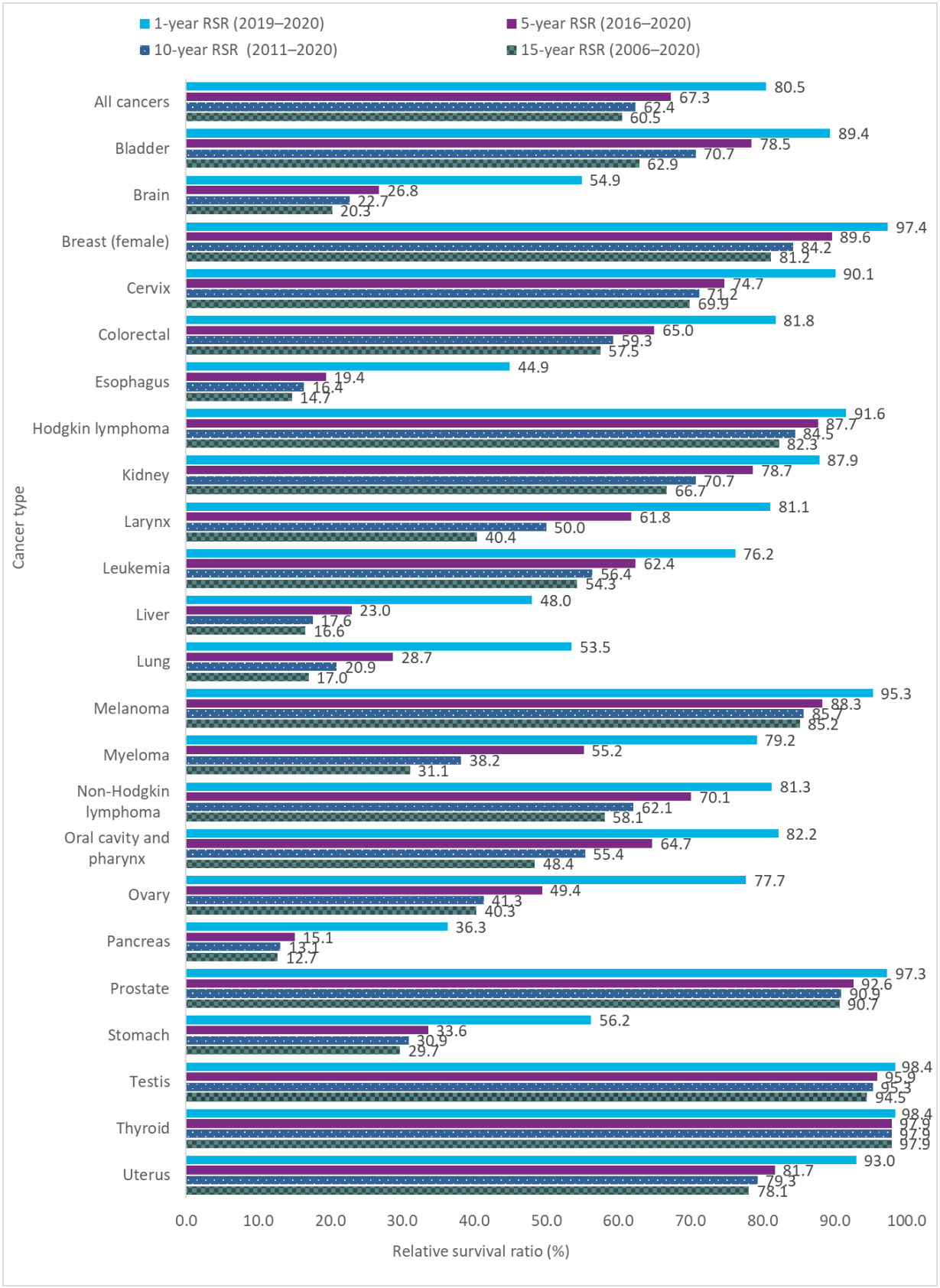
As of 2020, the relative survival ratio for all cancers combined was 80.5% for one year, 67.3% for five years, 62.4% for 10 years and 60.5% for 15 years (**Figure 4.3**).

As for most individual cancer types, survival for all cancers combined decreased with increasing follow-up duration, with the largest decreases occurring from one-year relative survival to five-year relative survival. Some of the largest drops in survival in the first year after diagnosis were for pancreatic, liver, esophageal, lung, brain, stomach and ovarian cancers, as well as leukemia.

For the four most common cancers, the following trends occurred for relative survival by duration:

- For breast cancer, the relative survival ratio one year after diagnosis was very high at 97.4%. At five years, the relative survival ratio fell to 89.6%. Survival at 10 years decreased slightly to 84.2% and at 15 years to 81.2%.
- For colorectal cancer, the relative survival ratio one year after diagnosis was 81.8%, but it fell to 65.0% at five years. Survival at 10 years decreased slightly to 59.3% and at 15 years to 57.5%.
- Lung cancer had one of the greatest drops in survival from one to five years after diagnosis, falling from 53.5% to just 28.7%. Survival continued to decrease significantly to 20.9% at 10 years and 17.0% at 15 years.
- Prostate cancer survival decreased by a small, but significant, amount from one to five years after diagnosis, but there was no significant difference between five-year, 10-year and 15-year survival. In fact, the 10-year relative survival (90.9%) and the 15-year relative survival ratio (90.7%) were nearly the same.

Figure 4.3 Relative survival ratios by cancer type and survival duration, Ontario, 2020



Abbreviation: RSR means relative survival ratio

Notes:

- Analysis was restricted to ages 15 to 99.
- Bladder cancer includes carcinoma *in situ* cases.
- The period method was used to derive relative survival ratios.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (December 2022), Ontario Health (Cancer Care Ontario)

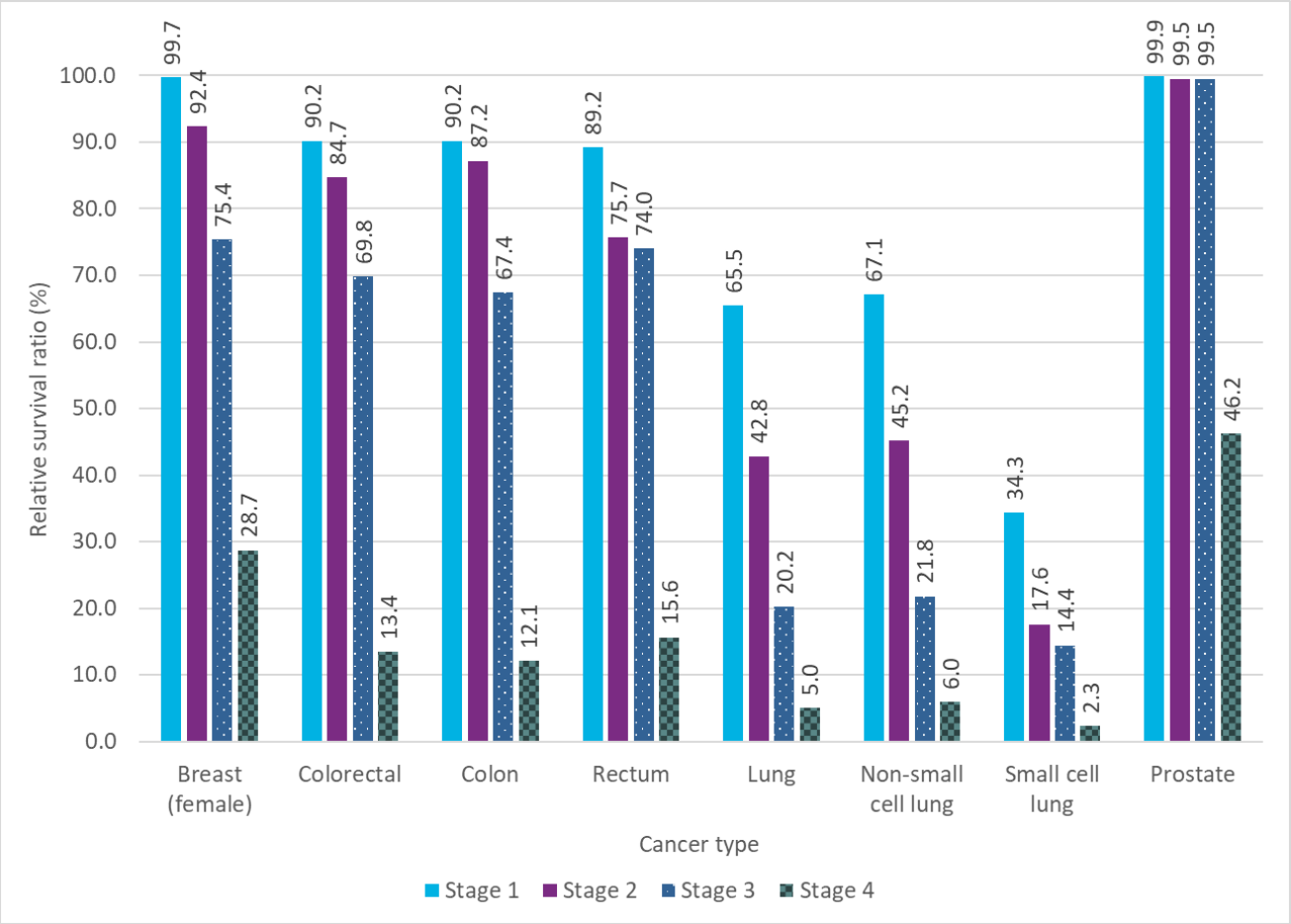
Survival by cancer stage

Stage at diagnosis is one of the most important predictors of cancer survival. Population-level stage data in Ontario are available from 2010 onward for the four most common cancers (breast, colorectal, lung and prostate) and cervical cancer, as well as for a limited number of years for thyroid cancer and melanoma. However, due to the changes in coding and case creation standards implemented in 2018 (see Appendix 1: Data Sources), this section focuses on survival by stage up to 2017 for the four most common cancers.

Five-year relative survival from 2013 to 2017 tended to decrease with advancing stage at diagnosis (**Figure 4.4**). The level of decrease varied by cancer type:

- While breast cancer cases diagnosed at stage 1 had a five-year relative survival ratio of 99.7%, the relative survival ratio decreased to just 28.7% for cases diagnosed at stage 4.
- Colorectal cancer cases diagnosed at stage 1 had a five-year relative survival ratio of 90.2%, which decreased to 84.7% for cases diagnosed at stage 2, 69.8% at stage 3 and just 13.4% at stage 4.
- Of the four most common cancers, lung cancer had the lowest relative survival ratio at every stage. Even at stage 1, five-year survival was just 65.5%, decreasing to 5.0% at stage 4.
- Stage at diagnosis had the least effect on prostate cancer. The five-year relative survival ratio for stage 1 was 99.9% and 99.5% for stages 2 and 3; however, survival dropped to 46.2% for cases diagnosed at stage 4.

Figure 4.4 Five-year relative survival ratios by cancer type and stage at diagnosis, Ontario, 2013 to 2017



Notes:

- Analysis was restricted to ages 15 to 99.
- Cases with unknown stage or that were not staged were excluded from this analysis.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (December 2022), Ontario Health (Cancer Care Ontario)

Conditional survival by cancer type

Relative survival ratios represent the likelihood of surviving a specific number of years after diagnosis. However, sometimes it is useful to measure survival starting at a time other than the date of diagnosis. Because risk of death associated with cancer is highest in the first year following diagnosis, survival after the first year (also called one-year conditional survival) may be very different from survival measured at diagnosis. **Table 4.3** presents survival at five years following diagnosis after already having survived zero, one, two, three and four years. Conditional survival at zero years is the equivalent of the five-year relative survival ratio at diagnosis, namely the statistic presented previously in this chapter.

While the five-year relative survival ratio measured at diagnosis was 67.3% for all cancers combined from 2016 to 2020, the five-year relative survival ratio increased to 83.6% for people who survived the first year after diagnosis. The five-year relative survival ratio increased for each year someone survived until four years after diagnosis, when it was 97.5%.

In general, once someone has survived the first year after cancer diagnosis, their chance of surviving five years continues to increase, but that increase gets smaller for each year they survive. For example, the five-year survival for colorectal cancer increased by 14.4% after surviving the first year (65.0% to 79.4%), but only increased by 7.8% after surviving the second year (from 79.4% to 87.2%).

People who have cancers with a poor prognosis (e.g., pancreatic, esophageal, liver, lung, stomach and brain) showed the highest relative gain in survival once they survived the first year after diagnosis. For example, the five-year relative survival ratio for pancreatic cancer was only 15.1% at diagnosis, but it rose to 41.7% for people who survived their first year. Cancers with a good prognosis (e.g., thyroid, testicular, prostate and breast) showed only a small difference in one-year conditional relative survival ratio because their survival at diagnosis was already high.

Table 4.3 Conditional five-year relative survival ratios by cancer type and years survived, Ontario, 2016 to 2020

Cancer type	0 years survived† – RSR (%)	0 years survived† – 95% CI	1 year survived – RSR (%)	1 year survived – 95% CI	2 years survived – RSR (%)	2 years survived – 95% CI	3 years survived – RSR (%)	3 years survived – 95% CI	4 years survived – RSR (%)	4 years survived – 95% CI
All cancers	**67.3**	**67.1–67.5**	**83.6**	**83.3–83.8**	**90.1**	**89.9–90.3**	**94.3**	**94.2–94.5**	**97.5**	**97.4–97.7**
Brain and other nervous system – malignant	26.8	25.1–28.5	48.9	46.3–51.5	71.8	68.8–74.6	84.1	81.4–86.5	92.4	90.1–94.1
Glioblastoma	6.3	5.2–7.7	15.1	12.4–18.1	35.8	29.9–41.7	56.2	48.0–63.6	75.8	66.8–82.7
All other gliomas	58.4	54.6–62.0	71.2	67.2–74.8	83.1	79.3–86.3	89.8	86.5–92.4	94.6	91.8–96.5
Brain and other nervous system – non-malignant	85.9	84.7–87.0	94.8	93.7–95.6	96.5	95.6–97.3	97.9	97.1–98.5	98.7	98.1–99.1
Meningiomas	93.3	91.3–94.9	96.3	94.4–97.6	97.3	95.5–98.3	98.2	96.6–99.0	98.9	97.6–99.5
Pituitary, pineal and craniopharyngeal duct	91.6	89.3–93.4	96.9	94.7–98.2	97.9	95.8–99.0	98.7	96.7–99.5	98.6	97.2–99.3
Breast (female)	89.6	89.1–90.1	92.1	91.6–92.5	94.1	93.6–94.5	96.3	96.0–96.7	98.3	98.0–98.5
Cervix	74.7	72.3–76.9	82.9	80.6–84.9	90.3	88.3–92.0	94.6	93.0–95.9	97.3	96.0–98.2
Ovary	49.4	47.6–51.3	63.6	61.5–65.7	74.0	71.8–76.0	85.3	83.3–87.0	92.8	91.2–94.1
Prostate	92.6	92.0–93.2	95.2	94.7–95.8	96.9	96.4–97.4	98.2	97.7–98.5	99.2	98.8–99.4
Testis	95.9	94.4–97.1	97.5	96.1–98.4	99.2	97.9–99.7	99.6	98.2–99.9	99.8	98.4–100.0
Uterus	81.7	80.6–82.7	87.9	86.9–88.8	92.9	92.0–93.7	96.3	95.6–96.9	98.2	97.7–98.7
Uterus – endometrial	84.3	83.2–85.3	88.8	87.8–89.7	93.5	92.6–94.3	96.5	95.8–97.2	98.3	97.8–98.8
Uterus – uterine sarcoma	52.4	45.2–59.1	65.2	57.0–72.3	76.7	68.1–83.3	88.9	80.8–93.7	94.6	87.0–97.8
Colorectal	65.0	64.2–65.8	79.4	78.6–80.2	87.2	86.5–87.9	92.8	92.2–93.4	97.3	96.8–97.7
Colon excluding rectum	64.3	63.3–65.3	79.7	78.7–80.7	87.2	86.3–88.1	92.9	92.1–93.6	97.3	96.7–97.8
Colon – left sided	67.6	66.0–69.1	79.9	78.4–81.4	87.1	85.7–88.5	92.2	91.0–93.3	97.0	96.0–97.7
Colon – right sided	65.6	64.3–66.9	80.6	79.2–81.9	88.2	86.9–89.4	94.1	92.9–95.0	97.8	96.9–98.4
Rectum and rectosigmoid junction	65.8	64.5–67.1	77.8	76.5–79.0	86.1	84.9–87.2	91.9	90.8–92.8	96.9	96.1–97.5
Rectosigmoid junction	59.0	56.3–61.6	75.7	72.8–78.3	84.8	82.0–87.1	91.5	89.1–93.4	96.6	94.8–97.8
Rectum	67.9	66.4–69.4	78.3	76.8–79.8	86.5	85.1–87.7	92.0	90.8–93.1	97.0	96.1–97.7
Esophagus	19.4	17.7–21.3	43.3	39.8–46.8	64.7	60.2–68.9	79.8	75.2–83.6	91.9	88.0–94.5
Esophagus – adenocarcinoma	21.6	19.2–24.0	43.0	38.7–47.2	67.3	61.7–72.2	82.7	77.1–87.0	93.2	88.6–96.0
Esophagus – squamous cell carcinoma	16.9	13.7–20.2	40.2	33.3–47.0	56.2	47.1–64.3	71.3	60.9–79.4	87.1	76.3–93.2

