Cancer Care Ontario

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Many of the tables and charts in this report contain information derived from the Ontario Cancer Registry. While Cancer Care Ontario makes every effort to ensure the completeness, accuracy and currency of this information at the time of writing this report, this information does change over time as does our interpretation of it.

The team welcomes comments and suggestions. To provide feedback, be notified about future editions of this report or about related information products, contact us at surveillance@cancercare.on.ca

CONTRIBUTORS

CCO Surveillance:
Tanya Navaneelan
Dr. Saber Fallahpour
Dr. Prithwish De
Aniq Anam
Zeinab El-Masri
Golara Farhoomand

CCO Ontario Cancer Registry:
Phoebe Ah-Nim
Roberta Albuquerque
Arnol Alon
Kyaw Aung
Raluca Bardi-Pal
Julie Bonthron
Toby Champagne
Joanne Gariepy
Karen Hofmann
Ernest Jimenez
Mary Jane King
Katie Larson
Grace Liu
Roula Livisianos
Liza Lovell
Marianne Luettschwager
Xiao Dong Ma
Joshua Mazuryk
Valerie Meehan
Ekua Morgan
Gina Naraine
Amy Parks
Katharine Pearson
Grace Pontanares
Bogdan Pylypenko
Myriel Quilacio
Veronica Rivera
Lois Visneskie
Saima Yaqoob
Lishen Zhou

Wait Time Information System and Access to Care Analytics:
Gener Austria
Sulin Shakya
Ryan Wood
Claudia Zanchetta

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The following people are acknowledged for their assistance in the development of this report:

CCO:
Chamila Adhihetty
Gillian Bromfield
Robert D'Addazio
Dana Chmelnitsky
Dr. Gail Darling
Dr. Andrea Eisen
Dr. Sarah Ferguson
Dr. Tony Finelli
Amber Hunter
Dr. Jonathan Irish
Dr. Hedy Jiang
Dr. Erin Kennedy
Julie Klein-Geltink
Dr. Tom Kouroukis
Jenny Lass
Bronwen McCurdy
Leigh McKnight
Dr. Teresa Petrella
Thivya Shanthakumar
Amy Snow
Jennifer Stiff
Samara Strub
Jasmine Tung
Dr. Alice Wei

Public Health Units:
Megan Hempel, Halton Region Health Unit
Adam Stevens, Brant County Health Unit

University of Toronto:
Dr. Eric Holowaty

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LIST OF ACRONYMS

ALR Activity-level reporting

AAPC Average annual percent change

AJCC American Joint Committee on Cancer

APC Annual percent change

ASIR Age-standardized incidence rate

ASMR Age-standardized mortality rate

CCI Charlson Comorbidity Index

CIHI Canadian Institute for Health Information

CS Collaborative Staging

DAD Discharge Abstract Database

DART Dates affecting readiness to treat

DCO Death certificate only

HIN Health insurance number

IACR International Association of Cancer Registries

IARC International Agency for Research on Cancer

ICSS International Cancer Survival Standard

NACRS National Ambulatory Care Reporting System

NCI National Cancer Institute

OCR Ontario Cancer Registry

OCRIS Ontario Cancer Registry Information System

PHU Public health unit

RCC Regional cancer centre

RSR Relative survival ratio

SEER Surveillance, Epidemiology and End Results

TNM Tumour-node-metastasis

WTIS Wait Time Information System

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Foreword

"For the first time in history more Ontarians are over the age of 65 than under 15. This aging of our population will have a tremendous impact on our healthcare system, as the incidence of many chronic illnesses, including cancer, increases with age."

Comprehensive, reliable cancer surveillance information is at the foundation of Cancer Care Ontario's role as the Ontario government's principal advisor on cancer. Through the Ontario Cancer Registry, Cancer Care Ontario is able to collect and analyze data on all cancer cases in Ontario. This information enables healthcare system planning that directly affects patient care.

Identifying emerging issues in cancer care is more important than ever, now that there are for the first time in history more Ontarians over the age of 65 than under 15. This aging of our population, combined with its increasing size, will have a tremendous impact on our healthcare system, as the incidence of many chronic illnesses, including cancer, increases with age.

As identified in this report, more than 90,000 new cases of cancer are expected to be diagnosed in 2018; over 30,000 people are expected to die from the disease in the same period. More than half a million Ontarians are alive today with a cancer diagnosed within the past 30 years, but survival rates are poorer among cancer patients with comorbidities. The most common comorbidities—diabetes, another cancer diagnosis and chronic obstructive pulmonary disease—are also associated with age.

As we work with our many partners to improve the performance of the cancer system, we must always remember the human lives behind the numbers in this report. Current and future patients and their families are at the centre of everything we do, and *Ontario Cancer Statistics 2018* enables us to continue to work together to ensure the quality and sustainability of our cancer system for all Ontarians.

Michael Sherar
President and CEO, CCO

"Reliable, standardized and accessible data are integral to our work with our partners to improve the cancer system. As we transform data into actionable information, we will continue to drive health system improvements for all Ontarians."

Ontario Cancer Statistics 2018 is the second in an evolving series of biennial reports providing a clear picture of the cancer burden, trends and progress made on cancer control activities in this province.

This year's report includes more data on the estimated current cancer incidence and mortality in Ontario up to 2018, more information to characterize the population living with cancer and additional cancer statistics at the public health unit level.

For the first time, emerging issues in cancer control are also examined in this report, including a focus on the impact of wait time to surgical treatment for seven cancer types and its association with survival.

Reliable, standardized and accessible data are integral to our work with our partners to improve the cancer system. Cancer Care Ontario takes very seriously the responsibility entrusted to us to handle such data with care. As we transform data into actionable information, we will continue to drive health system improvements for all Ontarians.

Jason Garay
Vice-President, Analytics and Informatics, CCO

Executive summary

Ontario Cancer Statistics is a biennial publication that provides information on the burden of cancer in Ontario. It is produced by the Surveillance and Cancer Registry department of CCO. The report is organized around four main types of indicators: incidence, mortality, survival and prevalence. This edition also includes a special chapter on emerging issues in cancer control, which examines cancer in relation to comorbidity and wait times.

KEY FINDINGS

INCIDENCE:

- In 2018, an estimated 90,483 new cases of malignant cancer (excluding non-melanoma skin cancer) are expected to be diagnosed in Ontario, resulting in an age-standardized incidence rate of 571.1 cases per 100,000.
  - The incidence rate is expected to be higher in males (613.2 per 100,000) than females (542.7 per 100,000).
- The most commonly diagnosed cancers in 2018 are expected to be breast, colorectal and lung.
- Cancer incidence is expected to be highest in people ages 60 to 79, with this age group accounting for more than half of all cancers diagnosed in 2018.
- The cancer incidence rate increased by 0.5% per year from 1983 to 2001, and then remained stable until 2013.
  - Among males, the incidence rate increased by 0.4% per year from 1983 to 2001, and then declined by 0.7% per year from 2001 to 2013.
  - In contrast, among females, the incidence rate increased by 0.4% per year from 1983 to 2013.
- The greatest decreases in incidence rates from 1983 to 2013 occurred in laryngeal, cervical, lung, bladder and stomach cancers. The greatest increases occurred in thyroid and liver cancers, as well as melanoma and non-Hodgkin lymphoma.
- Cancer incidence rates have been increasing over the past decade among people under age 60 and decreasing among people age 60 and older.
- Population-based stage data was available for six cancer types: breast, cervix, colorectal, lung, prostate and thyroid. The majority of breast, colorectal, prostate, cervical and thyroid cancer cases in 2013 were diagnosed at stage I or II. The majority of lung cancer cases, on the other hand, were diagnosed at stage IV.