Cancer type	0 years survived† – RSR (%)	0 years survived† – 95% CI	1 year survived – RSR (%)	1 year survived – 95% CI	2 years survived – RSR (%)	2 years survived – 95% CI	3 years survived – RSR (%)	3 years survived – 95% CI	4 years survived – RSR (%)	4 years survived – 95% CI
Liver	23.0	21.4–24.6	47.9	45.1–50.7	62.8	59.5–65.9	76.7	73.4–79.7	91.5	88.8–93.5
Pancreas	15.1	14.1–16.2	41.7	39.1–44.3	65.2	61.8–68.4	82.3	78.9–85.2	92.7	89.9–94.8
Stomach	33.6	32.0–35.3	59.9	57.5–62.2	78.3	75.8–80.7	90.6	88.3–92.4	95.8	94.0–97.1
Larynx	61.8	58.2–65.2	76.2	72.4–79.5	86.3	82.7–89.2	91.2	87.9–93.6	96.6	93.9–98.1
Oral cavity and pharynx	64.7	63.1–66.3	78.7	77.1–80.2	86.8	85.3–88.2	92.0	90.6–93.2	96.3	95.2–97.1
Hypopharynx	30.6	23.9–37.5	51.3	41.1–60.5	65.6	53.5–75.3	74.7	61.9–83.8	86.0	73.7–92.8
Lip and oral cavity	66.5	64.1–68.8	80.2	77.8–82.4	88.4	86.1–90.4	92.8	90.7–94.4	96.3	94.6–97.5
Nasopharynx	69.1	62.9–74.5	79.6	73.5–84.5	86.2	80.2–90.5	90.3	84.6–93.9	96.4	91.8–98.5
Oropharynx	66.1	63.6–68.5	78.8	76.2–81.1	86.3	83.9–88.3	92.4	90.3–94.0	97.0	95.4–98.1
Thyroid	97.9	97.3–98.4	99.5	98.9–99.8	99.6	99.0–99.8	99.8	99.2–99.9	99.9	99.3–100.0
Thyroid – anaplastic	22.1	11.7–34.4	73.3	41.5–89.6	100.0	‡	100.0	‡	100.0	‡
Thyroid – follicular	96.9	91.2–99.0	99.0	86.9–99.9	98.8	91.7–99.8	99.0	93.2–99.9	99.7	96.2–100.0
Thyroid – medullary	83.7	73.4–90.3	88.3	78.7–93.7	90.5	81.4–95.3	92.7	84.3–96.7	97.4	90.1–99.3
Thyroid – papillary	99.7	98.9–99.9	99.8	99.0–100.0	99.8	99.2–99.9	99.9	99.5–100.0	99.9	98.8–100.0
Leukemia	62.4	61.0–63.8	81.9	80.4–83.3	89.1	87.7–90.3	93.0	91.9–94.0	97.2	96.3–97.8
Acute lymphocytic leukemia	73.8	69.9–77.2	87.9	84.4–90.6	93.2	90.2–95.3	96.3	93.8–97.9	98.7	96.8–99.5
Acute monocytic leukemia	21.2	12.9–30.9	54.7	38.7–68.2	75.6	57.8–86.7	86.2	66.4–94.8	89.8	68.8–97.0
Acute myeloid leukemia	26.9	24.7–29.2	56.3	52.4–60.0	75.4	71.1–79.1	85.6	81.6–88.8	97.0	94.1–98.5
Chronic lymphocytic leukemia	89.9	87.7–91.8	92.6	90.5–94.3	93.8	91.8–95.2	95.3	93.6–96.6	97.6	96.3–98.4
Chronic myeloid leukemia	64.2	60.2–67.9	78.0	73.8–81.6	85.5	81.5–88.7	89.8	86.1–92.5	96.2	93.3–97.9
Lymphoma	71.7	70.7–72.7	87.2	86.3–88.1	92.5	91.7–93.3	95.5	94.8–96.1	98.0	97.4–98.4
Hodgkin lymphoma	87.7	85.3–89.7	95.7	93.7–97.1	96.4	94.6–97.7	97.4	95.7–98.4	98.5	97.1–99.2
Non-Hodgkin lymphoma	70.1	69.0–71.1	86.2	85.2–87.2	92.1	91.2–92.9	95.2	94.5–95.9	97.9	97.3–98.4
Non-Hodgkin lymphoma – extranodal	68.6	67.1–70.0	86.1	84.7–87.5	92.1	90.7–93.2	95.2	94.0–96.1	98.0	97.1–98.6
Non-Hodgkin lymphoma – nodal	71.6	70.1–73.1	86.3	84.9–87.7	92.0	90.8–93.2	95.2	94.1–96.1	97.8	96.9–98.4

Cancer type	0 years survived† – RSR (%)	0 years survived† – 95% CI	1 year survived – RSR (%)	1 year survived – 95% CI	2 years survived – RSR (%)	2 years survived – 95% CI	3 years survived – RSR (%)	3 years survived – 95% CI	4 years survived – RSR (%)	4 years survived – 95% CI
Myeloma	55.2	53.2–57.1	69.6	67.4–71.7	75.5	73.4–77.5	81.9	79.8–83.8	90.0	88.2–91.5
Melanoma of the skin	88.3	87.3–89.3	92.7	91.8–93.5	95.2	94.4–96.0	97.2	96.5–97.8	98.7	98.1–99.1
Melanoma (non-cutaneous)	70.8	65.4–75.5	75.8	70.4–80.3	82.2	76.9–86.3	88.2	83.2–91.8	94.9	90.6–97.3
Melanoma – mucosal	48.8	37.7–59.0	57.8	45.1–68.5	71.0	56.4–81.5	83.9	67.9–92.4	92.9	76.5–98.0
Melanoma – ocular	78.4	72.3–83.4	80.7	74.7–85.4	84.6	78.8–88.9	89.0	83.6–92.7	95.3	90.5–97.7
Lung	28.7	28.1–29.4	53.7	52.6–54.7	68.5	67.3–69.6	80.0	78.8–81.0	90.5	89.6–91.4
Lung – adenocarcinoma	32.4	31.4–33.4	55.4	54.0–56.8	70.0	68.5–71.5	80.8	79.3–82.1	90.8	89.6–91.9
Lung – large cell	27.6	22.5–32.9	53.1	44.4–61.1	81.1	70.7–88.1	92.9	81.7–97.4	96.4	85.6–99.1
Lung – small cell	9.9	8.7–11.3	30.0	26.5–33.6	54.7	49.2–59.9	77.0	70.7–82.1	90.6	84.9–94.2
Lung – squamous cell	26.0	24.5–27.5	46.0	43.7–48.4	61.0	58.2–63.6	75.2	72.3–77.9	86.7	84.1–89.0
Bladder	78.5	77.4–79.6	87.8	86.7–88.8	91.9	90.9–92.8	95.0	94.1–95.7	97.7	97.0–98.2
Kidney	78.7	77.5–80.0	89.5	88.4–90.6	93.0	91.9–93.9	95.8	94.8–96.5	97.8	97.1–98.4

Abbreviations:
CI means confidence interval
RSR means relative survival ratio

Symbols:
†Zero years survived is the equivalent of the five-year non–conditional survival (i.e., five-year relative survival ratio)
‡Estimate could not be calculated

Notes:

- Analysis was restricted to ages 15 to 99.
- Bladder cancer includes carcinoma *in situ* cases.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (December 2022), Ontario Health (Cancer Care Ontario)

Ch 5: Cancer Prevalence

Cancer prevalence refers to the number of people newly and previously diagnosed with cancer who are still alive at a given point in time. This chapter presents prevalence counts and proportions for people diagnosed with cancer within a specific time period who were still alive on January 1, 2021.

Prevalence overview

Cancer prevalence is a function of cancer incidence and survival, which means that prevalence increases as incidence increases and survival improves. With increasing incidence and improving survival in Ontario, the prevalence of cancer over time has also been increasing in this province with an estimated population of 14.2 million in 2021.(155) In Ontario, there are now more people living with a diagnosis of cancer than there were 20 years ago.

This chapter presents limited-duration, person-based prevalence counts:

- Limited-duration describes the number of people alive on a certain date (called the index date) who were diagnosed with cancer a *specified number of years* (e.g., two years, five years, 10 years, 30 years) before the index date. This report uses an index date of January 1, 2021, and focuses on 10- and 30-year durations.

- Person-based refers to the number of *people* with cancer who are alive on the index date. A person with multiple cancer diagnoses is counted once for each type of primary cancer they have been diagnosed with in the time period of interest. For all cancers combined, someone with cancer would only be counted once, regardless of the number of diagnoses they have had in the time period of interest. Although person-based prevalence may underestimate the burden of cancer by only counting one cancer diagnosis per person, it better describes the number of people living with cancer.

Because trends in cancer prevalence reflect the increase, decrease or stability of cancer incidence and mortality rates in the population, they can help determine how best to distribute diagnostic, treatment and care resources.(156) Therefore, prevalence counts are important for understanding the impacts of cancer on the health care system. The main health care services used by newly diagnosed people (usually in the first two years) relate to primary cancer treatment.(157) After treatment is done, the main services used are for follow-up care in survivors, including assessment for cancer recurrence, assessment for new cancers, and managing late effects (that appear after treatment has ended) and long-term effects (that begin during treatment and persist) of cancer.(158–160)

Ten- and 30-year limited durations provide reasonable windows of time to account for all people living with cancer, including longer-term survivors, defined here as people diagnosed 10 or more years ago.

Statistics by sex in this chapter refer to sex data that are binary and assigned at birth. For more information, refer to About This Report: Statistics by sex.

Prevalence by sex and cancer type

Of the people in Ontario diagnosed with cancer in the previous 10 years (since 2011), an estimated 419,355 of them were alive at the end of 2020 (on the index date of January 1, 2021), which is a prevalence proportion of 2,839.7 per 100,000 (**Table 5.1**).

At the end of 2020 (on the index date of January 1, 2021), an estimated 705,654 people (prevalence proportion of 4,778.4 per 100,000) living in Ontario had been diagnosed with cancer in the previous 30 years (since 1991). Even though the overall cancer incidence rates were higher among males, there were higher prevalence counts in females in the previous 10 years (53.1%) and 30 years (54.1%). See Chapter 2: Cancer Incidence. This discrepancy largely reflects the higher prevalence of thyroid and lung cancers in females due to the higher incidence of thyroid cancer, which has high survival rates, and higher lung cancer survival rates in females. Breast cancer also contributes to this discrepancy due to its high incidence and survival in females.

Table 5.1 Ten-year and 30-year prevalence by cancer type and binary sex, Ontario, 2020

Cancer type	Males and females combined – 10-year prevalence count	Males and females combined – 10-year prevalence proportion	Males and females combined – 30-year prevalence count	Males and females combined – 30-year prevalence proportion	Males – 10-year prevalence count	Males – 10-year prevalence proportion	Males – 30-year prevalence count	Males – 30-year prevalence proportion	Females – 10-year prevalence count	Females – 10-year prevalence proportion	Females – 30-year prevalence count	Females – 30-year prevalence proportion
All cancers	**419,355**	**2,839.7**	**705,654**	**4,778.4**	**196,776**	**2,696.9**	**323,725**	**4,436.8**	**222,579**	**2,979.1**	**381,929**	**5,112.0**
Brain and other nervous system – malignant	3,475	23.5	7,091	48.0	1,932	26.5	3,787	51.9	1,543	20.7	3,304	44.2
Glioblastoma	882	6.0	1,067	7.2	516	7.1	617	8.5	366	4.9	450	6.0
All other gliomas	1,700	11.5	3,459	23.4	932	12.8	1,828	25.1	768	10.3	1,631	21.8
Brain and other nervous system – non-malignant	17,323	117.3	n/a	n/a	6,901	94.6	n/a	n/a	10,422	139.5	n/a	n/a
Meningiomas	5,556	37.6	n/a	n/a	1,572	21.6	n/a	n/a	3,984	53.3	n/a	n/a
Pituitary, pineal and craniopharyngeal duct	4,477	30.3	n/a	n/a	2,108	28.9	n/a	n/a	2,369	31.7	n/a	n/a
Breast (female)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	80,486	1,077.3	148,752	1,991.0
Cervix	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	4,343	58.1	10,458	140.0
Ovary	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	6,038	80.8	10,794	144.5
Prostate	n/a	n/a	n/a	n/a	69,130	947.5	128,789	1,765.1	n/a	n/a	n/a	n/a
Testis	n/a	n/a	n/a	n/a	3,958	54.3	9,354	128.2	n/a	n/a	n/a	n/a
Uterine	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	21,018	281.3	35,014	468.7
Uterus – endometrial	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	19,957	267.1	32,586	436.2
Uterus – uterine sarcoma	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	414	5.5	839	11.2
Colorectal	44,924	304.2	76,260	516.4	24,416	334.6	40,655	557.2	20,508	274.5	35,605	476.6
Colon excluding rectum	29,707	201.2	50,266	340.4	15,254	209.1	25,310	346.9	14,453	193.5	24,956	334.0
Colon – left sided	12,002	81.3	21,693	146.9	6,823	93.5	11,929	163.5	5,179	69.3	9,764	130.7
Colon – right sided	17,207	116.5	27,090	183.4	8,180	112.1	12,615	172.9	9,027	120.8	14,475	193.7
Rectum and rectosigmoid junction	16,200	109.7	27,396	185.5	9,763	133.8	16,186	221.8	6,437	86.2	11,210	150.0
Rectosigmoid junction	3,853	26.1	7,245	49.1	2,281	31.3	4,121	56.5	1,572	21.0	3,124	41.8
Rectum	12,347	83.6	20,151	136.5	7,482	102.5	12,065	165.4	4,865	65.1	8,086	108.2
Esophagus	1,919	13.0	2,498	16.9	1,468	20.1	1,868	25.6	451	6.0	630	8.4
Esophagus – adenocarcinoma	1,242	8.4	1,526	10.3	1,059	14.5	1,306	17.9	183	2.5	220	2.9
Esophagus – squamous cell carcinoma	542	3.7	756	5.1	316	4.3	417	5.7	226	3.0	339	4.5
Liver	3,190	21.6	4,304	29.1	2,288	31.4	3,101	42.5	902	12.1	1,203	16.1
Pancreas	3,520	23.8	4,458	30.2	1,820	24.9	2,249	30.8	1,700	22.8	2,209	29.6
Stomach	5,026	34.0	7,414	50.2	3,090	42.4	4,449	61.0	1,936	25.9	2,965	39.7
Larynx	2,283	15.5	3,898	26.4	1,934	26.5	3,280	45.0	349	4.7	618	8.3
Oral cavity and pharynx	10,188	69.0	15,846	107.3	7,177	98.4	10,893	149.3	3,011	40.3	4,953	66.3
Lip and oral cavity	313	2.1	422	2.9	256	3.5	334	4.6	57	0.8	88	1.2
Hypopharynx	4,902	33.2	7,848	53.1	3,010	41.3	4,831	66.2	1,892	25.3	3,017	40.4
Nasopharynx	738	5.0	1,491	10.1	512	7.0	998	13.7	226	3.0	493	6.6

Cancer type	Males and females combined – 10-year prevalence count	Males and females combined – 10-year prevalence proportion	Males and females combined – 30-year prevalence count	Males and females combined – 30-year prevalence proportion	Males – 10-year prevalence count	Males – 10-year prevalence proportion	Males – 30-year prevalence count	Males – 30-year prevalence proportion	Females – 10-year prevalence count	Females – 10-year prevalence proportion	Females – 30-year prevalence count	Females – 30-year prevalence proportion
Oropharynx	4,076	27.6	5,788	39.2	3,291	45.1	4,557	62.5	785	10.5	1,231	16.5
Thyroid	27,998	189.6	50,437	341.5	6,753	92.6	10,957	150.2	21,245	284.4	39,480	528.4
Thyroid – anaplastic	32	0.2	41	0.3	12	0.2	13	0.2	20	0.3	28	0.4
Thyroid – follicular	885	6.0	2,045	13.9	235	3.2	472	6.5	650	8.7	1,573	21.1
Thyroid – medullary	288	2.0	575	3.9	117	1.6	212	2.9	171	2.3	363	4.9
Thyroid – papillary	26,419	178.9	46,005	311.5	6,274	86.0	9,886	135.5	20,145	269.6	36,119	483.4
Leukemia	13,187	89.3	21,980	148.8	7,776	106.6	12,683	173.8	5,411	72.4	9,297	124.4
Acute lymphocytic leukemia	1,568	10.6	3,500	23.7	901	12.4	1,992	27.3	667	8.9	1,508	20.2
Acute monocytic leukemia	90	0.6	150	1.0	41	0.6	71	1.0	49	0.7	79	1.1
Acute myeloid leukemia	1,776	12.0	2,873	19.5	940	12.9	1,460	20.0	836	11.2	1,413	18.9
Chronic lymphocytic leukemia	6,671	45.2	10,232	69.3	4,091	56.1	6,110	83.7	2,580	34.5	4,122	55.2
Chronic myeloid leukemia	1,878	12.7	2,998	20.3	1,071	14.7	1,687	23.1	807	10.8	1,311	17.6
Lymphoma	28,036	189.9	45,971	311.3	15,297	209.7	24,510	335.9	12,739	170.5	21,461	287.3
Hodgkin lymphoma	3,403	23.0	7,961	53.9	1,839	25.2	4,184	57.3	1,564	20.9	3,777	50.6
Non-Hodgkin lymphoma	24,679	167.1	38,078	257.9	13,487	184.9	20,366	279.1	11,192	149.8	17,712	237.1
Non-Hodgkin lymphoma – extranodal	12,326	83.5	14,792	100.2	6,736	92.3	8,004	109.7	5,590	74.8	6,788	90.9
Non-Hodgkin lymphoma – nodal	12,362	83.7	23,299	157.8	6,758	92.6	12,373	169.6	5,604	75.0	10,926	146.2
Myeloma	6,653	45.1	8,149	55.2	3,621	49.6	4,396	60.3	3,032	40.6	3,753	50.2
Melanoma of the skin	25,083	169.9	43,761	296.3	13,261	181.8	21,799	298.8	11,822	158.2	21,962	294.0
Melanoma (non-cutaneous)	1,069	7.2	1,790	12.1	518	7.1	891	12.2	551	7.4	899	12.0
Melanoma – mucosal	195	1.3	235	1.6	66	0.9	75	1.0	129	1.7	160	2.1
Melanoma – ocular	876	5.9	1,557	10.5	452	6.2	816	11.2	424	5.7	741	9.9
Lung	25,401	172.0	32,602	220.8	10,948	150.1	14,160	194.1	14,453	193.5	18,442	246.8
Lung – adenocarcinoma	12,278	83.1	15,457	104.7	4,720	64.7	5,854	80.2	7,558	101.2	9,603	128.5
Lung – large cell	346	2.3	545	3.7	181	2.5	277	3.8	165	2.2	268	3.6
Lung – small cell	1,305	8.8	1,634	11.1	565	7.7	722	9.9	740	9.9	912	12.2
Lung – squamous cell	4,440	30.1	5,632	38.1	2,620	35.9	3,377	46.3	1,820	24.4	2,255	30.2
Bladder	11,293	76.5	18,879	127.8	8,902	122.0	14,503	198.8	2,391	32.0	4,376	58.6
Kidney	15,724	106.5	24,525	166.1	10,179	139.5	15,270	209.3	5,545	74.2	9,255	123.9

Abbreviation: n/a means not applicable

Notes:

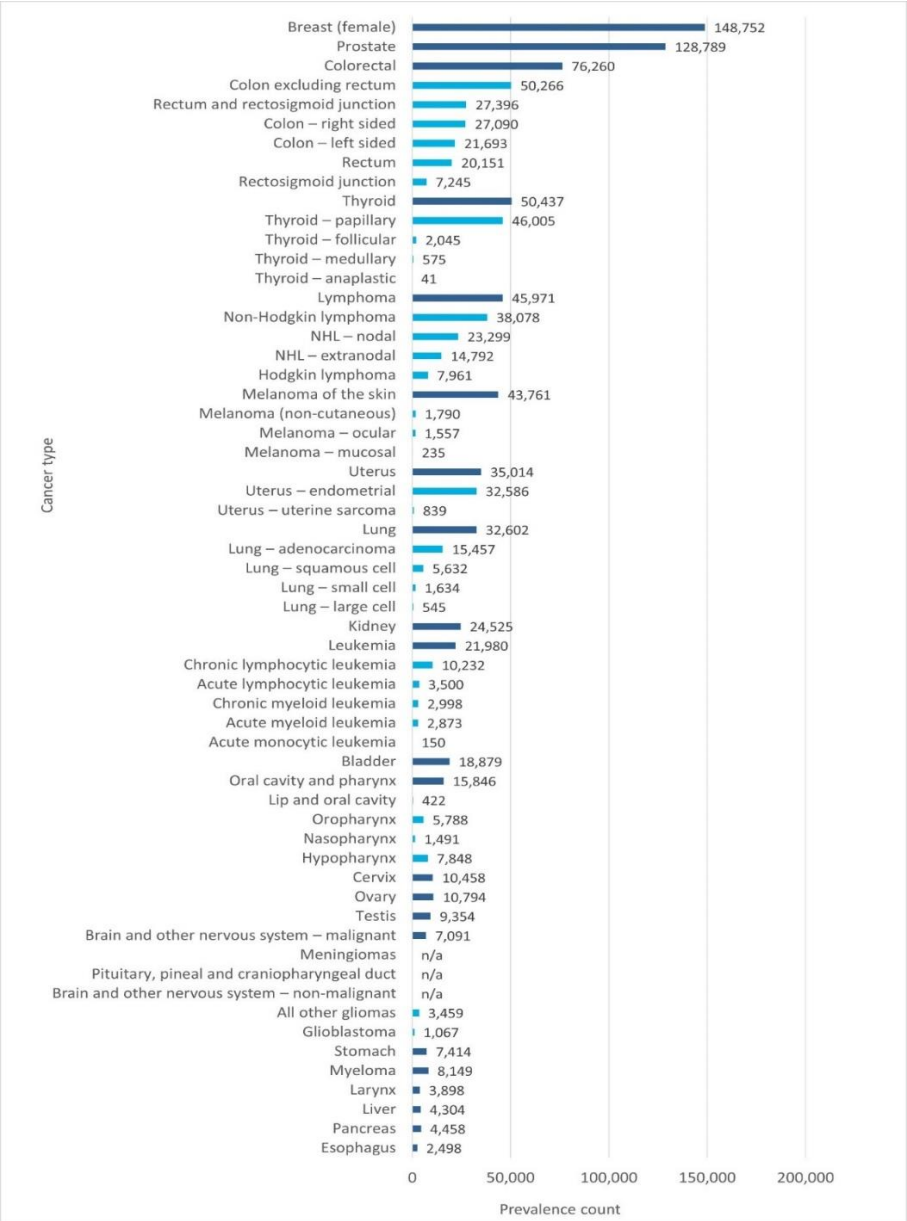
- Prevalence counts are based on incidence counts using International Agency for Research on Cancer/International Association of Cancer Registries rules for counting multiple primaries.
- Because the Ontario Cancer Registry began routinely registering non-malignant brain and other nervous system tumours in 2010, prevalence counts on these cases are only provided for 2010 onwards and are based on Surveillance, Epidemiology and End Results Program rules for counting multiple primary cancers.
- Prevalence proportions are per 100,000 people.

- Counts for cancer subsites and subtypes may not add up to the total because not all subsites and subtypes are included.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (December 2022), Ontario Health (Cancer Care Ontario)

Female breast cancer was the largest contributor to 30-year prevalence, accounting for 148,752 survivors at the end of 2020 (**Figure 5.1**). Of the other most commonly diagnosed cancers in Ontario, prostate (128,789) and colorectal (76,260) cancers were the next most prevalent types. Lung cancer (32,602), despite being the third most commonly diagnosed cancer, ranked eighth (excluding subtypes and subsites) in terms of prevalence because of its low survival. It was surpassed by several higher-survival cancers, despite their lower annual incidence: thyroid cancer (50,437), lymphoma (45,971), melanoma (43,761) and uterine cancer (35,014).

Figure 5.1 Thirty-year prevalence by cancer type, Ontario, 2020



Abbreviations:
NHL means non-Hodgkin lymphoma
n/a means not applicable

Notes:

- The 30-year prevalence for all cancers combined is 705,654.
- Prevalence counts are based on incidence counts using International Agency for Research on Cancer/International Association of Cancer Registries rules for counting multiple primaries.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (December 2022), Ontario Health (Cancer Care Ontario)

Prevalence by age and cancer type

For all cancers combined in males and females, the majority (52.7%) of 30-year prevalent cancers in Ontario in 2020 were among people ages 60 to 79, followed by people age 80 and older (22.5%) (**Table 5.2**). Although males had the same cancer prevalence pattern as males and females combined (25.3% among males ages 60 to 79; 11.5% among males age 80 and older), in females the second-highest prevalence was among people ages 40 to 59 (13.2%), followed by people age 80 and older (11.0%). Notable patterns by age group include:

- Among people ages zero to 39, females were more likely than males to be living with a diagnosis of cancer due to the higher prevalence of breast cancer, thyroid cancer and melanoma among females in this age group.

- Among people ages 40 to 59, there were almost 2 times as many females living with cancer than males. This difference was largely due to female breast cancer. Other cancers that contributed to more females living with a diagnosis of cancer in this age group include thyroid, uterine, cervical and ovarian cancers, as well as melanoma.

- Among people ages 60 to 79, there were more females living with a diagnosis of cancer than males. This difference was largely due to the higher prevalence of breast, lung, thyroid and uterine cancers among females in this age group.

- Among people age 80 and older, there were slightly fewer females living with a cancer diagnosis than males due to the prevalence of prostate cancer in males in this age group. Unlike in other age groups, the prevalence proportion in this age group is much higher in males than females because there are fewer males than females in this age group in Ontario.

Table 5.2 Thirty-year prevalence by cancer type, binary sex and age group, Ontario, 2020

Cancer type	Males and females combined – counts, ages 0 to 39	Males and females combined – proportion, ages 0 to 39	Males and females combined – counts, ages 40 to 59	Males and females combined – proportion, ages 40 to 59	Males and females combined – counts, ages 60 to 79	Males and females combined – proportion, ages 60 to 79	Males and females combined – counts, age 80 and older	Males and females combined – proportion, age 80 and older
All cancers	**32,382**	**445.5**	**142,736**	**3,676.0**	**371,826**	**12,612.2**	**158,710**	**23,755.8**
Bladder	75	1.0	1,272	32.8	9,805	332.6	7,727	1,156.6
Brain	2,703	37.2	2,137	55.0	1,841	62.5	410	61.4
Breast (female)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Cervix	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Colorectal	698	9.6	10,067	259.3	38,969	1,321.8	26,526	3,970.4
Esophagus	16	0.2	365	9.4	1,561	53.0	556	83.2
Hodgkin lymphoma	2,813	38.7	3,273	84.3	1,583	53.7	292	43.7
Kidney	907	12.5	5,464	140.7	13,709	465.0	4,445	665.3
Larynx	20	0.3	444	11.4	2,339	79.3	1,095	163.9
Leukemia	4,125	56.8	3,689	95.0	9,905	336.0	4,261	637.8
Liver	188	2.6	647	16.7	2,676	90.8	793	118.7
Lung	218	3.0	3,115	80.2	20,316	689.1	8,953	1,340.1
Melanoma	1,889	26.0	10,687	275.2	22,156	751.5	9,029	1,351.5
Myeloma	52	0.7	1,262	32.5	4,772	161.9	2,063	308.8
Non-Hodgkin lymphoma	2,256	31.0	7,840	201.9	19,865	673.8	8,117	1,215.0
Oral cavity and pharynx	314	4.3	3,575	92.1	9,408	319.1	2,549	381.5
Ovary	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Pancreas	101	1.4	913	23.5	2,552	86.6	892	133.5
Prostate	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Stomach	91	1.3	1,198	30.9	3,906	132.5	2,219	332.1
Testis	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Thyroid	5,340	73.5	21,860	563.0	19,816	672.2	3,421	512.1
Uterus	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Cancer type	Males – counts, ages 0 to 39	Males – proportion, ages 0 to 39	Males – counts, ages 40 to 59	Males – proportion, ages 40 to 59	Males – counts, ages 60 to 79	Males – proportion, ages 60 to 79	Males – counts, age 80 and older	Males – proportion, age 80 and older
All cancers	**14,396**	**387.5**	**49,463**	**2,595.2**	**178,591**	**12,704.5**	**81,275**	**30,150.4**
Bladder	43	1.2	952	50.0	7,699	547.7	5,809	2,155.0
Brain	1,505	40.5	1,141	59.9	961	68.4	180	66.8
Breast (female)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Cervix	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Colorectal	365	9.8	5,451	286.0	22,064	1,569.6	12,775	4,739.1
Esophagus	**	**	290†	15.2	1,194	84.9	373	138.4
Hodgkin lymphoma	1,446	38.9	1,705	89.5	887	63.1	146	54.2
Kidney	456	12.3	3,544	185.9	8,729	621.0	2,541	942.6
Larynx	9	0.2	349	18.3	1,995	141.9	927	343.9
Leukemia	2,323	62.5	2,119	111.2	6,017	428.0	2,224	825.0
Liver	115	3.1	449	23.6	2,034	144.7	503	186.6
Lung	94	2.5	1,245	65.3	8,712	619.8	4,109	1,524.3
Melanoma	639	17.2	4,488	235.5	11,747	835.7	4,925	1,827.0
Myeloma	27	0.7	692	36.3	2,637	187.6	1,040	385.8
Non-Hodgkin lymphoma	1,367	36.8	4,399	230.8	10,755	765.1	3,845	1,426.4
Oral cavity and pharynx	179	4.8	2,490	130.6	6,775	482.0	1,449	537.5
Ovary	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Pancreas	40	1.1	458	24.0	1,329	94.5	422	156.6
Prostate	11	0.3	6,343	332.8	80,116	5,699.3	42,319	15,699.0
Stomach	38	1.0	677	35.5	2,434	173.2	1,300	482.3
Testis	2,771	74.6	4,894	256.8	1,594	113.4	95	35.2
Thyroid	1,066	28.7	4,341	227.8	4,729	336.4	821	304.6
Uterus	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Cancer type	Females – counts, ages 0 to 39	Females – proportion, ages 0 to 39	Females – counts, ages 40 to 59	Females – proportion, ages 40 to 59	Females – counts, ages 60 to 79	Females – proportion, ages 60 to 79	Females – counts, age 80 and older	Females – proportion, age 80 and older
All cancers	**17,986**	**506.2**	**93,273**	**4,718.0**	**193,235**	**12,528.1**	**77,435**	**19,430.5**
Bladder	32	0.9	320	16.2	2,106	136.5	1,918	481.3
Brain	1,198	33.7	996	50.4	880	57.1	230	57.7
Breast (female)	2,011	56.6	34,447	1,742.4	81,738	5,299.4	30,556	7,667.3
Cervix	981	27.6	4,864	246.0	3,884	251.8	729	182.9
Colorectal	333	9.4	4,616	233.5	16,905	1,096.0	13,751	3,450.5
Esophagus	**	**	75†	3.8	367	23.8	183	45.9
Hodgkin lymphoma	1,367	38.5	1,568	79.3	696	45.1	146	36.6
Kidney	451	12.7	1,920	97.1	4,980	322.9	1,904	477.8
Larynx	11	0.3	95	4.8	344	22.3	168	42.2
Leukemia	1,802	50.7	1,570	79.4	3,888	252.1	2,037	511.1
Liver	73	2.1	198	10.0	642	41.6	290	72.8
Lung	124	3.5	1,870	94.6	11,604	752.3	4,844	1,215.5
Melanoma	1,250	35.2	6,199	313.6	10,409	674.9	4,104	1,029.8
Myeloma	25	0.7	570	28.8	2,135	138.4	1,023	256.7
Non-Hodgkin lymphoma	889	25.0	3,441	174.1	9,110	590.6	4,272	1,072.0
Oral cavity and pharynx	135	3.8	1,085	54.9	2,633	170.7	1,100	276.0
Ovary	710	20.0	3,214	162.6	5,337	346.0	1,533	384.7
Pancreas	61	1.7	455	23.0	1,223	79.3	470	117.9
Prostate	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Stomach	53	1.5	521	26.4	1,472	95.4	919	230.6
Testis	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Thyroid	4,274	120.3	17,519	886.2	15,087	978.1	2,600	652.4
Uterus	286	8.1	5,865	296.7	21,802	1,413.5	7,061	1,771.8

Abbreviation: n/a means not applicable

Symbols:
**Suppressed due to small case count of less than six
†Count has been rounded to ensure confidentiality and associated proportion has been adjusted to reflect rounded count

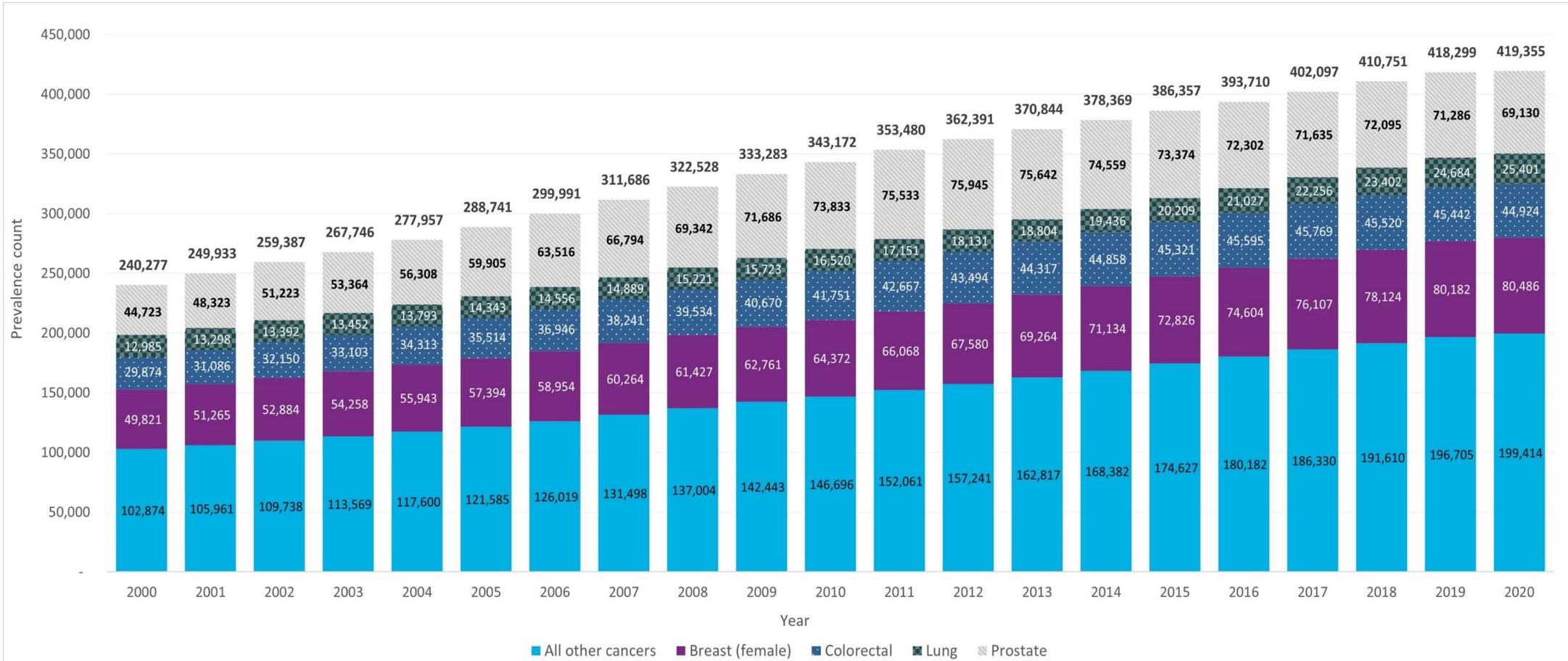
Notes:
- Prevalence counts are based on incidence counts using International Agency for Research on Cancer/International Association of Cancer Registries rules for counting multiple primaries.
- Prevalence proportions are per 100,000 people.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (December 2022), Ontario Health (Cancer Care Ontario)

Prevalence trends by sex and cancer type

The increases over time in 10-year prevalence counts for the most common cancers, all cancers combined and all other cancers are shown in **Figure 5.2**. Growth in prevalence counts over time is expected and is in part attributable to increases in new cancer cases due to a growing and aging population. The highest increases in prevalence counts by cancer type were for female breast cancer and prostate cancer, which have some of the highest survival ratios, while the lowest increases were for colorectal cancer and lung cancer.