MORTALITY:

- In 2018, an estimated 30,574 deaths from cancer (excluding non-melanoma skin cancer) are expected to occur in Ontario, resulting in an age-standardized mortality rate of 186.9 deaths per 100,000.
  - The mortality rate is expected to be higher in males (219.5 per 100,000) than females (162.5 per 100,000).
- The leading cause of cancer death in 2018 is expected to be lung cancer, which is projected to cause almost one quarter of all cancer deaths. The next most common causes of cancer death are expected to be colorectal, breast and pancreatic cancers.
- More than half of all the cancer deaths in 2018 are expected to occur in people ages 60 to 79, while more than one-third are expected to occur in people age 80 and older.
- The cancer mortality rate declined by 0.4% per year from 1983 to 2001 and then declined by 1.6% per year from 2001 to 2013.
  - Among males, the cancer mortality rate was stable from 1983 to 1988, declined by 0.9% per year from 1988 to 2001, and then declined a further 1.8% per year from 2001 to 2013.
  - Among females, the cancer mortality rate declined by 0.2% per year from 1983 to 2002, and then declined a further 1.6% per year from 2002 to 2013.
- From 1983 to 2013, the greatest decreases in mortality occurred in Hodgkin lymphoma and cervical, stomach and testicular cancers. The greatest increases occurred in liver cancer, melanoma and lung cancer.

SURVIVAL:

- For the 2009–2013 time period, the five-year relative survival ratio for all cancers combined was 64.7%.
  - Survival was significantly higher among females (66.4%) than males (63.0%).
- Five-year relative survival was highest for thyroid (98.8%), testicular (97.0%) and prostate (95.4%) cancers.
- Five-year relative survival was lowest for pancreatic (9.5%), esophageal (15.3%), lung (20.0%) and liver (20.4%) cancers.
- Five-year relative survival decreased with increasing age, from 87.1% for people diagnosed between the ages of 15 and 39 to 44.7% for people diagnosed at age 80 or older.
- Although cancer survival has improved over the past three decades, since 1984-1988 the greatest improvements in five-year relative survival have been made in people diagnosed between the ages of 40 and 79. Over the same time period, there was no significant improvement in five-year relative survival for people diagnosed at age 80 or older.
- While five-year relative survival from diagnosis was 64.7%, it increased to 82.7% for people who survived the first year after their diagnosis. Five-year relative survival increased for each year survived until four years after diagnosis, when the relative survival ratio was 97.7%.

PREVALENCE:

- The number of cancer survivors in Ontario is increasing. As of January 1, 2014, an estimated 370,713 people living in Ontario had been diagnosed with cancer in the previous 10 years. This is more than double the number of people (184,309) who had been diagnosed in the previous 10 years living at the end of 1993.
- Prostate cancer was the largest contributor to 10-year prevalence, accounting for 75,610 prevalent cases.
- The greatest relative increases in 10-year prevalence from 1993 to 2013 were in liver and thyroid cancers.

COMORBIDITY AND CANCER:

This section examines the burden of comorbidities among people diagnosed with cancer, given that comorbidities affect the treatment and prognosis of patients. Seven cancer types diagnosed from 2011 to 2015 were analyzed—bladder, breast (female), colorectal, kidney, lung, melanoma and pancreas.

- Of the cancers studied, the prevalence of comorbidity ranged from 10.2% among breast cancer patients to 48.0% among pancreatic cancer patients.
- Patients with comorbid conditions were more likely to be diagnosed at stage III or IV than those without comorbidities.
- The most common comorbidities among the cancer patients studied were diabetes, another primary cancer diagnosis and chronic obstructive pulmonary disease.
- Three-year relative survival tended to decrease with increasing Charlson Comorbidity Index (CCI) score. Among the cancers studied, comorbidity had the greatest effect on survival for pancreatic cancer (reducing survival from 15.9% among people with no comorbidity [CCI score of zero] to 5.4% among people with severe comorbidities [CCI score of three or more]) and lung cancer (reducing survival from 32.5% to 13.5%).

WAIT TIME AND CANCER:

This section examines wait times to surgical cancer treatment. While some wait for treatment is inevitable, a delay in initiating treatment may result in the loss of an opportunity for a cure because cancer may grow and spread to other parts of the body over time. Wait time is defined in this report as the time between the decision to treat with surgery and the first therapeutic surgery performed after diagnosis.

In Ontario, once the decision to treat a cancer with surgery is made, the patient is assigned a priority level that reflects the urgency of surgery. There are four priority levels:

- level I (surgery recommended within 24 hours);
- level II (highly aggressive malignancies, surgery recommended within 14 days);
- level III (invasive malignancies that do not meet the criteria for priority level II or IV, surgery recommended with 28 days); and
- level IV (slow growing malignancies, surgery recommended within 84 days).

Seven cancer types, diagnosed from 2011 to 2015, were analyzed—breast (female), colorectal, esophagus, lung, oral cavity & pharynx, ovary and pancreas. The analysis was restricted to cases assigned priority level II, III or IV.

- Of the cancers studied, patients with breast or esophageal cancer had the shortest median wait times to surgical treatment (16 days) while those with oral cavity & pharynx cancer had the longest (20 days).
- The majority of cases were assigned priority level III, regardless of cancer type or stage.
- Most patients received surgical treatment within the recommended wait time. Additionally, the proportion of patients receiving treatment within the recommended time increased with increasing priority level.
- Among priority level II patients, lung cancer patients were the most likely to receive surgical treatment within the recommended 14 days (92.7%), while those with ovarian cancer were the least likely (65.2%).
- Breast and esophageal cancer patients experienced no decrease in survival with increasing wait time to surgical treatment. However, shorter wait times were associated with poorer survival for people with colorectal, lung, oral cavity & pharynx, ovarian and pancreatic cancers.

KEY FINDINGS

Breast cancer

Breast cancer is expected to be the most commonly diagnosed cancer in Ontario, and the third leading cause of cancer death, in 2018.

INCIDENCE:

- In 2018, 11,762 cases of female breast cancer are expected to be diagnosed in Ontario, resulting in an age-standardized rate of 146.4 per 100,000.
- The breast cancer incidence rate increased by 2.0% per year from 1983 to 1992, then declined by 0.2% per year from 1992 to 2013.
- The majority of staged breast cancer cases in 2013 were diagnosed at stage I (42.9%) or stage II (38.3%).