Figure 5.2 Ten-year prevalence counts by cancer type, Ontario, 2000 to 2020



Note:

- Prevalence counts are based on incidence counts using International Agency for Research on Cancer/International Association of Cancer Registries rules for counting multiple primaries.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (December 2022), Ontario Health (Cancer Care Ontario)

For males and females combined, the 10-year prevalence counts for most cancer types (not including subsites) increased each decade from 2000 to 2010 to 2020 (**Table 5.3**). Exceptions included malignant brain, cervical, prostate, laryngeal and bladder cancers. For these cancer types, there were either minimal changes or a decline in 10-year prevalence counts between time periods.

- While the prevalence of malignant brain cancer went up over time in males, the prevalence decreased slightly in females from 2010 to 2020.
- In males and in females, the prevalence of laryngeal cancer was stable over time.
- In males, the prevalence of prostate cancer decreased from 2010 to 2020 after a large increase from 2000 to 2010.
- In females, the prevalence of cervical and bladder cancers changed very little over time.

Table 5.3 Ten-year prevalence by cancer type, binary sex and time period, Ontario, 2000, 2010, 2020

Cancer type	Males and females combined – count (2000)	Males and females combined – proportion (2000)	Males and females combined – count (2010)	Males and females combined – proportion (2010)	Males and females combined – count (2020)	Males and females combined – proportion (2020)	Males – count (2000)	Males – proportion (2000)	Males – count (2010)	Males – proportion (2010)	Males – count (2020)	Males – proportion (2020)	Females – count (2000)	Females – proportion (2000)	Females – count (2010)	Females – proportion (2010)	Females – count (2020)	Females – proportion (2020)
All cancers	**240,277**	**2,037.9**	**343,172**	**2,600.1**	**419,355**	**2,839.7**	**116,102**	**1,993.6**	**170,713**	**2,633.2**	**196,776**	**2,696.9**	**124,175**	**2,081.2**	**172,459**	**2,568.1**	**222,579**	**2,979.1**
Brain and other nervous system – malignant	3,034	25.7	3,567	27.0	3,475	23.5	1,596	27.4	1,881	29.0	1,932	26.5	1,438	24.1	1,686	25.1	1,543	20.7
Glioblastoma	394	3.3	610	4.6	882	6.0	219	3.8	358	5.5	516	7.1	175	2.9	252	3.8	366	4.9
All other gliomas	1,382	11.7	1,633	12.4	1,700	11.5	753	12.9	854	13.2	932	12.8	629	10.5	779	11.6	768	10.3
Brain and other nervous system – non-malignant	n/a	n/a	n/a	n/a	17,323	117.3	n/a	n/a	n/a	n/a	6,901	94.6	n/a	n/a	n/a	n/a	10,422	139.5
Meningiomas	n/a	n/a	n/a	n/a	5,556	37.6	n/a	n/a	n/a	n/a	1,572	21.6	n/a	n/a	n/a	n/a	3,984	53.3
Pituitary, pineal and craniopharyngeal duct	n/a	n/a	n/a	n/a	4,477	30.3	n/a	n/a	n/a	n/a	2,108	28.9	n/a	n/a	n/a	n/a	2,369	31.7
Breast (female)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	49,821	835.0	64,372	958.6	80,486	1,077.3
Cervix	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	4,087	68.5	4,060	60.5	4,343	58.1
Ovary	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	3,968	66.5	5,269	78.5	6,038	80.8
Prostate	n/a	n/a	n/a	n/a	n/a	n/a	44,723	767.9	73,833	1,138.9	69,130	947.5	n/a	n/a	n/a	n/a	n/a	n/a
Testis	n/a	n/a	n/a	n/a	n/a	n/a	2,624	45.1	3,255	50.2	3,958	54.3	n/a	n/a	n/a	n/a	n/a	n/a
Uterine	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	9,202	154.2	13,338	198.6	21,018	281.3
Uterus – endometrial	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	8,138	136.4	12,196	181.6	19,957	267.1
Uterus – uterine sarcoma	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	290	4.9	380	5.7	414	5.5
Colorectal	29,874	253.4	41,751	316.3	44,924	304.2	15,521	266.5	22,609	348.7	24,416	334.6	14,353	240.6	19,142	285.0	20,508	274.5
Colon excluding rectum	20,031	169.9	27,682	209.7	29,707	201.2	9,698	166.5	14,090	217.3	15,254	209.1	10,333	173.2	13,592	202.4	14,453	193.5
Colon – left sided	8,617	73.1	12,091	91.6	12,002	81.3	4,613	79.2	6,847	105.6	6,823	93.5	4,004	67.1	5,244	78.1	5,179	69.3
Colon – right sided	10,150	86.1	14,589	110.5	17,207	116.5	4,446	76.3	6,692	103.2	8,180	112.1	5,704	95.6	7,897	117.6	9,027	120.8
Rectum and rectosigmoid junction	10,021	85.0	14,386	109.0	16,200	109.7	5,917	101.6	8,713	134.4	9,763	133.8	4,104	68.8	5,673	84.5	6,437	86.2
Rectosigmoid junction	3,355	28.5	4,221	32.0	3,853	26.1	1,905	32.7	2,441	37.7	2,281	31.3	1,450	24.3	1,780	26.5	1,572	21.0
Rectum	6,666	56.5	10,165	77.0	12,347	83.6	4,012	68.9	6,272	96.7	7,482	102.5	2,654	44.5	3,893	58.0	4,865	65.1
Esophagus	905	7.7	1,326	10.1	1,919	13.0	615	10.6	976	15.1	1,468	20.1	290	4.9	350	5.2	451	6.0
Esophagus – adenocarcinoma	377	3.2	740	5.6	1,242	8.4	312	5.4	638	9.8	1,059	14.5	65	1.1	102	1.5	183	2.5
Esophagus – squamous cell carcinoma	430	3.7	455	3.5	542	3.7	249	4.3	250	3.9	316	4.3	181	3.0	205	3.1	226	3.0
Liver	777	6.6	1,921	14.6	3,190	21.6	536	9.2	1,431	22.1	2,288	31.4	241	4.0	490	7.3	902	12.1
Pancreas	1,231	10.4	1,838	13.9	3,520	23.8	608	10.4	871	13.4	1,820	24.9	623	10.4	967	14.4	1,700	22.8

Cancer type	Males and females combined – count (2000)	Males and females combined – proportion (2000)	Males and females combined – count (2010)	Males and females combined – proportion (2010)	Males and females combined – count (2020)	Males and females combined – proportion (2020)	Males – count (2000)	Males – proportion (2000)	Males – count (2010)	Males – proportion (2010)	Males – count (2020)	Males – proportion (2020)	Females – count (2000)	Females – proportion (2000)	Females – count (2010)	Females – proportion (2010)	Females – count (2020)	Females – proportion (2020)
Stomach	2,596	22.0	3,447	26.1	5,026	34.0	1,614	27.7	2,074	32.0	3,090	42.4	982	16.5	1,373	20.5	1,936	25.9
Larynx	2,339	19.8	2,315	17.5	2,283	15.5	1,950	33.5	1,954	30.1	1,934	26.5	389	6.5	361	5.4	349	4.7
Oral cavity and pharynx	5,702	48.4	7,102	53.8	10,188	69.0	3,867	66.4	4,839	74.6	7,177	98.4	1,835	30.8	2,263	33.7	3,011	40.3
Lip and oral cavity	253	2.2	290	2.2	313	2.1	205	3.5	231	3.6	256	3.5	48	0.8	59	0.9	57	0.8
Hypopharynx	3,308	28.1	3,592	27.2	4,902	33.2	2,205	37.9	2,258	34.8	3,010	41.3	1,103	18.5	1,334	19.9	1,892	25.3
Nasopharynx	554	4.7	683	5.2	738	5.0	381	6.5	456	7.0	512	7.0	173	2.9	227	3.4	226	3.0
Oropharynx	1,242	10.5	2,286	17.3	4,076	27.6	870	14.9	1,738	26.8	3,291	45.1	372	6.2	548	8.2	785	10.5
Thyroid	6,880	58.4	18,349	139.0	27,998	189.6	1,498	25.7	3,618	55.8	6,753	92.6	5,382	90.2	14,731	219.4	21,245	284.4
Thyroid – anaplastic	20†	0.2	20†	0.2	32	0.2	**	**	0	0.0	12	0.2	10	0.2	10	0.2	20	0.3
Thyroid – follicular	682	5.8	816	6.2	885	6.0	162	2.8	189	2.9	235	3.2	520	8.7	627	9.3	650	8.7
Thyroid – medullary	149	1.3	231	1.8	288	2.0	55	0.9	88	1.4	117	1.6	94	1.6	143	2.1	171	2.3
Thyroid – papillary	5,497	46.6	16,169	122.5	26,419	178.9	1,163	20.0	3,123	48.2	6,274	86.0	4,334	72.6	13,046	194.3	20,145	269.6
Leukemia	6,452	54.7	10,452	79.2	13,187	89.3	3,655	62.8	6,046	93.3	7,776	106.6	2,797	46.9	4,406	65.6	5,411	72.4
Acute lymphocytic leukemia	940	8.0	1,250	9.5	1,568	10.6	531	9.1	715	11.0	901	12.4	409	6.9	535	8.0	667	8.9
Acute monocytic leukemia	46	0.4	65	0.5	90	0.6	24	0.4	36	0.6	41	0.6	22	0.4	29	0.4	49	0.7
Acute myeloid leukemia	785	6.7	1,195	9.1	1,776	12.0	377	6.5	608	9.4	940	12.9	408	6.8	587	8.7	836	11.2
Chronic lymphocytic leukemia	3,193	27.1	5,665	42.9	6,671	45.2	1,834	31.5	3,375	52.1	4,091	56.1	1,359	22.8	2,290	34.1	2,580	34.5
Chronic myeloid leukemia	740	6.3	1,225	9.3	1,878	12.7	447	7.7	655	10.1	1,071	14.7	293	4.9	570	8.5	807	10.8
Lymphoma	12,524	106.2	18,672	141.5	28,036	189.9	6,470	111.1	9,815	151.4	15,297	209.7	6,054	101.5	8,857	131.9	12,739	170.5
Hodgkin lymphoma	2,700	22.9	2,937	22.3	3,403	23.0	1,457	25.0	1,552	23.9	1,839	25.2	1,243	20.8	1,385	20.6	1,564	20.9
Non-Hodgkin lymphoma	9,825	83.3	15,743	119.3	24,679	167.1	5,014	86.1	8,265	127.5	13,487	184.9	4,811	80.6	7,478	111.4	11,192	149.8
Non-Hodgkin lymphoma – extranodal	925	7.9	3,221	24.4	12,326	83.5	491	8.4	1,700	26.2	6,736	92.3	434	7.3	1,521	22.7	5,590	74.8
Non-Hodgkin lymphoma – nodal	8,900	75.5	12,525	94.9	12,362	83.7	4,523	77.7	6,568	101.3	6,758	92.6	4,377	73.4	5,957	88.7	5,604	75.0
Myeloma	2,345	19.9	3,590	27.2	6,653	45.1	1,195	20.5	1,974	30.5	3,621	49.6	1,150	19.3	1,616	24.1	3,032	40.6
Melanoma of the skin	11,082	94.0	17,199	130.3	25,083	169.9	5,498	94.4	8,727	134.6	13,261	181.8	5,584	93.6	8,472	126.2	11,822	158.2
Melanoma (non-cutaneous)	628	5.3	763	5.8	1,069	7.2	311	5.3	377	5.8	518	7.1	317	5.3	386	5.8	551	7.4
Melanoma – mucosal	42	0.4	85	0.6	195	1.3	6	0.1	18	0.3	66	0.9	36	0.6	67	1.0	129	1.7
Melanoma – ocular	586	5.0	678	5.1	876	5.9	305	5.2	359	5.5	452	6.2	281	4.7	319	4.8	424	5.7
Lung	12,985	110.1	16,520	125.2	25,401	172.0	7,005	120.3	7,849	121.1	10,948	150.1	5,980	100.2	8,671	129.1	14,453	193.5
Lung – adenocarcinoma	4,868	41.3	6,931	52.5	12,278	83.1	2,226	38.2	2,743	42.3	4,720	64.7	2,642	44.3	4,188	62.4	7,558	101.2

Cancer type	Males and females combined – count (2000)	Males and females combined – proportion (2000)	Males and females combined – count (2010)	Males and females combined – proportion (2010)	Males and females combined – count (2020)	Males and females combined – proportion (2020)	Males – count (2000)	Males – proportion (2000)	Males – count (2010)	Males – proportion (2010)	Males – count (2020)	Males – proportion (2020)	Females – count (2000)	Females – proportion (2000)	Females – count (2010)	Females – proportion (2010)	Females – count (2020)	Females – proportion (2020)
Lung – large cell	528	4.5	404	3.1	346	2.3	279	4.8	209	3.2	181	2.5	249	4.2	195	2.9	165	2.2
Lung – small cell	1,003	8.5	1,107	8.4	1,305	8.8	520	8.9	542	8.4	565	7.7	483	8.1	565	8.4	740	9.9
Lung – squamous cell	3,147	26.7	3,271	24.8	4,440	30.1	2,125	36.5	2,089	32.2	2,620	35.9	1,022	17.1	1,182	17.6	1,820	24.4
Bladder	9,875	83.8	11,063	83.8	11,293	76.5	7,415	127.3	8,466	130.6	8,902	122.0	2,460	41.2	2,597	38.7	2,391	32.0
Kidney	6,192	52.5	9,882	74.9	15,724	106.5	3,659	62.8	5,949	91.8	10,179	139.5	2,533	42.5	3,933	58.6	5,545	74.2

Abbreviation: n/a means not applicable

Symbol:

**Suppressed due to small case count of less than six

†Count has been rounded to ensure confidentiality and associated proportion has been adjusted to reflect rounded count

Notes:

- Prevalence counts are based on incidence counts using International Agency for Research on Cancer/International Association of Cancer Registries rules for counting multiple primaries.
- Because the Ontario Cancer Registry began routinely registering non-malignant brain and other nervous system tumours in 2010, prevalence counts on these cases are only provided for 2010 onwards and are based on Surveillance, Epidemiology and End Results Program rules for counting multiple primary cancers.
- Prevalence proportions are per 100,000 people.
- Counts for cancer subsites and subtypes may not add up to the total because not all subsites and subtypes are included.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (December 2022), Ontario Health (Cancer Care Ontario)

Appendix 1: Data Sources

The Ontario Cancer Registry, which is maintained by Ontario Health (Cancer Care Ontario), is the main data source for this report. Other data sources are noted in footnotes of Tables and Figures. The Ontario Cancer Registry's goals are to collect, analyze and disseminate timely and high-quality information describing cases of cancer diagnosed in people in Ontario. The binary female and male sex terms used in this report refer to the sexes that are received by the Ontario Cancer Registry and therefore do not capture all gender identities (see Statistics by Sex in the About This Report section for more information).

The registry is a dynamic database; new case information and updates to past cases may be added throughout the year. Consequently, the results of analyses vary based on when the data are extracted from the registry.

Ontario Cancer Registry records are created using data collected for purposes other than cancer registration. This information comes from various administrative databases, laboratory reports and clinical records. Four primary sources are used to generate case records in the registry:

- provincial pathology reports from Ontario's public hospital laboratories and private laboratories
- activity-level reporting database, which contains data from Ontario's 14 regional cancer centres and their associated hospitals for selected systemic therapy and all radiation treatment
- admission and discharge information from the Canadian Institute of Health Information's hospital abstracting databases (Discharge Abstract Database, National Ambulatory Care and Reporting System)
- cause-of-death data from the Office of the Registrar General for Ontario in the Ministry of Government and Consumer Services (MGCS) also known as Ministry of Public and Business Service Delivery and Procurement

Safeguarding confidential information is a guiding principle for Ontario Health (Cancer Care Ontario). All activities – from the initial registration of a new cancer case in the Ontario Cancer Registry, through to research and reporting – are governed by the Personal Health Information Protection Act, 2004.(161) This Ontario law governs the collection and use of data, and the disclosure of personal health information. The act designates Ontario Health as a prescribed entity and authorizes the organization to collect, use and disclose personal health information for the purposes of managing and planning Ontario's health system. See our Statement of Information Practices for details.