SURVIVAL:

- Five-year relative survival for breast cancer was 88.9% for the 2009–2013 time period.
- Conditional five-year relative survival increased to 91.5% for those that survive one year and 98.2% for those who survive four years.
- Five-year relative survival for breast cancer was 98.3% for people diagnosed at stage I but decreased to 19.0% for people diagnosed at stage IV.

MORTALITY:

- In 2018, 1,977 deaths from female breast cancer are expected to occur in Ontario, resulting in an age-standardized rate of 23.0 per 100,000.
- The breast cancer mortality rate decreased by 0.6% per year from 1983 to 1994. The rate of decrease then accelerated to 2.6% per year from 1994 to 2013.

PREVALENCE:

- Ten-year prevalence for breast cancer was 69,412 and 30-year prevalence was 121,658 as of January 1, 2014.

KEY FINDINGS

Colorectal cancer

Colorectal cancer is expected to be the second most commonly diagnosed cancer in Ontario, and the second leading cause of cancer death, in 2018.

INCIDENCE:

- In 2018, 11,595 cases of colorectal cancer are expected to be diagnosed in Ontario, resulting in an age-standardized rate of 72.3 per 100,000. Incidence is projected to be higher in males (86.2 per 100,000) than females (60.4 per 100,000).
- The colorectal cancer incidence rate declined by 0.9% per year from 1983 to 1997, remained stable until 2000, and then declined by 1.2% per year from 2000 to 2013.
  - Among males, the rate declined by 0.3% per year from 1983 to 2008 and then declined a further 2.1% per year from 2008 to 2013. Among females, the rate declined by 1.4% per year between 1983 and 1996, then remained stable until 1999 and then declined by 1.1% per year from 1999 to 2013.
- The greatest proportion of staged colorectal cancer cases in 2013 were diagnosed at stage III (29.9%).

MORTALITY:

- In 2018, 3,359 deaths from colorectal cancer are expected to occur in Ontario, resulting in an age-standardized rate of 20.4 per 100,000. Mortality is projected to be higher in males (24.9 per 100,000) than females (16.8 per 100,000).
- The colorectal cancer mortality rate decreased by 1.5% per year from 1983 to 2005. The rate of decrease then accelerated to 3.1% per year from 2005 to 2013. The trend was similar for males and females separately.

SURVIVAL:

- Five-year relative survival for colorectal cancer was 66.7% for the 2009–2013 time period. There was no significant difference in five-year survival between males and females.
- Conditional five-year relative survival for colorectal cancer increased to 80.6% for those who survive one year and to 97.0% for those who survive four years.
- Five-year relative survival for colorectal cancer was 94.5% for people diagnosed at stage I but decreased to 9.5% for people diagnosed at stage IV.

PREVALENCE:

- Ten-year prevalence for colorectal cancer was 45,346 and 30-year prevalence was 69,966 as of January 1, 2014.

KEY FINDINGS

Lung cancer

Lung cancer is expected to be the third most commonly diagnosed cancer in Ontario, and the leading cause of cancer death, in 2018.

INCIDENCE:

- In 2018, 11,396 cases of lung cancer are expected to be diagnosed in Ontario, resulting in an age-standardized rate of 69.6 per 100,000. Incidence is projected to be higher in males (76.2 per 100,000) than females (64.9 per 100,000).
- The lung cancer incidence rate decreased by 0.8% per year from 1990 to 2008, then remained stable from 2008 to 2013.
  - Among males the rate decreased by 1.8% per year from 1983 to 2008, then remained stable until 2013. Among females however, the rate increased by 2.4% per year from 1983 to 1995 and by 0.7% per year from 1995 to 2013.
- The majority of staged lung cancer cases in 2013 were diagnosed at stage IV (51.6%).

MORTALITY:

- In 2018, 7,414 deaths from lung cancer are expected to occur in Ontario, resulting in an age-standardized rate of 20.4 per 100,000. Mortality is projected to be higher in males (52.0 per 100,000) than females (39.6 per 100,000).
- The lung cancer mortality rate decreased by 1.1% per year from 1993 to 2013, following a decade of stability. The trend was similar for males; however, among females the rate increased by 2.1% per year from 1983 to 2000, then declined by 0.5% per year from 2000 to 2013.

SURVIVAL:

- Five-year relative survival for lung cancer was 20.0% for the 2009–2013 time period. Survival was significantly lower for males (17.0%) than females (23.3%).
- Conditional five-year relative survival for lung cancer increased to 45.6% for those who survive one year and to 90.3% for those who survive four years.
- Five-year relative survival for lung cancer was 60.8% for people diagnosed at stage I but decreased to 3.3% for people diagnosed at stage IV.

PREVALENCE:

- Ten-year prevalence for lung cancer was 18,941 and 30-year prevalence was 24,839 as of January 1, 2014.

KEY FINDINGS

Prostate cancer

Prostate cancer is expected to be the fourth most commonly diagnosed cancer in Ontario, and the fifth leading cause of cancer death, in 2018.

INCIDENCE:

- In 2018, 8,828 cases of prostate cancer are expected to be diagnosed in Ontario, resulting in an age-standardized rate of 115.6 per 100,000.
- The prostate cancer incidence rate increased by 5.4% per year from 1983 to 1993 and by 1.2% per year from 1993 to 2007. The rate then decreased by 6.0% per year from 2007 to 2013.
- The majority of staged prostate cancer cases in 2013 were diagnosed at stage II (51.9%).

MORTALITY:

- In 2018, 1,647 deaths from prostate cancer are expected to occur in Ontario, resulting in an age-standardized rate of 23.3 per 100,000.
- The prostate cancer mortality rate increased by 1.6 % per year from 1983 to 1994, and then decreased by 2.8% per year from 1994 to 2013.

SURVIVAL:

- Five-year relative survival for prostate cancer was 95.4% for the 2009–2013 time period.
- Conditional five-year relative survival for prostate cancer increased to 97.3% for those who survive one year and to 99.8% for those who survive four years.
- Five-year relative survival for prostate cancer was 100% for people diagnosed at stages I, II or III but decreased to 35.6% for people diagnosed at stage IV.

PREVALENCE:

- Ten-year prevalence for prostate cancer was 75,610 and 30-year prevalence was 111,759 as of January 1, 2014.

About this publication

Ontario cancer surveillance

CCO is the Ontario government's principal advisor on the cancer and kidney care systems as well as access to care for key health services. Our mission is to work together with our many partners to improve the performance of our health systems by driving quality, accountability, innovation and value. CCO is governed by Ontario's Cancer Act[1] and is accountable to the Ministry of Health and Long-Term Care. Encompassing Cancer Care Ontario and the Ontario Renal Network, CCO drives continuous improvement in disease prevention and screening, delivery of care and the patient experience for chronic diseases.

Cancer Care Ontario plays an important role in equipping health professionals, organizations and policy-makers with the most up-to-date cancer knowledge and tools to prevent cancer, inform cancer control policies and deliver high-quality patient care. Cancer surveillance is a cornerstone of this work.

Cancer Care Ontario's Cancer Surveillance Program analyzes and interprets cancer data to examine and report on Ontario's cancer burden and trends. Specifically, the program examines the number of people affected, their age and sex, the region where they live and their likelihood of surviving or dying from the disease. This information supports public health decisions and policies and identifies new areas of research, with the ultimate goal of improving the well-being of Ontarians.

The Ontario Cancer Registry

Cancer Care Ontario has been granted authority under the Cancer Act[1] to operate the Ontario Cancer Registry (OCR), a population-based cancer registry that maintains data on diagnosed cases of cancer among Ontario residents.

Established in 1964, Ontario's cancer registry is one of the oldest and most comprehensive population-based cancer registries in North America. In the fall of 2014, Cancer Care Ontario launched the new OCR and decommissioned its predecessor, the Ontario Cancer Registry Information System (OCRIS).

The OCR covers a population of approximately 14 million people. Close to 78,000 new cases of cancer are recorded by the OCR every year. Mortality from cancer is determined by linking cause of death data obtained from the Office of the Registrar General for Ontario to incidence data within the OCR (see the *Technical appendix* for more information on the OCR).

Our mission is to work together with our many partners to improve the performance of our health systems by driving quality, accountability, innovation and value.

Purpose of this report

This report provides comprehensive information about cancer incidence, mortality, survival and prevalence in Ontario. This information is intended to support decision-makers, the public health community, healthcare providers, researchers and others in planning, investigating, measuring and monitoring population-based cancer control efforts, including those related to cancer screening, prevention and treatment. This report may also be useful for the media and general public with an interest in cancer.

This report provides comprehensive information about cancer incidence, mortality, survival and prevalence in Ontario.

DATA SOURCES

Cancer data were obtained from the OCR, which depends on the following data sources:

- provincial pathology reports from Ontario's public hospital laboratories and private laboratories;
- activity-level reporting (ALR) from the 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 [DAD], National Ambulatory Care and Reporting System [NACRS]);
- hospital electronic medical records, used for deriving stage at cancer diagnosis; and
- cause of death data from the Office of the Registrar General for Ontario.

As of 2017, all 14 regional cancer centres in Ontario, as well as 32 other hospitals, reported through ALR. Many of those reporting through ALR transmitted data for other institutions in addition to their own.

Case records in the OCR are also supplemented using information exchanged with other provincial and territorial cancer registries about Ontario residents who were diagnosed, treated or both in other jurisdictions.

DATA NOTES

There are several points that readers of this report should be aware of:

- Statistics reported here generally refer to malignant (i.e., invasive) cancers. The exception is bladder cancer. Similar to other jurisdictions, *in situ* cases are reported jointly with invasive cases for the purpose of incidence surveillance. Because the OCR only began registering *in situ* bladder cancer cases in 2010, *in situ* cases are excluded in analyses of incidence trends for periods prior to 2010 and from all mortality, survival and prevalence analyses. Where non-invasive cancers (other than bladder) are presented in this report, they are indicated as such.
- Shortened forms of the names of cancer types are used throughout this report. See Table TA.5 in the Technical appendix for the corresponding full names and definitions.
- Because non-melanoma skin cancer records are not routinely collected by the OCR, statistics for these cases are excluded from this report, including from statistics for all cancers combined.
- Both actual and estimated data are reported in this publication and distinctions between them are made where applicable. Statistics presented in *Chapter 1: Estimated current cancer incidence in Ontario*, and *Chapter 2: Estimated current cancer mortality in Ontario*, are based on projected data; the statistics in the rest of the report are based on actual data.
- Given that the OCR is a dynamic database, new case information and updates to existing records occur on an ongoing basis. As a result, statistics in this report should be considered accurate only at the time of analysis.
- Starting with diagnosis year 2010, the OCR adopted the multiple primary and histology coding rules of the Surveillance, Epidemiology and End Results (SEER) Program.[2] These coding rules have resulted in an increase in the reported incidence of certain cancer types because they use more liberal counting methods than the previously used method derived from the International Agency for Research on Cancer/International Association of Cancer Registries (IARC/IACR) multiple primary rules[3] (see the *Technical appendix* for further details). The resulting change means that more cases are being included in the analysis than previously. Therefore, caution should be taken when comparing this report to previously reported statistics.
- To align with the same reference population increasingly being used by other Canadian organizations, age-standardized rates are calculated using the 2011 Canadian reference population. As a result, readers may notice higher rates for most cancer types compared to other reports which may use the 1991 Canadian reference population for age-standardization (see the *Technical appendix* for further details).
- This report focuses on cancer in adults. In depth statistics on childhood cancer in Ontario are available from the Pediatric Oncology Group of Ontario (http://www.pogo.ca/).
- The use of the word "significant" throughout this report refers to statistical significance at an alpha level of 0.05.

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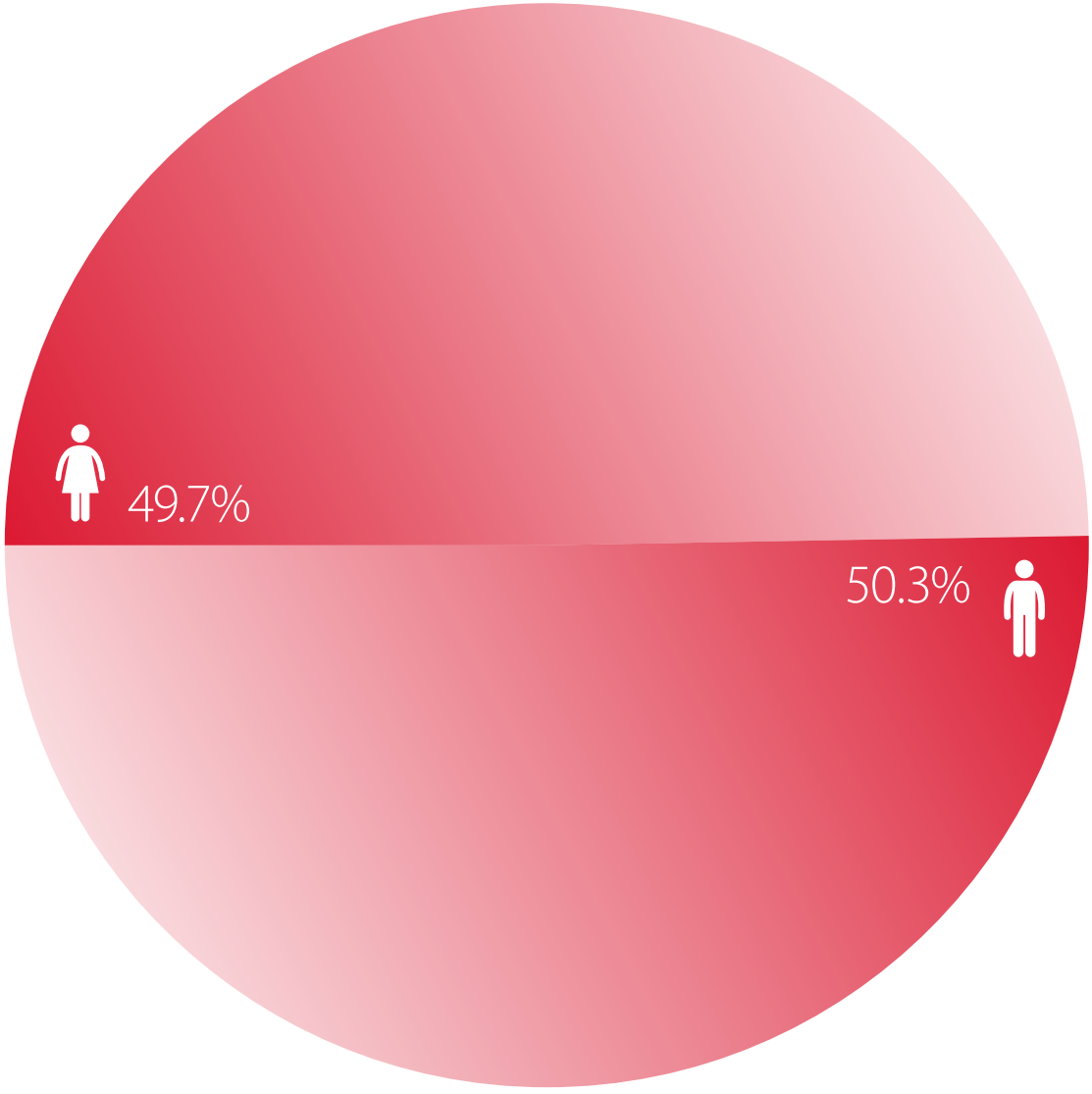
Chapter 1