Data quality

Death certificate only and microscopically confirmed cases

Table A.1 shows the percentage of cases in the Ontario Cancer Registry diagnosed based on a death certificate only and the percentage microscopically confirmed.

Overall, 1.4% of cases diagnosed in 2020 were based on a death certificate only. The percentage ranged from a low of 0.2% for melanoma to a high of 4.6% for pancreatic cancer.

For all cancers combined, 89.6% of cases were microscopically confirmed. This falls slightly below the Surveillance, Epidemiology and End Results Program's recommendation of at least 93% of cases microscopically confirmed.(162) The percentage microscopically confirmed varied from a low of 57.7% for liver cancer to a high of 98.9% for thyroid cancer.

Table A.1 Death certificate only and microscopically confirmed cases by cancer type, Ontario Cancer Registry, 2020

Cancer type	Death certificate only – number of cases	Death certificate only – % of cases	Microscopically confirmed – number of cases	Microscopically confirmed – % of cases
All cancers	**1,018**	**1.4**	**70,547**	**89.6**
Bladder	36	0.9	3,769	97.3
Brain	32	2.7	985	82.0
Breast	64	0.6	10,485	98.1
Cervix	**	**	591	97.8
Colorectal	163	2.0	7,397	92.4
Esophagus	17	1.8	864	92.4
Hodgkin lymphoma	**	**	406	92.5
Kidney	42	1.8	2,164	90.7
Larynx	**	**	374	94.9
Leukemia	19	0.8	1,929	82.6
Liver	45	3.3	776	57.7
Lung	278	2.8	8,238	82.0
Melanoma	8	0.2	3,346	97.1
Myeloma	16	1.2	868	64.0
Non-Hodgkin lymphoma	32	0.8	3,342	83.1
Oral cavity and pharynx	27	1.4	1,784	93.2
Ovary	18	1.4	1,137	89.1
Pancreas	107	4.6	1,701	72.5
Prostate	54	0.7	7,098	94.4
Stomach	26	1.7	1,445	92.9
Testis	**	**	434	96.0
Thyroid	8	0.3	2,380	98.9
Uterus	16	0.5	2,852	97.4

Symbol: **Suppressed due to small case count of less than six

Analysis by: Ontario Cancer Registry, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (December 2022), Ontario Health (Cancer Care Ontario)

Incidence-to-mortality ratio

The age-standardized incidence-to-mortality rate ratio identifies areas of under-coverage in a cancer registry. The incidence-to-mortality ratio for the Ontario Cancer Registry for 2020 was 2.7:1 (**Table A.2**). This ratio meets the Canadian Partnership Against Cancer's recommended ratio of at least 2.3:1 (162), with variation by cancer type. An incidence-to-mortality ratio below the recommended level may indicate incomplete registration of cases.

Table A.2 Age-standardized incidence-to-mortality ratio by cancer type, Ontario, 2020

Cancer type	I:M ratio
All cancers	**2.7**
Bladder	4.8
Brain	1.3
Breast	5.9
Cervix	4.2
Colorectal	2.7
Esophagus	1.1
Hodgkin lymphoma	10.5
Kidney	4.2
Larynx	2.6
Leukemia	2.2
Liver	1.0
Lung	1.5
Melanoma	6.8
Myeloma	2.5
Non-Hodgkin lymphoma	3.6
Oral cavity and pharynx	3.5
Ovary	2.0
Pancreas	1.2
Prostate	4.0
Stomach	2.0
Testis	17.7
Thyroid	33.3
Uterus	5.5

Abbreviation: I means incidence and M means mortality

Note:

- The I:M ratio is the ratio of the age-standardized incidence rate to the age-standardized mortality rate.

Analysis by: Surveillance, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry [incidence (December 2022) and mortality (December 2022)], Ontario Health (Cancer Care Ontario)

Data element completeness

All the data quality indicators met the minimal requirements from the Canadian Cancer Registry guideline, the Gold (i.e., highest) certification standard of the North American Association of Central Cancer Registries, and the Surveillance, Epidemiology and End Results Program guideline:

- Stage capture rates overall and for collaborative staging achieved the provincial target of 90% for breast, prostate, colorectal, lung and cervical cancers in 2020.
- There were no cases missing information about "age at diagnosis," "age at death" or "sex," thereby meeting the North American Association of Central Cancer Registries Gold standard of a maximum of 2% or less. Furthermore, 0.01% of cases were listed as "alive with current age over 100" and no cases were listed as "dead" with missing death date.
- Postal codes were missing for 2.1% of the cases, which is under the 5% Canadian Cancer Registry's threshold for this indicator.
- The 2% of cases with unknown primary (C80.9) also met the less than 2.3% threshold of the Surveillance, Epidemiology and End Results Program standard.

In 2020, 89% of discrete synoptic cancer pathology reports had all mandatory elements complete in accordance with the College of American Pathologists electronic Cancer Checklists.

There are no standards for the average number of sources or notifications per case, or for the percentage of cases with unknown morphology. Cases with a greater number of supporting data sources or notifications are considered to be more complete and credible. The high percentage of unknown morphology raises some concern about data quality and data collection. **Table A.3** presents other data quality measures related to completeness of Ontario Cancer Registry case registration.

Table A.3 Data element completeness estimates, Ontario Cancer Registry, 2020

Measure	Value
Average number of sources or notifications per case	15.5
Cases with unknown primary site of cancer	2.0%
Cases with unknown morphology†	7.0%
Cases staged, all incident (stageable)‡	92.0% (94.5%)
Completeness of Ontario Cancer Registry data collection‡	91.3%
Synoptic pathology reports with mandatory elements	89.0%
Cases missing "age at diagnosis or death"	0.0%
Cases missing "sex"	0.0%
Cases missing "postal code" at diagnosis	2.1%
Patients listed as "alive" with current age >100	0.01%
Patients listed as "dead" missing death date	0.0%

Symbols:
†Histology range 8000 to 8005 (not otherwise specified)
‡For lung, female breast, colorectal, cervical and prostate cancers only

Notes:

- Estimates are for all malignant cases and *in situ* bladder unless noted otherwise.
- Total number of cases is 78,776 and represents 75,094 people.

Analysis by: Ontario Cancer Registry, Ontario Health (Cancer Care Ontario)
Data source: Ontario Cancer Registry (December 2022), Ontario Health (Cancer Care Ontario)

Population data

Population data used for analyses

In this report, the population data for Ontario used in denominators for relevant analyses for years up to 2020 come from Statistics Canada (Table 17-10-0005-01 based on 2016 census population estimates released July 1, 2022).(163) Except where otherwise noted, population data used in denominators for cancer projections (for the years 2021 to 2024) are from the Ontario Ministry of Finance (spring 2021 release).(164)

For Chapter 1: COVID-19 and Cancer in Ontario, the population data for Ontario used in denominators for relevant analyses for the years 2019 to 2022 are from Statistics Canada (Table 17-10-0005-01 based on 2021 census population estimates released December 21, 2022). (163)

Population data used for age-standardization

The population used in this report for age standardization is the 2011 Canadian Standard population (**Table A.4**), which is based on the 2011 Statistics Canada census.

Cancer Care Ontario surveillance reports published before 2016 used the 1991 Canadian Standard population. Therefore, comparing age-standardized rates in this report with the rates in earlier reports is not recommended.

The 1991 Standard population is no longer appropriate because the population age structure has changed considerably since then. Using the 2011 Standard population results in age-standardized rates that are closer to the crude rate (i.e., rate unadjusted for age distribution).

Table A.4 Population counts from the 2011 Canadian Standard population used for age-standardized rates by age group, Canada, 2011

Age group (years)	Population
0 to 4	1,899,064
5 to 9	1,810,433
10 to 14	1,918,164
15 to 19	2,238,952
20 to 24	2,354,354
25 to 29	2,369,841
30 to 34	2,327,955
35 to 39	2,273,087
40 to 44	2,385,918
45 to 49	2,719,909
50 to 54	2,691,260
55 to 59	2,353,090
60 to 64	2,050,443
65 to 69	1,532,940
70 to 74	1,153,822
75 to 79	919,338
80 to 84	701,140
85 and older	643,070

Note:

- Post-censal estimates are based on the 2011 census counts adjusted for census net under-coverage (including adjustment for incompletely enumerated lndian reserves) and the components of demographic growth that took place since that census. lntercensal estimates use counts from two consecutive censuses adjusted for census net under-coverage (including incompletely enumerated lndian reserves and postcensal estimates).

Data source: Statistics Canada. Canada, July 1, 2011 Population by Age Group (both sexes combined). (statcan.gc.ca/en/statistical-programs/document/3207_D12_V4).

Cancer site grouping

The Ontario Cancer Registry codes cancer cases using the third edition of the International Classification of Diseases for Oncology (ICD-O-3) (20). Deaths in the cancer registry are based on the tenth edition of the International Classification of Diseases and Related Health Problems (ICD-10) (165).

In this report, cancer sites are grouped according to the Surveillance, Epidemiology and End Results Program's recode systems, with some exceptions (166). In these exceptions, the cancer groupings were redefined to be more clinically relevant or to align with definitions used by other cancer surveillance systems.The full list of cancer definitions and groupings used in this report are in **Table A.5**.

Table A.5A Definitions for cancer incidence

Cancer type: short form / long form	ICD-0-3 Site and histology code
Bladder / urinary bladder	C67
Brain / brain and other nervous system	C70–C72, C75.1–C75.3
Glioblastoma	C71 with histologies 9440, 9441, 9442
All other gliomas	C71 with histologies 9380-9385, 9391–9439, 9443–9444, 9446–9460
Meningiomas	C70.0-C70.1, C70.9 with histologies 9530–9534, 9537-9539
Pituitary, pineal and craniopharyngeal duct	C75.1–C75.3
Breast (female)	C50
Cervix / cervix uteri	C53
Colorectal / colon and rectum	C18.0, C18.2–C20, C26.0
Colon / colon excluding rectum	C18.0, C18.2–C18.9
Colon - left-sided	C18.5, C18.6, C18.7
Colon - right-sided	C18.0, C18.2, 18.3, C18.4
Rectum and rectosigmoid junction	C19.9, C20.9
Rectosigmoid junction	C19.9
Rectum	C20.9
Esophagus	C15
Esophagus - adenocarcinoma	C15 with histologies 8140–8573
Esophagus - squamous cell carcinoma	C15 with histologies 8050–8082
Kidney	C64.9
Larynx	C32
Leukemia	C42.0, C42.1, C42.4 with histologies 9811–9818, 9837,9823 9827. Histologies 9826, 9835–9836, 9820, 9832–9834, 9940, 9840, 9861, 9865–9867, 9869, 9871–9874, 9895–9897, 9898, 9910–9911, 9920, 9891, 9863, 9875–9876, 9945–9946, 9860,

Cancer type: short form / long form	ICD-0-3 Site and histology code
	9930, 9801, 9805–9809, 9931, 9733, 9742, 9800, 9831, 9870, 9948, 9963–9964
Acute lymphocytic leukemia	Histologies 9826, 9835–9836 C42.0, C42.1, C42.4 with histologies 9811–9818, 9837
Acute monocytic leukemia	9891
Acute myeloid leukemia	Histologies 9840, 9861, 9865–9867, 9869, 9871–9874, 9895–9897, 9898, 9910–9911, 9920
Chronic lymphocytic leukemia	C42.0, C42.1, C42.4 with histology 9823
Chronic myeloid leukemia	Histologies 9863, 9875–9876, 9945–9946
Liver / liver and intrahepatic bile duct	C22.0, C22.1
Lung / lung and bronchus	C34
Lung – adenocarcinoma / adenocarcinoma (NSCLC)	C34 with histologies 8015, 8050, 8140–1, 8143–5, 8147, 8190, 8201, 8211, 8250–5, 8260, 8290, 8310, 8320, 8323, 8333, 8401, 8440, 8470–1, 8480–1, 8490, 8503, 8507, 8550, 8570–2, 8574, 8576
Lung - large cell / large cell carcinoma (NSCLC)	C34 with histologies 8012–4, 8021, 8034, 8082
Lung - small cell / small cell carcinoma	C34 with histologies 8022, 8041, 8045
Lung - squamous cell / squamous cell carcinoma (NSCLC)	C34 with histologies 8051–2, 8070–6, 8078, 8083–4, 8090, 8094, 8120, 8123
Lymphoma	All sites with histologies 9650–9667; Histologies 9590–9597, 9670–9671, 9673, 9675, 9678–9680, 9684, 9687, 9689–9691, 9695, 9698–9702, 9705, 9708–9709, 9714–9719, 9727–9729; All sites other than C42.0, C42.1, C42.4 with histologies 9823, 9827
Hodgkin lymphoma	All sites with histologies 9650–9667
Non-Hodgkin lymphoma	Histologies 9590–9597, 9670–9671, 9673, 9675, 9678–9680, 9684, 9687, 9689–9691, 9695, 9698–9702, 9705, 9708–9709, 9714–9719, 9727–9729; All sites other than C42.0, C42.1, C42.4 with histologies 9823, 9827

Cancer type: short form / long form	ICD-0-3 Site and histology code
Non-Hodgkin lymphoma – extranodal	All sites except C02.4, C09.8–C09.9, C11.1, C14.2, C37.9, C42.2, C77.0–C77.9 with histologies 9590–9597, 9670–9671, 9673, 9675, 9678–9680, 9684, 9687, 9688, 9689–9691, 9695, 9698–9702, 9705, 9708–9709, 9712, 9714–9719, 9724–9729, 9735, 9737, 9738 All sites except C02.4, C09.8–C09.9, C11.1, C14.2, C37.9, C42.0–C42.2, C42.4, C77.0–C77.9 with histologies 9811–9818, 9823, 9827, 9837
Non-Hodgkin lymphoma – nodal	C02.4, C09.8, C09.9, C11.1, C14.2, C37.9, C42.2, C77 with histologies 9590–9597, 9670–9671, 9673, 9675, 9678–9680, 9684, 9687–9691, 9695, 9698–9702, 9705, 9708–9709, 9712, 9714–9719, 9724–9729, 9735, 9737–9738, 9811–9818, 9823, 9827, 9837
Melanoma (non-cutaneous)	C00–14, C20–C21, C30–31, C51–63, C69 with histologies 8720–8774
Melanoma - mucosal	C00–14, C20–C21, C30–31, C51–63
Melanoma - ocular	C69
Melanoma / melanoma of the skin	C44 with histologies 8720–8790
Myeloma / multiple myeloma	9731–9732, 9734
Oral cavity and pharynx	C00–C06, C09–C14
Lip and oral cavity	C00, C02, C03, C04, C05.0, C06
Hypopharynx	C12.9, C13
Nasopharynx	C11
Oropharynx	C01.9, C05.1, C05.2, C09, C10
Ovary	C56.9
Pancreas	C25
Prostate	C61.9
Stomach	C16
Testis	C62
Thyroid	C73.9
Thyroid - anaplastic / anaplastic carcinoma	C73.9 with histologies 8012, 8020–8021, 8030–8032
Thyroid - follicular / follicular carcinoma	C73.9 with histologies 8290, 8330–8332, 8335
Thyroid - medullary / medullar carcinoma	C73.9 with histologies 8345, 8346, 8510
Thyroid - papillary / papillary carcinoma	C73.9 with histologies 8050, 8260, 8340–8344
Uterus / corpus and uterus NOS (not otherwise specified)	C54, C55.9
Uterus - endometrial	C54, C55.9 with histologies 8050, 8140, 8143,8 210–8211, 8255, 8260–8263, 8310, 8323, 8340,

Cancer type: short form / long form	ICD-0-3 Site and histology code
	8380–8384, 8441, 8460–8461, 8560, 8570, 8950–8951, 8980–8981
Uterus - sarcoma	C54, C55.9 with histologies 8800–8802, 8805, 8890–8891, 8896, 8900, 8910, 8930–8931

Abbreviations:
ICD-O-3 means International Classification of Disease for Oncology, Third Edition
NOS means Not otherwise specified
NSCLC means Non-small cell lung cancer

Notes:

- Histology types 9590 to 9989 (leukemias, lymphomas and hematopoietic diseases), 9050 to 9055 (mesothelioma) and 9140 (Kaposi sarcoma) are excluded from other specific organ sites.
- Histology types 8720 to 8774 (mucosal melanoma) are excluded from the following sites (and selected subsites): colorectal, ovary, uterine, cervix, prostate, testis and oral cavity and pharynx.

Table A.5B Definitions for cancer mortality

Cancer type: short form / long form	ICD-10 code
Bladder / urinary bladder	C67
Brain / brain and other nervous system	C70–C72, C75.1–C75.3
Breast (female)	C50
Cervix / cervix uteri	C53
Colorectal / colon and rectum	C18.0, C18.2–C20, C26
Esophagus	C15
Hodgkin lymphoma	C81
Kidney	C64
Larynx	C32
Leukemia	C90.1, C91.0–C91.7, C91.9, C92.0–C92.4, C92.6–C92.9, C93.0–C93.3, C93.7, C93.9, C94.0–C94.5, C94.7, C95.0–C95.2, C95.7, C95.9
Liver / liver and intrahepatic bile duct	C22.0–C22.4, C22.7, C22.9
Lung / lung and bronchus	C34
Melanoma / melanoma of the skin	C43
Myeloma / multiple myeloma	C90.0, C90.2, C90.3
Non-Hodgkin lymphoma	C82–C86, C96.3
Oral cavity and pharynx	C00–C06, C09–C14
Ovary	C56
Pancreas	C25
Prostate	C61
Stomach	C16
Testis	C62
Thyroid	C73
Uterus / corpus and uterus NOS (not otherwise specified)	C54–C55

Abbreviation: ICD-10 means International Statistical Classification of Diseases and Related Health Problems, Tenth Revision

Non-melanoma skin cancer

Data in this report exclude cases of basal cell and squamous cell carcinoma of the skin, the most common types of non-melanoma skin cancer.

These tumours are generally not life-threatening and are treated in outpatient settings. Although these cases are captured in pathology reports, their large number poses a challenge for data capture and quality assurance. These challenges prevent the Ontario Cancer Registry from capturing complete, accurate, timely and consistent data on non-melanoma skin cancer, which are requirements of a robust surveillance system. Ontario Health is currently exploring ways to conduct surveillance of non-melanoma skin cancer and expects to report on statistics for this group of cancers in the future.

Cancer stage at diagnosis

The tumour-node-metastasis (TNM) system is the most widely used classification system for stage at diagnosis. It is recognized as the international standard for describing the anatomical extent of cancers. TNM definitions, now in their eighth edition, are maintained by the Union for International Cancer Control and the American Joint Committee on Cancer. The stage data for diagnosis year 2018 onwards in this report are based on the eighth edition of TNM (167), while previous years (2010 to 2017 years of diagnosis) use collaborative stage (see Recent Changes in Cancer Staging, Coding and Case Creation Standards for more information on this change).

Collaborative staging (2010 to 2017 years of diagnosis) was a staging approach used by central cancer registries. Collaborative staging brought together the principles of the following:

- National Cancer Institute's Surveillance, Epidemiology and End Results Program Summary Stage
- TNM categories and stage groupings
- Surveillance, Epidemiology and End Results extent of disease coding structure

Most of the collaborative staging data items were traditionally collected by some cancer registries. These items included tumour size, extension, lymph node status and metastatic status. Other data, such as site-specific or histology-specific factors (e.g., Gleason score and receptor status), were specific to collaborative staging. The data were used to derive the "best stage" grouping consistent with the American Joint Committee on Cancer Staging Manual (in its eighth edition). (167)

Ontario Cancer Registry staging values for invasive cancer range from stage 1, which means the disease is in the early phase, to stage 4, which means the cancer has spread (or metastasized) to other organs or places in the body. An "unknown stage" is the result of limited stage workup, limited documentation in the person's health record or both. "Not staged" means no attempt at staging has taken place.

Starting with cases diagnosed on January 1, 2005, the Ontario Cancer Registry phased in various versions of collaborative staging by reporting selected cancer type and hospital (see the list of contributing hospitals and regional cancer centres below). Collaborative staging was fully

implemented for breast, lung, colorectal and prostate cancers in 2010; for ovarian, uterine and cervical cancers, and melanoma in 2011; and for thyroid cancer in 2013.

Cancer cases in the Ontario Cancer Registry that do not have information on the stage at diagnosis (i.e., "not staged" and "unknown") are excluded from all analyses in this report.

- Cases may be **"not staged"** for various reasons, including a lack of access to clinical records. The number of cases not staged varies by cancer type and year. For example:
    - In 2017 (collaboratively staged cancers), approximately 6.5% of breast, 12.1% of colorectal, 16.6% of lung and 7.4% of prostate cancer cases were not able to be reviewed and staged.
    - In 2020 (TNM staged cancers), approximately 3.9% of breast, 7.9% of colorectal, 5.7% of lung and 4.8% of prostate cancer cases were not able to be reviewed and staged. The percentages of "not staged" cases are not directly comparable with 2017, given the increase in the percentage of "unknown" stage since 2017 described below. There is evidence of a higher number of "not staged" cases in 2020 compared with 2019 and 2018 for some cancers. This could be related to greater restrictions in accessing documentation required for staging and other operational challenges in 2020.
- Stage at diagnosis may be **"unknown"** for various reasons, including inadequate documentation in the patient's medical record. Even if there are some stage data elements collected to partially stage a cancer, if an overall stage group cannot be derived, it is considered "unknown." The number of cases with unknown stage varies by cancer type and year. For example:
    - In 2017 (collaboratively staged cancers), approximately 0.5% of breast, 2.4% of colorectal, 0.3% of lung and 0.2% of prostate cancer cases were staged as unknown, due to missing documentation for key data elements used to derive stage group.
    - In 2020 (TNM staged cancers), approximately 10.4% of colorectal and 10.5% of prostate cancer cases were staged as unknown, due to missing documentation for key data elements used to derive stage group.

Recent changes in cancer staging, coding and case creation standards

Changes in coding and case creation standards implemented in 2018 provide cancer registries with a standard set of rules to follow when coding and counting distinct cancers.

- The 2018 Surveillance, Epidemiology and End Results Solid Tumor Coding Rules replaced the 2007 Surveillance, Epidemiology and End Results Multiple Primary and Histology Coding Rules for cases diagnosed from January 1, 2018, onward in the Ontario Cancer Registry. While this update has not resulted in significant changes in incidence for overall cancer sites, there have been changes to some subtypes and histology codes.
- With the new coding rules, ambiguous terminology (e.g., "with features of") is no longer used to determine a subtype or histology code. As a result, the prevalence of histological subtypes

that have been affected by the new rules may appear to have decreased in 2018. However, this is not a true decrease because the 2018 Surveillance, Epidemiology and End Results Solid Tumor Coding Rules have grouped some subtypes under one histology code. One of the sites where this 2018 rule has the greatest impact is breast.

Beginning with the 2018 diagnosis year, the Collaborative Stage Data Collection System was decommissioned by the Canadian Council of Cancer Registries and use of the eighth edition of the American Joint Committee on Cancer's tumour-node-metastases staging system (TNM 8th edition) was mandated.

- TNM 8th edition has stricter requirements than the Collaborative Stage Data Collection System for key data elements when mapping to an overall stage group. Due to these stricter requirements, since 2018 there has been an increase in unknown stage group cancers and a shift in stage distribution for certain cancer types compared with previous years. As a result, it is recommended that comparisons be avoided between pre- and post-2018 stage data.
- The introduction of TNM 8th edition resulted in unknown stage group cancers. This increase is primarily due to the lack of the computer algorithm that was part of the Collaborative Stage Data Collection System, which derived a "combined best stage" using whatever clinical and pathological data elements the cancer registrar was able to collect from the patient record.

Contributing facilities to activity-level reporting data used for population-level staging, Ontario

Regional cancer centres

- Cancer Centre of Southeastern Ontario
- Carlo Fidani Regional Cancer Centre
- Grand River Regional Cancer Centre
- Juravinski Cancer Centre
- London Regional Cancer Program
- Northeast Cancer Centre
- Odette Cancer Centre
- Princess Margaret Cancer Centre
- R.S. McLaughlin Durham Regional Cancer Centre
- Regional Cancer Care Northwest
- Simcoe Muskoka Regional Cancer Centre
- Stronach Regional Cancer Centre
- The Ottawa Hospital Cancer Program
- Windsor Regional Cancer Centre

Contributing facilities to Ontario Cancer Registry population-level staging, Ontario

Hospitals

- Alexandra Marine and General Hospital
- Alexandra Hospital
- Bluewater Health
- Bluewater Health Sarnia General
- Brant Community Healthcare System – Brantford
- Brockville General Hospital
- Cambridge Memorial Hospital
- Cambridge Memorial Hospital
- Chatham Kent Health Alliance – Chatham
- Collingwood General and Marine Hospital
- Cornwall Community Hospital
- Four Counties Health Services Corp
- Georgian Bay General Hospital – Midland
- Grand River Hospital Corp – Waterloo
- Grey Bruce Health Services – Owen Sound
- Guelph General Hospital
- Halton Healthcare Services
- Halton Healthcare Services Corp – Oakville
- Hamilton Health Sciences Corporation – Juravinski
- Hawkesbury and District General Hospital
- Headwaters Health Care Centre – Dufferin
- Health Sciences North – Laurentian Site
- Hopital Montfort
- Humber River Hospital – Wilson Site
- Joseph Brant Hospital
- Kemptville District Hospital
- Kingston Health Sciences Centre (HDH)
- Kingston Health Sciences Centre – Kingston General
- Kirkland and District Hospital
- Lake of the Woods District Hospital
- Lakeridge Health – Oshawa
- Lennox and Addington County General Hospital
- Listowel Memorial Hospital
- London Health Sciences Centre – Victoria Hospital
- Mackenzie Health – Richmond Hill Hospital
- Markham Stouffville Hospital
- Muskoka Algonquin Healthcare – Bracebridge
- Muskoka Algonquin Healthcare – Huntsville
- Niagara Health System – St. Catharines General
- Norfolk General Hospital
- North Bay Regional Health Centre
- North York General Hospital
- Northumberland Hills Hospital
- Orillia Soldiers' Memorial Hospital
- Ottawa Hospital (The)
- Pembroke Regional Hospital Inc.
- Perth & Smiths Falls District – Smiths Falls
- Peterborough Regional Health Centre
- Queensway Carleton Hospital
- Quinte Healthcare Corporation – Belleville
- Renfrew Victoria Hospital
- Riverside Health Care Facility
- Ross Memorial Hospital
- Royal Victoria Regional Health Centre
- Sault Area Hospital – Sault Ste Marie
- Scarborough Health Network – Centenary
- Scarborough Health Network – Scarborough General Site
- Sinai Health System
- Sinai Health System – Mount Sinai Site
- South Bruce Grey Health Centre – Kincardine
- Southlake Regional Health Centre

- St. Joseph's General Hospital
- St. Joseph's Health Care – London
- St. Joseph's Health Care System – Hamilton
- St. Mary's General Hospital
- St. Mary's Memorial Hospital
- St. Thomas Elgin General Hospital
- Stevenson Memorial Hospital – Alliston
- Stratford General Hospital
- Strathroy Middlesex General Hospital
- Sunnybrook Health Sciences Centre
- Temiskaming Hospital
- Thunder Bay Regional Health Sciences Centre
- Tillsonburg District Memorial Hospital
- Timmins & District General Hospital
- Toronto East Health Network – Michael Garron Hospital
- Trillium Health Partners Credit Valley
- Trillium Health Partners Mississauga
- Trillium Health Partners Queensway Health
- Unity Health Toronto St. Joseph's
- Unity Health Toronto St. Michael's
- University Health Network Princess Margaret
- West Parry Sound Health Centre
- William Osler Health Centre
- Winchester District Memorial Hospital
- Windsor Regional Hospital – Metropolitan
- Windsor Regional Hospital – Ouellette Campus
- Women's College Hospital
- Woodstock General Hospital

Coding rules for multiple primary cancers

Different rules exist to determine whether a cancer is a new primary cancer or an extension of a previous cancer. Following a recent rebuild, and similar to other North American cancer registries, the Ontario Cancer Registry adopted the Surveillance, Epidemiology and End Results Program's rules for counting multiple primaries and assigning histology (168).

To identify multiple primary cancers, the Surveillance, Epidemiology and End Results counting rules take into account histology, site, laterality and time since the initial diagnosis. The Surveillance, Epidemiology and End Results rules are more liberal than the rules previously used in the Ontario Cancer Registry for counting multiple primaries in their definition of a new primary case.

The Surveillance, Epidemiology and End Results rules for multiple primary cancers have been applied to cases in the Ontario Cancer Registry diagnosed on or after January 1, 2010.

Cases from the years before the Surveillance, Epidemiology and End Results rules adoption (i.e., 1964 to 2009) have been imported into the new Ontario Cancer Registry from the Ontario Cancer Registry Information System for continued analytic use. The Ontario Cancer Registry Information System applied a modified version of the International Agency for Research on Cancer/International Association of Cancer Registries (IARC/IACR) rules (169), which are more conservative than the Surveillance, Epidemiology and End Results rules. Under the IARC/IACR rules, only one tumour is registered for an organ, irrespective of time, unless there are histological differences. ln this report, data were converted using the IARC/IACR rules when:

- trend analyses span both the Ontario Cancer Registry (2010 onward) and Ontario Cancer Registry Information System (1983 to 2009)
- comparisons are made between data from the two registry systems

When data are presented only from 2010 onward, the Surveillance, Epidemiology and End Results Program rules were applied.

Given that the Surveillance, Epidemiology and End Results rules are more liberal than the IARC/IACR rules, applying the Surveillance, Epidemiology and End Results Program rules results in an increase in the number of cases included in incidence counts. This increase is a result of using a different methodology and does not reflect an actual increase in the number of people diagnosed with cancer. In 2020, 4.1% of new cases were considered multiple primaries in Ontario.

Childhood cancer data

The Pediatric Oncology Group of Ontario Networked Information System (POGONIS), maintained by the Pediatric Oncology Group of Ontario (POGO) and funded by the Ontario Ministry of Health, is the data source for the age group zero to 14 years. POGONIS is a reliable, validated data source used to estimate incidence, inform policy and planning, and provide essential data for research on childhood cancer cases in Ontario.

POGONIS, like the Ontario Cancer Registry, is a dynamic database, with data continuously being entered into it. The childhood cancer data used in this report were extracted from POGONIS in May 2023.

POGONIS is a population-based registry and database that captures detailed demographic, diagnostic, treatment and outcome information starting in 1985 on all children and adolescents diagnosed or treated with cancer in a specialized childhood cancer program in Ontario. Standardized POGONIS data are actively collected by dedicated data managers or clinical research associates at each of the five tertiary centres with specialized childhood cancer programs across Ontario. The information comes from comprehensive hospital chart review, internal hospital information systems and direct connections with patient health care teams. Death information in POGONIS is validated and supplemented via annual record linkage to the Ontario Cancer Registry and the Ontario Registrar General Death File under a data sharing agreement with Ontario Health (Cancer Care Ontario) to systematically capture deaths in the entire cohort.

POGO is also designated as a Prescribed Entity under the Ontario, Personal Health Information Protection Act, 2004. POGO has created and operationalized detailed policies and procedures that govern all aspects of the collection, use and disclosure of personal health information.

Classification

The Pediatric Oncology Group of Ontario Networked Information System (POGONIS) database classifies childhood cancer according to the International Classification of Childhood Cancer, third edition (ICCC-3).(170) This classification divides childhood cancer into 12 main diagnostic groups and 47 sub-groups for additional refinement.

The classification of each case applied in this analysis is true to the timing of the diagnosis and the associated International Classification of Diseases for Oncology (ICD-O) morphology code for that period. Because the ICCC-3 (published in 2005) does not incorporate coding changes made in the updated version of the ICD-O-3 system (ICD-O-3.2, published in 2019), the Pediatric Oncology Group of Ontario (POGO) has incorporated changes to the ICD-O-3.2 codes into an updated ICCC classification based on Ontario clinical and epidemiological expertise. Details of the differences in coding between POGONIS and the ICCC-3 are available in the Pediatric Oncology Group of Ontario surveillance report.

Population data

Included in incidence, mortality and survival analyses:

- children diagnosed from ages zero to 14 years and residents of Ontario who were treated in a specialized childhood cancer program in Ontario with a diagnosis included in the in Pediatric Oncology Group of Ontario (POGO) updated ICCC-3 classification system

Excluded from incidence, mortality and survival analyses:

- children who were not residents of Ontario, but who were diagnosed or treated in a specialized childhood cancer program in Ontario
- cases not diagnosed and fully treated in a specialized childhood cancer program in Ontario

The population used in this report for age standardization of childhood cancers is the 2011 Canadian Standard population (**Table A.4**).

Coding rules for multiple primary cancers

Childhood cancer incidence counts and rates are based on all cases of cancer diagnosed in children, ages zero to 14 years at time of diagnosis for the 1988 to 2022 period who were diagnosed in a specialized childhood cancer program in Ontario and registered in the Pediatric Oncology Group of Ontario Networked Information System (POGONIS). Every occurrence of childhood cancer is considered an incident (or new) case. Following the International Agency for Research on Cancer rules for primary cancers, the Pediatric Oncology Group of Ontario (POGO) registers or counts neoplasms of different morphology as multiple cancers (even if they are diagnosed simultaneously in the same site).(169)

COVID-19 data

The COVID-19 data for this report are from cases reported to public health units and recorded in the Public Health Case and Contact Management Solution (CCM). CCM is a dynamic reporting system that adds new case information and includes updates to past cases. Therefore, the results of analyses will vary based on when the data are extracted.

For the analyses in this report, data were extracted from CCM on March 1, 2023 and were subject to the following:

- Inclusions
  - confirmed cases of COVID-19, as per the Ontario Ministry of Health's case definition (171)
  - only someone's first episode of COVID-19 because their first episode was likely the most severe (171)

- Exclusions
  - probable cases or reinfections with COVID-19, as per the Ontario Ministry of Health's case definition (171)
  - cases that were not reported to a public health unit (e.g., positive COVID-19 cases based on at-home rapid antigen tests) (171)

Additionally, the following definitions were applied to the selection of cases for analysis:

- **People with cancer and COVID-19 positive:** people that had a cancer diagnosis prior to having COVID-19 within the time period noted on relevant Figures. The years of cancer diagnosis included in each analysis varies as described in Appendix 2: Analysis.
- **People with cancer and COVID-19 negative/not tested:** people that had a cancer diagnosis and either no COVID-19 or no test for COVID-19 within the time period noted on relevant Figures. The years of cancer diagnosis included in each analysis varies as described in Appendix 2: Analysis.
- **General population and COVID-19 positive:** people that had a confirmed case of COVID-19 and no cancer diagnosis within the time period noted on relevant Figures.

Appendix 2: Analysis

Significance testing

Throughout this report, the word "significant" refers to statistical significance at an alpha level of 0.05 for changes in trend or when comparing differences in rates or ratios. When referring to changes in trends, statistically non-significant changes are described in this report as "stable." Any other noted trend changes (increasing or decreasing) are statistically significant. In some instances (such as for survival statistics), statistical significance is assessed using a confidence interval, which accounts for variations and chance errors, and represents the frequency that the actual (true, but unknown) measure is within the interval, here 95% of the time.