Estimated current cancer incidence

Incidence measures the number of new cases of cancer diagnosed within a specific time period. This chapter presents projected statistics on cancer incidence in Ontario for the current year.

Expected new cases of cancer

"In 2018, 90,483 new cases of cancer are expected to be diagnosed in Ontario, 45,518 in males and 44,965 in females."



The number of new cancer cases diagnosed each year in Ontario (the incidence) and the incidence rate have increased since at least 1983. In general, the incidence of cancer is influenced by:

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

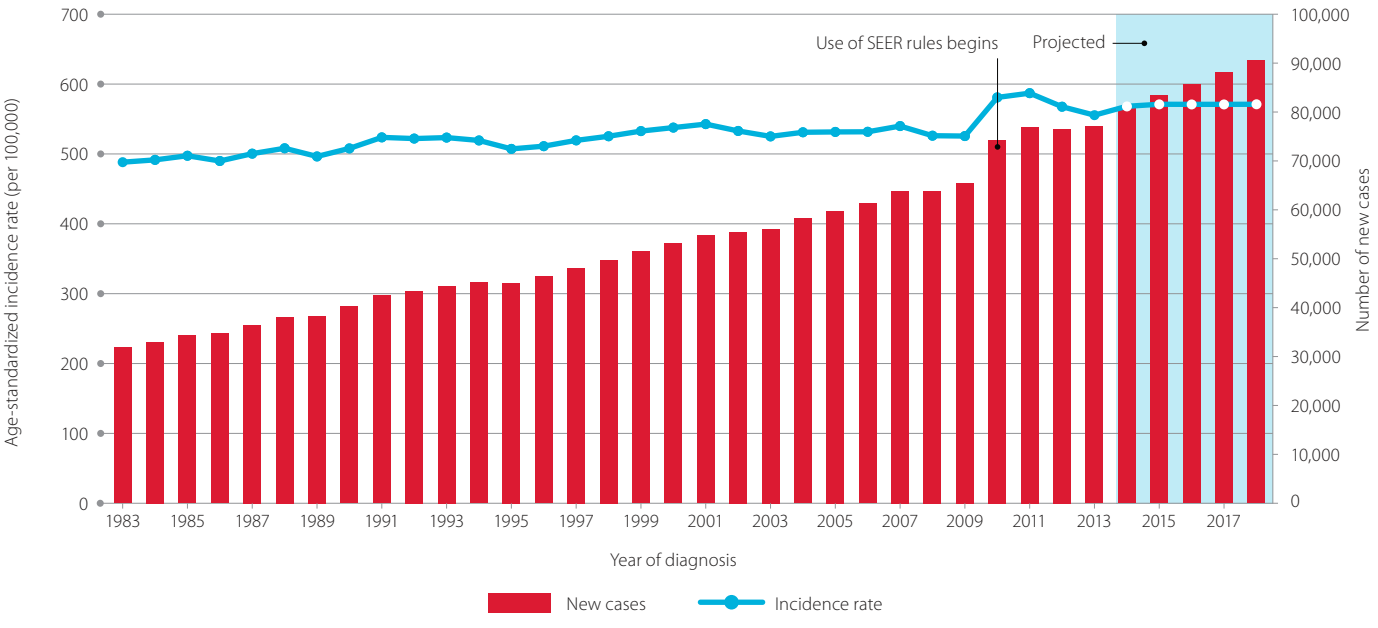
Risk factors can include unhealthy behaviours (e.g., smoking, poor diet, alcohol consumption, physical inactivity), non-modifiable factors (e.g., age at menarche and menopause), lifestyle factors (e.g., oral contraceptive use, hormone-replacement therapy use), exposure to certain environmental and occupational carcinogens (e.g., radon, PM2.5 [fine particulate matter], UV exposure, asbestos, diesel engine exhaust) and genetic predispositions (e.g., BRCA1 and BRCA2 genes).

The statistics reported in this chapter are projections for the years 2014 to 2018.

In 2018 an estimated 90,483 new cases of malignant cancer (excluding non-melanoma skin cancer) are expected to be diagnosed in Ontario, resulting in an age-standardized incidence rate (ASIR) of 571.1 cases per 100,000 people (Figure 1.1).

The abrupt increase in the count and incidence rate seen in 2010 is a result of the Ontario Cancer Registry's adoption of the National Cancer Institute (NCI) Surveillance, Epidemiology and End Results (SEER) Program's rules for counting multiple primaries. Those rules were applied starting in diagnosis year 2010, which means the higher numbers observed that year do not reflect a true increase in the incidence of cancer (see the *Technical appendix* for more information).[1]

Figure 1.1 **Projected incidence counts and age-standardized rates for all cancers combined, Ontario, 1983–2018**



Notes: 1. Rates are per 100,000 and standardized to the age distribution of the 2011 Canadian population.
2. Observed incidence rates are based on the NCI SEER standards for counting multiple primary cancers, which were adopted by the Ontario Cancer Registry for cases diagnosed in 2010 and beyond. Direct comparisons with rates for 2009 and prior years are shown here to highlight the impact of this change in counting standards for multiple primary cancers but should generally not be made.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

Incidence by sex

Among males, 45,518 cases of cancer are expected to be diagnosed in 2018 for an ASIR of 613.2 per 100,000 (Figure 1.2). The temporary decrease in the count and rate after 2011 can be attributed to the declining rate of prostate cancer, resulting from recommendations from the U.S. Preventive Services Task Force against using prostate-specific antigen (PSA) testing for the routine screening of healthy males.[2]