COVID-19 and cancer

Incidence trends and cancer stage

Study design

- Cancer outcomes (frequency of new cancer diagnoses, stage at diagnosis) are reported according to the date (e.g., year or month) of diagnosis (cross-sectional design).

Inclusion criteria

- All primary cancer cases diagnosed from 2019 to 2022 are included, which may include multiple cases for one person in accordance with the National Cancer Institute's Surveillance, Epidemiology and End Results standards for counting multiple primary cancers.
- Cancer stage data for this report are based on TNM 8th edition; details can be found in the Appendix 1: Data Sources.

Data limitations

- Reporting delay can affect incidence counts. Delays can be due to a lack of cancer coding capacity in Ontario hospitals, which serve as one of the data sources of the Ontario Cancer Registry. Reporting delay mostly affects cancer cases diagnosed in 2022.
- Cancer reporting completeness was not considered an issue for the statistics in 2020 because enough time has now passed to allow for complete collection of case information. However, an estimated 1.4% of new cancer cases may be missing in the Ontario Cancer Registry for 2021 and 2022 at the time of analysis. These cases represent incident cases that are identified exclusively from death certificates, which are referred to as death certificate only cases. In addition, the data for 2022 include some cancer cases that were still undergoing validation by the Ontario Cancer Registry.

Analysis

- Age-standardized incidence rates by cancer type used the 2011 Canadian Standard population with the following age groups to calculate rates using the direct method (i.e., to provide observations in each age group): zero to 39, 40 to 49, 50 to 59, 60 to 69, 70 to 79, 80 and older.
- Wilcoxon rank sum test is used to test for significance at an alpha level of 0.05 between early and advanced stage cancers. Chi-square test for statistical significance at an alpha level of 0.05 is used to determine a difference in number of people with unknown cancer stage.

COVID-19 hospitalization

Study design

- Using linked historical data sets, people diagnosed with cancer from 2015 to 2020 were followed through time to determine whether they were hospitalized within approximately two weeks (see below) of a lab-confirmed positive test for COVID-19 (retrospective cohort design).

Inclusion criteria

- People who were diagnosed with cancer from 2015 to 2020 were included. For people with a history of two or more primary cancers, only the most recent primary cancer within the analysis period was included. It was assumed that the most recent cancer would have the greater impact on their recent health.
- COVID-19 hospitalizations were identified using the Case and Contact Management Solution. Cases flagged as hospitalized in these data and with a hospital admission date within 14 days after or three days before the first COVID-19 symptom or positive test result were included in the analyses. These COVID-19 timelines were chosen to distinguish between COVID-19 infections that were acquired outside the hospital setting versus those in the hospital setting. However, there is no indication whether people with COVID-19 were hospitalized due to COVID-19 or from an unrelated cause.

Data linkage

- COVID-19 cases were linked to cancer cases using health card number, date of birth and sex. If a person with cancer had no matching record in the Case and Contact Management Solution database or if their recorded COVID-19 case occurred after 2021, their COVID-19 status was assigned as “negative/not tested”.

Analysis

- Rates were calculated using the person-days denominator. If hospitalized, the days from the first COVID-19 symptom (when date was available) or positive test date to the hospital admission date was calculated. If someone did not test positive until after being admitted to the hospital, their follow-up time was set to zero. For people who were never hospitalized, the person-days denominator was the full 14-day follow-up post-COVID-19 because this is when cases are deemed resolved in the Case and Contact Management Solution.

- Age-standardized incidence rates were calculated using the direct method and the 2011 Canadian Standard population with the following age groups (i.e., to provide observations in each age group): zero to 19, 20 to 29, 30 to 39, 40 to 49, 50 to 59, 60 to 69, 70 to 79, 80 and older.

Mortality trends and excess deaths

Study design

- Cancer outcomes (frequency of deaths, excess deaths) are reported according to the date (e.g., year or month) of diagnosis (cross-sectional design).

Inclusion criteria

- People diagnosed with cancer from 1981 to 2022 were included. For people with a history of two or more cancers, only the most recent cancer within the analysis period was included so deaths would not be double counted.
- Fact of death (i.e., all-cause mortality) was considered for these analyses.

Analysis – excess deaths

- The Farrington surveillance algorithm implemented in the R software surveillance package was used to estimate excess mortality.(172,173) The number of all cause deaths from 2015 to 2019 among the cancer population (diagnosed from 1981 to 2021) were aggregated by month and used to calculate expected deaths for 2020 and 2021. The model provides an expected count and a one-sided 95% upper bound prediction interval. The number of excess deaths is calculated by subtracting the monthly observed deaths from the expected deaths, where if the number of deaths falls below the expected, the excess deaths is set to zero. Monthly excess deaths were summed to produce a total number of excess deaths for 2020 and 2021.

Data limitations

- Reporting delay can affect mortality counts but is expected to be less problematic than reporting of incident counts.
- Cause of death information was not included because it was only complete in the Ontario Cancer Registry up to 2020 at the time of analysis.

Premature mortality

Study design

- Using linked historical data sets, people diagnosed with cancer were followed through time to determine their vital status within a calendar year and whether they died before age 75 (retrospective cohort design). People most recently diagnosed with cancer (2018 to 2020) were followed through time to determine whether they had a positive lab test for COVID-19.

Inclusion criteria

- People diagnosed with cancer from 2015 to 2017 (pre-COVID-19 pandemic 2017 rates) and from 2018 to 2020 (COVID-19 pandemic 2020 rates) were included. For people with a history of two or more primary cancers, only the most recent primary cancer within the analysis period was included. It was assumed that the most recent cancer would have the greater impact on their recent health.
- COVID-19 status was obtained from the Case and Contact Management Solution as described above.

Data linkage

- COVID-19 cases were linked to cancer cases using health card number, date of birth and sex assigned at birth. If a cancer case had no matching record in the Case and Contact Management Solution or if their recorded COVID-19 case occurred after 2021, their COVID-19 status was assigned as "negative/not tested."

Analysis

- Rates were calculated using the cancer population under age 75 as the denominator for each period.
- Age-standardized rates were calculated by the direct method with five-year age groups using the 2011 Canadian Standard population.

Survival

Study design

- People diagnosed with cancer were followed through time to determine their vital status after one and two years of follow-up time since cancer diagnosis (retrospective cohort design).

Inclusion and exclusion criteria

- People ages 15 to 99 who were diagnosed with cancer from 2018 to 2020.
- For people with cancer who have a history of two or more cancers, only the first primary cancer per person within the analysis period was included.
- Death certificate or autopsy only cancer cases are excluded because they had no follow-up time.

Analysis

- Relative survival ratios are estimated by comparing the survival of people with cancer (observed survival) with the survival of similar people in the general population of Ontario during the same time period (expected survival). Methods are outlined in detail in the main report analysis section.
- Three-year complete life tables for Ontario up to 2018/2020 were used (Statistics Canada, January 24, 2022 release).(45)
- Relative survival ratios were age-standardized by weighting with the International Cancer Survival Standard weights.(52) See **Table A.8** for details on weightings.

Data limitations

- Life table estimates for the COVID-19 pandemic years were not available at the time of analysis. A three-year estimate based on the 2018 to 2020 was used instead for each year between 2019 and 2022.

Probability of developing or dying from cancer

The probability of developing or dying from cancer refers to the probability at birth of someone developing or dying from cancer at some point during their lifetime. Lifetime risk calculations are based on incidence data from 2016 to 2019 and mortality rates from 2016 to 2020. Therefore, these risk calculations assume that the current rates within each age group will remain constant during the life of the person.

The probability of developing or dying from cancer was calculated using DevCan software.(174) The DevCan software program uses life table methods based on cross-sectional incidence, mortality and population data for 18 age groups to compute the lifetime and age-conditional probabilities of developing or dying from cancer.

Projections

Projections of incidence from 2021 to 2024 and mortality from 2021 to 2024 were estimated using the Canproj projection package (175) in R software (176). The Canproj package is a modified version of Nordpred Power 5 package (177), which is based on an age-period-cohort Poisson regression model. The Canproj package has enhancements that overcome difficulties in the standard Poisson model and improve projection accuracy.

To generate incidence projections (for 2021 to 2024), cases from 1986 to 2019 that meet the International Association for Research on Cancer/International Association of Cancer Registries multiple primary rules were used and then converted to the Surveillance, Epidemiology and End Results rules, described below. To generate mortality projections (for 2021 to 2024), cancer deaths from 1986 to 2020 were included.

The Ontario populations used for the cancer incidence and mortality projections were from population projections up to 2046 derived by the Ontario Ministry of Finance. The methodology and assumptions for the projected populations can be found elsewhere.(164)

Canproj consists of three sub-packages:

- Nordpred method (adpcproj: age-drift-period-cohort models)
- AC-model method (acproj: age-cohort models)
- hybrid method (hybdproj: four candidate models)

Each sub-package can work independently for projections. Canproj has a built-in decision tree to help determine which of the three models is most appropriate. The package can also replace

the Poisson distribution to a negative-binomial distribution when over-dispersion is present in the data. Finally, Canproj tests the goodness-of-fit of the chosen model.

Projections for "all cancers" and each individual cancer site were estimated using the Canproj package.

Age-drift-period-cohort model (Nordpred)

The Norpred Power 5 model is represented as:

$$Case_{ap} \sim Poisson\left(\mu_{ap}\right),$$
$$R_{ap} = \frac{\mu_{ap}}{n_{ap}} = (A_a + P_p + C_c + D \times p)^5,$$

where the symbols represent the following:

- $Case_{ap}$ is the number of age-specific cases in five-year age group *a* in five-year calendar period *p*
- μ_{ap} is the mean count of cases in five-year age group *a* five-year period *p*
- R_{ap} is the incidence rate in five-year age group *a* in the five-year period *p*
- n_{ap} is the size of the corresponding age-specific population
- A_a is the non-linear age component for age group *a*
- P_p is the non-linear period component of period *p*
- C_c is the non-linear cohort component of cohort *c*
- *D* is the common linear drift parameter
- p is the index of 5-year period
- a is the index of 5-year age group

Cohorts were calculated as $c = A + p - a$ with A equaling the total number of age groups. The estimated rates and numbers derived from the model represent the middle year of the respective five-year periods. A segmental linear interpolation method is utilized to expand the estimated rates into annual rates. The annual estimated counts and age-standardized rates are included in this report. (175)

Age-cohort model (AC-model)

The age-cohort model is a reduced form of the Nordpred model selected by Canproj when sparse data exist in the youngest and oldest birth cohorts. Due to sparseness of the data at both extreme cohorts, the remaining cohorts with complete observations are set as reference when age and cohort affects are being estimated.(175)

The expression for the age-cohort model with “power 5” link function is

$$Case_{ap} \sim Poisson\left(\mu_{ap}\right),$$
$$R_{ap} = \frac{\mu_{ap}}{n_{ap}} = (A_a + C_c)^5, c = A + p - a, p = \ 1,2, \dots, P, c = 1,2, \dots, C \ where \ C = \ A + P - 1$$

Hybrid method: age-only, common trend and age-specific trend models

When cohort effects are not significant, three types of hybrid models are used: age-specific (most complex), common trend and age-only (least complex). The hybrid models use a combination of averages, joinpoint regression and Poisson regression.(178) The Canproj package first compares the common trend model with the age-specific model using a chi-square test in the age groups when data exist for the entire periods. The age-specific model is selected when there is a significant difference between these two models. The common trend model is selected when there is no significant difference between the common trend and age-specific models, and the common trend is significant (i.e., the slope of the common trend parameter is not zero). The age-only model is selected when there is no significant difference between common trend and age-specific models, and the common trend is not significant (i.e., the slope of the common trend parameter does not differ from zero).

Historical data for projections

The incidence, death and population data were classified by year of diagnosis, year of death and binary sex, and grouped by five-year age groups (zero to 4, five to nine … 85 and older). For incidence projections, cases meeting the International Association for Research on Cancer/International Association of Cancer Registries multiple primary rules from 1986 to 2019 were projected. These were later converted for the 2010 to 2019 period to Surveillance, Epidemiology and End Results multiple primary rules by applying an inflation factor based on the age-specific increase in multiple primary cancers. Projections for all cancers combined were estimated based on the sum of all data from the 23 cancer sites in this report.

Mortality projections were also made with the Canproj package using cancer deaths from 1986 to 2020 divided into five-year age groups and calendar year. To get incidence and mortality projections for all cancers combined, projections were calculated by binary sex and then summed. This method was used because the projections based only on the data for all cancers combined are not equal to the sum of the projections for males and for females. The lists of models used for all cancers combined and for each individual cancer site by binary sex are in **Table A.6** for incidence projections and **Table A.7** for mortality projections.

Table A.6 Canproj models for cancer incidence projections by cancer type and binary sex, Ontario

Cancer type	Males	Females
All cancers	**adpcproj (NB)**	**adpcproj (NB)**
Bladder	adpcproj (NB)	adpcproj (P)
Brain	acproj (P)	acproj (P)
Breast (female)	n/a	adpcproj (NB)
Cervix	n/a	adpcproj (P)
Colorectal	adpcproj (NB)	adpcproj (NB)
Esophagus	hybdproj (Avg)	adpcproj (P)
Hodgkin lymphoma	hybdproj (Ags)	hybdproj (Ags)
Kidney	adpcproj (NB)	hybdproj (Ags)
Larynx	adpcproj (P)	adpcproj (P)
Leukemia	hybdproj (Ags)	hybdproj (NBags)
Liver	adpcproj (NB)	adpcproj (NB)
Lung	adpcproj (NB)	acproj (NB)
Melanoma	adpcproj (NB)	adpcproj (NB)
Myeloma	adpcproj (NB)	hybdproj (ComT)
Non-Hodgkin lymphoma	adpcproj (P)	adpcproj (P)
Oral cavity and pharynx	adpcproj (NB)	adpcproj (P)
Ovary	n/a	adpcproj (NB)
Pancreas	adpcproj (NB)	hybdproj (ComT)
Prostate	adpcproj (NB)	n/a
Stomach	adpcproj (P)	adpcproj (NB)
Testis	acproj (P)	n/a
Thyroid	adpcproj (P)	adpcproj (NB)
Uterus	n/a	adpcproj (P)

Abbreviations:

- acproj (P) means age-cohort model with Poisson distribution
- acproj (NB) means age-cohort model with negative-binomial distribution
- adpcproj (NB) means Nordpred model with negative-binomial distribution
- adpcproj (P) means Nordpred model with Poisson distribution
- hybdproj (NBags) means hybrid model with age-specific and negative-binomial distribution
- hybdproj (Ags) means hybrid model with age-specific and Poisson distribution
- hybdproj (ComT) means hybrid model with common-trend
- hybdproj (Avg) means hybrid model with average method
- n/a means not applicable

Table A.7 Canproj models for cancer mortality projections by cancer type and binary sex, Ontario

Cancer type	Males	Females
All cancers	**adpcproj (NB)**	**adpcproj (P)**
Bladder	hybdproj (NBags)	hybdproj (ComT)
Brain	adpcproj (P)	adpcproj (NB)
Breast (female)	n/a	adpcproj (P)
Cervix	n/a	adpcproj (P)
Colorectal	adpcproj (NB)	adpcproj (P)
Esophagus	acproj (P)	adpcproj (P)
Hodgkin lymphoma	hybdproj (ComT)	hybdproj (ComT)
Kidney	adpcproj (P)	adpcproj (P)
Larynx	adpcproj (P)	adpcproj (P)
Leukemia	hybdproj (Ags)	hybdproj (Ags)
Liver	adpcproj (P)	adpcproj (P)
Lung	adpcproj (NB)	adpcproj (P)
Melanoma	adpcproj (P)	acproj (P)
Myeloma	hybdproj (NBags)	adpcproj (P)
Non-Hodgkin lymphoma	adpcproj (P)	adpcproj (P)
Oral cavity and pharynx	hybdproj (Ags)	hybdproj (Ags)
Ovary	n/a	adpcproj (NB)
Pancreas	hybdproj (Avg)	adpcproj (P)
Prostate	adpcproj (NB)	n/a
Stomach	adpcproj (P)	adpcproj (P)
Testis	hybdproj (Avg)	n/a
Thyroid	hybdproj (Avg)	hybdproj (Avg)
Uterus	n/a	adpcproj (P)

Abbreviations:

- acproj (P) means age-cohort model with Poisson distribution
- acproj (NB) means age-cohort model with negative-binomial distribution
- adpcproj (NB) means Nordpred model with negative-binomial distribution
- adpcproj (P) means Nordpred model with Poisson distribution
- hybdproj (NBags) means hybrid model with age-specific and negative-binomial distribution
- hybdproj (Ags) means hybrid model with age-specific and Poisson distribution
- hybdproj (ComT) means hybrid model with common-trend
- hybdproj (Avg) means hybrid model with average method
- n/a means not applicable

Incidence and mortality

The information described below is specific to analyses of cancer incidence and cancer mortality in Chapters 2 and 3. For information about cancer incidence and mortality analyses for Chapter 1: COVID-19 and Cancer in Ontario, such as design, data sources and limitations, refer to Appendix 2: COVID-19 and Cancer.

Counts

Incidence counts are the number of new cancer cases diagnosed in a population during a specific period. ln this report, incidence counts refer to the number of new cancer diagnoses in a calendar year in Ontario. At the time of analysis, complete death-cleared incidence data were available up to 2020.

Mortality counts describe the number of deaths attributed to cancer during a specific period in a specific population. ln this report, mortality refers to the number of deaths due to cancer in a calendar year in Ontario. For consistency, this report uses data for the same range of years for incidence and mortality (i.e., 1986 to 2020).

The childhood cancer incidence statistics included this report are based on the cohort of children diagnosed with cancer from 1988 to 2022 and are presented for 1988 to 2022. Childhood cancer mortality statistics are based on the cohort of children diagnosed with cancer from 1986 to 2021 and are presented for 1991 to 2021.

Rates

Incidence and mortality rates are the number of new cancer cases or deaths per 100,000 people in a population during a specific period. Rates presented by binary sex are per 100,000 males or per 100,000 females in the population during the specified period. The rates are sometimes called crude rates because they do not adjust for the age distribution of the population. Rates were calculated using SEER*Stat software (version 8.4.0.1).(179)

For children with cancer (ages zero to 14 years), incidence and mortality rates are the number of new cancer cases or deaths per 1,000,000 people in the population during a specific period. Childhood cancer rates were calculated using Statistical Analysis System software version 9.4.(180)

Relative contribution of factors to incidence trend

Changes in cancer risk and cancer control practices, as well as growth and aging of the population have contributed to the increasing incidence of cancer cases in Ontario. The relative contribution of these factors to the annual increase in cancer incidence from 1986 to 2019 was calculated as follows:

- Changes in cancer risk represent the total number of new cases that would have occurred each year if cancer incidence rates (specific rates by age group and binary sex) alone had changed but the population had remained the same as in 1986 (the baseline year). For each year from 1987 to 2019, this number was calculated by multiplying incidence rates of each age group and binary sex by the corresponding populations of the baseline year (1986). The sum across all groups represents the total number for that year.
- Population growth represents the number of new cases that would have occurred each year from 1987 to 2019 if the population alone had grown larger, but the population age distribution had remained the same as in 1986 (the baseline year). To calculate the contribution of population growth, the total population of each subsequent year was multiplied by the weights of each age group and binary sex in the baseline year (i.e. 1986) to obtain the hypothetical population structure. Then the specific cancer incidence rates by age group and binary sex of a given year were applied to the hypothetical population and summed across all groups to obtain the total number for that year.
- For each year from 1987 to 2019, the remaining incidence counts were attributed to population aging. To calculate the contribution of aging, the number of incidence counts due to changes in cancer risk and population growth (calculated above) were subtracted from the total incidence count of that year.

Age-standardized rates

Age-standardized rates are weighted averages of age-specific rates using a standard population. Age-standardized incidence rates and age-standardized mortality rates are adjusted for differences in the age structure of different populations. This adjustment permits comparisons of cancer incidence or mortality between different populations, which may be different segments of a population (e.g., different geography) or the same population at different times. An age-standardized rate gives the rate that would have occurred if the population had the same age distribution as the standard population.

This report uses direct standardization, which produces artificial rates for the purpose of comparison only. The standard population used is based on the 2011 Canadian Standard population (with five-year age groups).

Trends in age-standardized rates

Incidence and mortality trends were determined using annual per cent change and average annual per cent change, calculated using age-standardized rates. Annual per cent change was used when examining short-term changes in trend. Average annual per cent change is a summary measure that describes the change in trend over a longer period with a single statistic.

Annual per cent change and average annual per cent change statistics were produced using the Joinpoint Regression Program (version 4.8.0.1 and version 4.7.0.0 for childhood cancer).(181,182) The Joinpoint software uses piecewise regression to model the change in rates on the log scale.

The Joinpoint software uses a statistical algorithm to interpret data and determine statistically significant changes in trend. The software chooses the best points for a trend to change (called joinpoints) and how many changes there should be. Joinpoint uses the Monte Carlo Permutation test to determine whether the change in trend is statistically significant.(177) In general, the model that the Joinpoint software found to be the best fit was used. A maximum of three joinpoints and a minimum of five data points between joinpoints were allowed.

Jump model for incidence trend analysis

For most cancer sites, the standard joinpoint model (see above) was used to analyze incidence trends. Furthermore, these analyses only included cancer cases meeting the International Association for Research on Cancer/International Association of Cancer Registries criteria for multiple primary cancers.

However, for selected cancer sites, the jump model was used instead of the standard joinpoint model to analyze trends in age-standardized incidence. The jump model is an option available in the Joinpoint software to estimate trends in situations where a coding change has resulted in a sudden shift (or "jump") in cancer rates. Since a shift in rates caused by a coding change is assumed to be artificial, the jump model accounts for this type of shift to produce estimates of the underlying trend.(183)

In this report, the jump model was used for the following cancer sites for cases meeting the National Cancer Institute's Surveillance, Epidemiology and End Results standards for multiple primaries (see Appendix 1: Coding Rules for Multiple Primary Cancers):

- all cancers combined
- bladder
- breast (female)
- melanoma

For all cancers combined, melanoma and breast (female), an abrupt increase in incidence rates occurred due to the impact of applying the Surveillance, Epidemiology and End Results rules for cases diagnosed from 2010 onwards. For bladder cancer, an abrupt increase in incidence rates occurred primarily due to the inclusion of *in situ* bladder cases, also from 2010 onwards.

The jump model accounted for these artificial increases to produce estimates of the underlying trend.

Cancers with notable trends

Cancers with a statistically significant annual per cent change (APC) in the most recent time period in all three categories (i.e., males, females and males and females combined) were categorized by the direction of the change (increasing or decreasing) and ranked. For non-sex-specific cancers, the APC of males and females combined was used for ranking, while the APC from the relevant sex was used for sex-specific cancers. Cancers ranked the highest in each direction are highlighted in the text. The four most commonly diagnosed cancers are always described and were not considered in this ranking. In addition, select cancers with recent trends that may not have been statistically significant but are noteworthy in terms of similar patterns to other jurisdictions or sex disparities are also highlighted.

Survival

Definition

In this report, survival analyses measure net cancer survival. Net survival is the probability of surviving cancer in the absence of other causes of death. It is a measure that is not influenced by changes in mortality from other causes and is therefore a useful way to track cancer survival across time, as well as between population groups and between registries. The measure of net survival used in this report is the relative survival ratio, which shows how much a cancer diagnosis can shorten a life span. Relative survival ratios are estimated by comparing the survival of people with cancer (observed survival) with the survival of similar people in the general population of Ontario during the same time period (expected survival):

- observed survival is the percentage of people with cancer who are alive at the end of a selected time period out of the total number of people with cancer at the start of the time period; it can also be described as the probability of surviving all causes of death among people with a cancer diagnosis
- expected survival is the percentage of similar people in the general population (matched by age and binary sex to the cancer population) expected to be alive at the end of the same time period

The relative survival ratio is a ratio of percentages and is usually expressed as a percentage. The closer the value is to 100%, the closer the survival of the cancer population is to the general population.

Analyses

For more detailed information on cancer survival analyses for Chapter 1: COVID-19 and Cancer in Ontario, such as design, data sources and limitations, refer to Appendix 2: COVID-19 and Cancer .

Survival analyses were based on first primary cancers. This means that only the first occurrence of cancer per person in a specific time period was included in survival analyses. Furthermore, relative survival ratios are provided for cases diagnosed in people ages 15 to 99. Cases were excluded from the survival analyses in the following situations:

- the age of the person was unknown
- they were diagnosed on the basis of an autopsy only
- their date of diagnosis and date of death were the same (i.e., death certificate only cases where the diagnosis happened at or following death); see Table A.1 in Data Sources for details on death certificate only cases

For survival analyses that included cases diagnosed before 2010, the International Association for Research on Cancer/International Association of Cancer Registries multiple primary rules for counting cancer cases were used. For survival analyses that only included cases diagnosed from 2010 onward, the National Cancer Institute's Surveillance, Epidemiology and End Results (SEER) Program's standards for counting multiple primary cancers were used.

In Chapter 4: Cancer survival, survival analyses were performed using SEER*Stat software (version 8.4.0.1).(179) In Chapter 1: COVID-19 and Cancer in Ontario, survival analyses were performed using SAS 9.4.(180) Expected survival was derived using the Ederer II approach (184) from provincial life tables produced by Statistics Canada. Life tables currently available for calculating expected survival may not completely reflect all factors contributing to variation in all-cause mortality, such as smoking. This possible gap should be taken into account when interpreting the estimates.

Relative survival ratios were estimated by different methods according to the availability of follow-up data. When complete follow-up data after diagnosis were available, the cohort method was used to estimate relative survival ratios (e.g., at least five years of follow-up to estimate a five-year relative survival ratio). For recently diagnosed cases that did not have complete follow-up data available, the estimates were computed using the period method. Period analysis uses the survival experience of people in a recent interval to estimate survival.(185) The period method allows for more up-to-date estimates because it means the analysis does not have to wait for data on the full follow-up period (e.g., five years for a five-year ratio). Comparisons between cohort and period relative survival ratios should be interpreted with caution because of the two different methods used to derive each of these relative survival ratios.

Relative survival ratios were age-standardized by weighting with the International Cancer Survival Standard weights.(52) See **Table A.8** for details on weightings.

Table A.8 International cancer survival standards used for standardizing relative survival ratios by cancer type and age group

Age groups (years)	Weightings	Cancer types
15 to 44, 45 to 54, 55 to 64, 65 to 74, 75 to 99	60, 10, 10, 10, 10	Testis, Hodgkin lymphoma, acute lymphatic leukemia
15 to 44, 45 to 54, 55 to 64, 65 to 74, 75 to 99	28, 17, 21, 20,14	Nasopharynx, soft tissues, melanoma, cervix uteri, brain, thyroid gland, bone
15 to 44, 45 to 54, 55 to 64, 65 to 74, 75 to 99	7, 12, 23, 29, 29	All other cancer types except prostate
15 to 54, 55 to 64, 65 to 74, 75 to 84, 85 to 99	19, 23, 29, 23, 6	Prostate

For children ages zero to 14 years, five-year overall survival proportions were estimated based on first primary cancers diagnosed from 1987 to 2021. This means that only the first occurrence of cancer per child in a specific time period was included in the childhood cancer survival analyses. Overall survival is an estimate of the probability of surviving all causes of death for a specified interval following a diagnosis of cancer. Unlike relative survival ratios, overall survival proportions do not adjust for the expected survival of the general population in Ontario of the same age and binary sex during the same period. Overall survival proportions were calculated using the cohort method when complete follow-up data were available (for cases diagnosed historically from 1987 to 2016) and the period method when complete follow-up data were not available (for cases more recently diagnosed from 2017 to 2021). People with cancer were followed until date of death or December 31, 2021 (whichever occurred first).

Prevalence

Prevalence analyses were performed using SEER*Stat software (version 8.4.0.1).(179) This report provides person-based limited-duration prevalence, which is the number of people diagnosed with cancer over a specific period (e.g., two years, five years or 10 years) who were still alive on the index date. This report also provides the crude prevalence proportion per 100,000, which is the number of people alive with a past cancer diagnosis for the period of interest for every 100,000 people in the general population as of the index date. The chosen index date was January 1, 2021, and therefore represents people with cancer who were still alive at the end of 2020. Prevalence analyses by age group refer to the age of the person at the index date of January 1, 2021, not their age at diagnosis.

Only the first primary cancer per person was included in the prevalence count for all cancers combined, but for individual cancer types, all people with a given cancer type were counted. For example, someone with a first primary of prostate cancer and a second primary of colorectal cancer would be included once in the prevalence count for all cancers combined, but twice in the individual cancer type counts (i.e., once in the prostate prevalence count and once in the colorectal prevalence count).

Appendix 3: Glossary

Term	Definition
Age-standardized incidence rate (ASIR)	A weighted average (based on a standard population) of the number of new cases of cancer per 100,000 people in a five-year age group (zero to 4, five to nine ... 85 and older) diagnosed during a year divided by the total number of people in that age group in that year. An age-standardized rate gives the rate that would occur if the population of interest had the same age distribution as a given standard population. In this report, the standard population is the 2011 Canadian Standard population.
Age-standardized mortality rate (ASMR)	A weighted average (based on a standard population) of the number of deaths from cancer per 100,000 people in a five-year age group (zero to 4, 5 to 9 ... 85 and older) that occurred during a year divided by the number of people in that age group in that year. An age-standardized rate gives the rate that would occur if the population of interest had the same age distribution as a given standard population. In this report, the standard population is the 2011 Canadian Standard population.
Annual per cent change (APC)	A measure that characterizes the change over time of a rate (e.g., incidence or mortality rate). It represents the short-term percentage increase or decrease per year in blocks of time over a specified time period.
Average annual per cent change (AAPC)	A summary measure that allows the use of a single number to describe the *average* of the annual per cent changes over a specified time period.
Breakthrough infection	Refers to a COVID-19 infection that occurs after completing a recommended COVID-19 vaccine series.
Cancer incidence	The number of new cancer cases diagnosed in a population during a specific period.
Cancer mortality	The number of deaths from cancer in a population during a specific period.
Cancer prevalence	The number of people newly diagnosed with cancer, as well as people previously diagnosed with cancer who are still alive.

Term	Definition
Canproj	A statistical cancer projection method based on age, period and/or cohort statistical modelling.
Conditional survival	The probability of someone surviving for a certain number of years if they have already survived "x" years after their diagnosis. In this report, five-year conditional survival looks at the chance of surviving at least five years, given that someone has already survived one, two, three or four years after their initial diagnosis.
COVID-19	Coronavirus disease 2019 caused by infection with the SARS-CoV-2 virus. In this report, a COVID-19 case refers to a confirmed case of the disease as defined by the Ontario Ministry of Health's case definition for COVID-19 disease.
Computed tomography (CT)	A type of diagnostic imaging used to help identify and diagnose cancer.
Death certificate only (DCO)	Cases that only have a death certificate as their data source. These cases are excluded from survival analyses.
Excess mortality	Describes the difference between the number of observed deaths and the number of expected deaths, based on the trend in mortality rates in previous years. Excess mortality is a measure that can signal a change in the cause of deaths. Excess deaths occur when there are more deaths during a period of time than is typical for that period.
International Cancer Survival Standards (ICSS)	An internationally accepted population weighting method for age standardizing survival ratios.
International Classification of Childhood Cancer (ICCC)	A diagnostic classification scheme for childhood cancer based on tumour morphology and primary site that has a greater emphasis on morphology than the classification of cancers for adults.
International Classification of Diseases for Oncology (ICD-O)	An international standard for classifying a cancer using a topographical code, which describes the anatomical site of origin (or organ system) of the tumour, and a morphological code, which describes the cell type (or histology) of the tumour and its behaviour (malignant or benign).
Lead time bias	The length of time between the early detection of cancer and the time of its usual clinical presentation and diagnosis.

Term	Definition
Lifetime probability (of developing or dying from cancer)	The chance someone has over the course of their lifetime (from birth to death) of being diagnosed with or dying from cancer.
Limited-duration prevalence	Describes the number of people alive on a certain date (called the index date) who were diagnosed with cancer a specified number of years (e.g., two years, five years, 10 years, 30 years) before the index date.
Magnetic resonance imaging (MRI)	A type of diagnostic imaging used to help identify and diagnose cancer.
Median age (at diagnosis)	Age at which half of the cancer cases reported are in people who are older and half are in people who are younger.
Microscopically confirmed	Percentage of cases that were diagnosed on the basis of microscopic verification of a tissue specimen, including histologically confirmed cases, cases diagnosed on the basis of cytology specimens and cases of leukemia diagnosed on the basis of hematological examination.
Most common cancers	In this report, the four most commonly diagnosed cancers in Ontario are breast, prostate, lung and colorectal.
Multiple primary and histology coding rules	A set of rules that guide and standardize the process of determining the number of primary cancers. The histology rules contain detailed histology coding instructions for cancer registrars.
Overall survival proportion	An estimate of the probability of surviving all causes of death for a specified time interval (e.g., five years) following a diagnosis of cancer. May also be referred to as observed survival.
Overweight and obesity	The World Health Organization (WHO) describes overweight as "a condition of excessive fat deposits" and obesity as "a chronic complex disease defined by excessive fat deposits that can impair health," both of which can be diagnosed using body mass index (BMI) as key measure. [Obesity and overweight (who.int)]
Person-time (e.g., person-years or person-days)	A measure combining number of people and time as the denominator in a rate when people are at risk of developing disease, being hospitalized or dying.

Term	Definition
Population aging	An increasing proportion of people age 65 and older in the population.
Prevalence proportion	The number of people for every 100,000 people in the general population who are alive as of the index date and who have had a cancer diagnosis.
Primary cancer	The original, or first, tumour in the body. Cancer cells from a primary cancer may spread to other parts of the body and form new, or secondary, tumours.
Prognosis	The probable outcome or course of cancer.
Projection	A prediction or forecast of cancer incidence, mortality or prevalence based on current and historical data.
Recurrence	The reappearance of cancer at the same site or in another location after remission.
Relative survival ratio (RSR)	The proportion of people surviving for a certain amount of time (e.g., five years) compared with the expected survival of similar people (based on age, binary sex and time) in the general population.
Solid tumour coding rules	The new multiple primary and histology rules that replaced the 2007 Surveillance, Epidemiology and End Results multiple primary and histology coding rules. They are used for cases diagnosed from 2018 onward in the Ontario Cancer Registry.
Stage at diagnosis	Refers to how much a cancer has spread at the time of diagnosis.
Standard population	The age distribution used as weights to create age-standardized (i.e., age-adjusted) statistics.
Subsite	An anatomical part of the body where a cancer is growing, such as the oropharynx within the oral cavity and pharynx.
Subtype	The type of cancerous cells (histological type) that specifies the subcategory of a cancer, such as adenocarcinoma versus squamous cell carcinoma.

Term	Definition
Tumour-node-metastasis (TNM) classification of malignant tumours	The recognized standard for classifying how much a cancer has spread.

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