The numbers are expected to be lower for females, with 44,965 cases diagnosed for an ASIR of 542.7 per 100,000 (Figure 1.2). The incidence rate has been higher for males than females for every year since 1983. This sex difference has been observed in many different jurisdictions and is not unique to Ontario.[3,4] Higher rates of cancer among males have been attributed to behavioural, immunity and hormonal differences between the sexes; however, for some cancer types the mechanism underlying the difference is still unknown.[5]

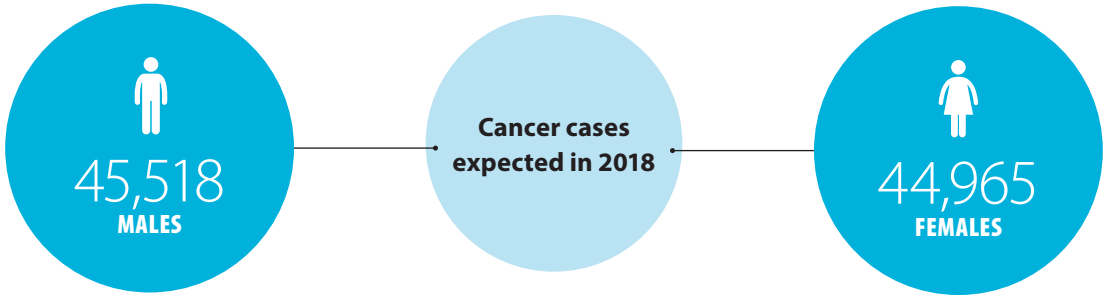
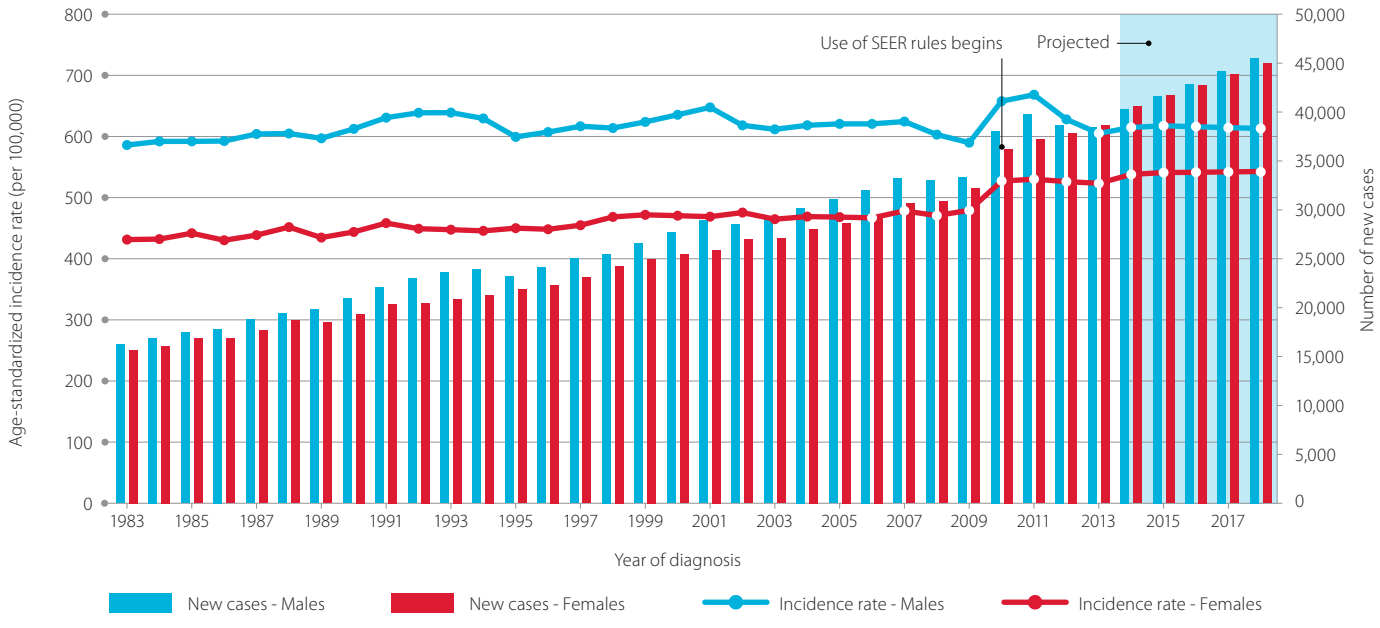


Figure 1.2 **Projected incidence counts and age-standardized rates by sex for all cancers combined, Ontario, 1983–2018**



Notes: 1. Rates are per 100,000 and standardized to the age distribution of the 2011 Canadian population.
2. Observed incidence rates are based on the NCI SEER standards for counting multiple primary cancers, which were adopted by the Ontario Cancer Registry for cases diagnosed in 2010 and beyond. Direct comparisons with rates for 2009 and prior years are shown here to highlight the impact of this change in counting standards for multiple primary cancers but should generally not be made.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

Incidence by cancer type

In 2018, the most commonly diagnosed cancer is expected to be female breast cancer (11,762 cases or 13.0% of all new cases), followed closely by colorectal (11,595 cases or 12.8%) and lung (11,396 cases or 12.6%) cancers (Table 1.1). These three cancers alone are projected to account for almost 40% of all new cancers diagnosed in 2018. Among males, the most commonly diagnosed cancer is expected to be prostate cancer, accounting for an estimated 8,828 new cases for an ASIR of 115.6 per 100,000. Breast cancer (with an ASIR of 146.4 per 100,000) is projected to be the most commonly diagnosed cancer among females.

With the exception of thyroid cancer, the ASIR is expected to be higher in males than females for all the cancers listed in Table 1.1. For thyroid cancer, female incidence will outpace male by more than 3:1. A number of possible reasons for the higher incidence of thyroid cancer in females have been proposed. For example, females are more likely to have thyroid disease and therefore have an increased likelihood of diagnostic investigation,[6] females have a greater tendency to seek medical attention and participate more actively in medical visits,[7–9] males and females have biological differences in their hormone levels, including thyroid stimulated hormone and sex steroids.[10–12] While the incidence of less aggressive types, such as papillary thyroid cancer, has been higher in females than males in a number of jurisdictions, the rate of more aggressive types such as anaplastic and medullary thyroid cancers are generally similar between the sexes.[6, 13] As a result thyroid mortality rates have been fairly equal between males and females (see *Chapter 5: Cancer mortality rates and trends*).

Table 1.1 **Projected incidence counts and age-standardized rates by cancer type and sex for selected cancers, Ontario, 2018**

Cancer type	Both sexes		Males		Females	
	New cases	ASIR	New cases	ASIR	New cases	ASIR
All cancers	**90,483**	**571.1**	**45,518**	**613.2**	**44,965**	**542.7**
Bladder	5,176	31.5	3,959	53.4	1,217	13.7
Breast (female)	—	—	—	—	11,762	146.4
Cervix	—	—	—	—	748	10.1
Colorectal	11,595	72.3	6,376	86.2	5,219	60.4
Kidney	2,814	18	1,800	24.5	1,014	12.1
Liver	1,495	9.3	1,064	14.2	431	4.9
Lung	11,396	69.6	5,698	76.2	5,698	64.9
Melanoma	4,129	26.4	2,372	32.5	1,757	21.6
Pancreas	2,281	14	1,116	15	1,165	13.1
Prostate	—	—	8,828	115.6	—	—
Thyroid	3,341	23	746	10.4	2,595	35.1
Uterus	—	—	—	—	3,544	43.6

ASIR=Age-standardized incidence rate
Note: Rates are per 100,000 and standardized to the age distribution of the 2011 Canadian population.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

Other than thyroid cancer, the greatest disparities between the sexes in cancer incidence are expected to occur in bladder and liver cancer. Specifically:

- For bladder cancer, the male rate will be almost four times the female rate. One of the risk factors for bladder cancer is a history of smoking, with smokers being two to three times as likely to develop bladder cancer as non-smokers.[14, 15] A history of tobacco use is more common in males, which may be one of the reasons bladder cancer incidence is much higher in males.[16]
- For liver cancer, the male rate is expected to be almost three times the female rate. While higher male prevalence of risk factors such as alcohol use and smoking may account for some of the discrepancy,[17–19] recent research indicates the possibility that there are genetic differences in the way males and females respond to the chronic inflammation caused by infectious agents such as hepatitis B or hepatitis C viruses, which are the most common liver cancer risk factors.[20–22]

The greatest number of new cancer cases are expected to be diagnosed in those ages 60 to 79 with an estimated 53.1% of all cases in 2018 projected to occur in this age group.

Incidence by age group

The greatest number of new cancer cases are expected to be diagnosed in those ages 60 to 79 with an estimated 53.1% of all cases in 2018 projected to occur in this age group (Table 1.2). The next most common age group for new cancer cases will be 40 to 59 year olds (22.9%) followed by those 80 and older (19.4%). Only 4.7% of cases are expected to be diagnosed in those under the age of 40.

Cancer incidence increases with age. The incidence rate in 2018 is projected to range from 61.1 per 100,000 in those ages 39 and under to 2,716.8 per 100,000 in people age 80 and older. Further:

- The incidence rates for bladder and colorectal cancers and melanoma are expected to increase significantly with age.
- The incidence rates for breast, kidney, liver, lung and pancreas cancers are expected to increase non-significantly with age.
- The incidence rates of both cervical and thyroid cancer are expected to peak in those ages 40 to 59.
- The incidence rates of prostate and uterine cancer are expected to peak in the 60 to 79 age group, although for prostate cancer the rate is expected to be very similar to that of the 80 and over group.

The incidence of the 12 cancers reported in Table 1.2 are projected to be very low in those under the age of 40. The exceptions are breast cancer, for which the rate is expected to be 15.4 per 100,000; thyroid cancer, for which the rate is expected to be 9.0 per 100,000; and cervical cancer, for which the rate is expected to be 5.3 per 100,000. Bladder, liver, lung and pancreas cancers are very rare in people under the age of 40; prostate cancer is non-existent.

Female breast cancer will account for 20.0% of all cases diagnosed in those ages 40 to 59. Among the oldest Ontarians—those 80 years and older—prostate will be the most commonly diagnosed cancer (463.1 per 100,000) followed by colorectal (439.9 per 100,000) and lung (432.1 per 100,000) cancers.

Table 1.2 **Projected incidence counts and age-specific rates by cancer type and age group for selected cancers, Ontario, 2018**

Cancer type	Age group (years)							
	0–39		40–59		60–79		80+	
	New cases	Age-specific rate	New cases	Age-specific rate	New cases	Age-specific rate	New cases	Age-specific rate
All cancers*	**4,256**	**61.1**	**20,681**	**524.3**	**48,038**	**1748.1**	**17,509**	**2716.8**
Bladder*	52	0.7	588	14.9	2,996	109.0	1,540	239.0
Breast (female)	531	15.4	4,155	207.9	5,561	386.6	1,515	391.3
Cervix	184	5.3	325	16.2	202	14.0	37	9.6
Colorectal*	223	3.2	2,339	59.3	6,198	225.5	2,835	439.9
Kidney	98	1.4	809	20.5	1,473	53.6	434	67.3
Liver	22	0.3	290	7.3	893	32.5	290	45.0
Lung	59	0.8	1,530	38.8	7,022	255.5	2,785	432.1
Melanoma*	345	5.0	1,012	25.7	1,924	70.0	848	131.5
Pancreas	20	0.3	377	9.5	1,284	46.7	601	93.2
Prostate	0	0.0	1,485	76.3	6,152	469.8	1,192	463.1
Thyroid	627	9.0	1,544	39.1	1,064	38.7	106	16.5
Uterus	72	2.1	1,188	59.5	1,941	135.0	342	88.3

*Significant increasing trend in age-specific rate with increasing age
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

This chapter presented an overview of projected incidence frequencies and rates for 2018 for selected cancer types. For more information on cancer incidence in Ontario, including data on more cancer types and trends over time, see *Chapter 4: Cancer incidence rates and trends*.

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Chapter 2

Estimated current cancer mortality

Mortality measures the number of deaths caused by cancer. This chapter presents projected statistics on cancer mortality in Ontario for the current year.

Expected deaths from cancer

"In 2018, 30,574 deaths from cancer are expected to occur in Ontario, 16,039 in males and 14,535 in females."

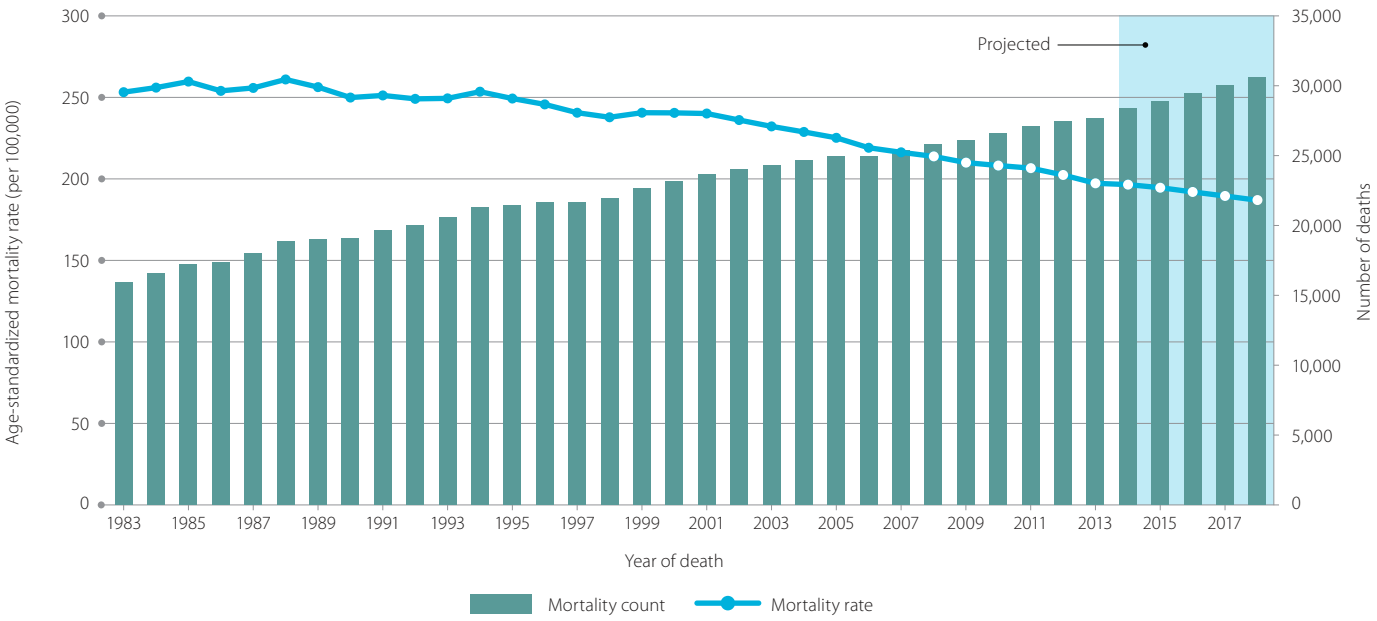
While the number of cancer deaths in Ontario (mortality) has increased over the past three decades, the mortality rate has declined. In general, cancer mortality is affected by:

- the incidence of cancer;
- cancer survival;
- socio-demographic factors;
- the effectiveness of early detection for cancer in extending life; and
- the availability of and access to effective treatment for cancer.

The statistics reported in this chapter are projections for the years 2014 to 2018.

In 2018, an estimated 30,574 deaths from cancer (excluding non-melanoma skin cancer) are expected to occur in Ontario, resulting in an age-standardized mortality rate (ASMR) of 186.9 per 100,000 people (Figure 2.1). While the number of cancer deaths has increased each year since 1983, the ASMR peaked in 1988 and has decreased every year since 1999.

Figure 2.1 **Projected mortality counts and age-standardized rates for all cancers combined, Ontario, 1983–2018**



Note: Rates are per 100,000 and standardized to the age distribution of the 2011 Canadian population.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

Mortality by sex

Among males, 16,039 deaths are expected to be caused by cancer in 2018, resulting in an ASMR of 219.5 per 100,000 (Figure 2.2). As with cancer incidence, the numbers are expected to be lower for females, with 14,535 deaths expected to occur for an ASMR of 162.5 per 100,000. Males are projected to account for 52.5% of all cancer deaths in 2018. This number has stayed remarkably stable over time; in 1983, males accounted for 54.4% of all cancer deaths.

While the number of cancer deaths has increased over time, the ASMR has declined for both males and females. The male ASMR started declining with each year in 1995; the female rate did not start declining in the same way until 2001. The later decline in the female ASMR is probably due to lung cancer mortality. The lung cancer mortality rate for females did not start to decline until 2000—more than 10 years after the male rate started to decline.

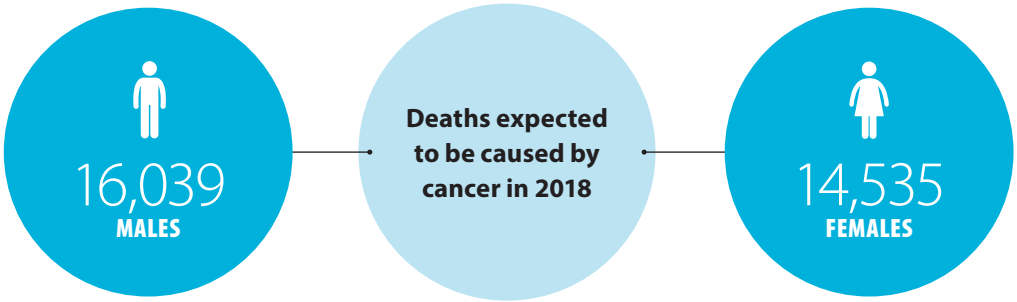
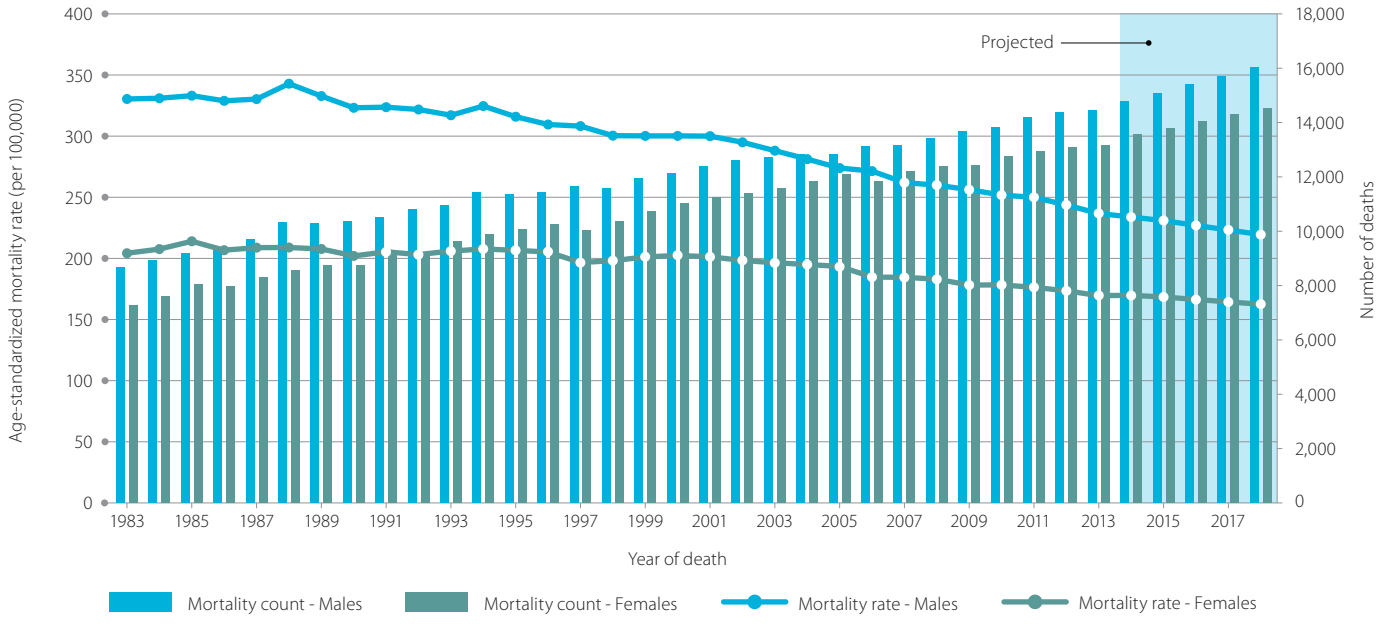


Figure 2.2 **Projected mortality counts and age-standardized rates by sex for all cancers combined, Ontario, 1983–2018**



Note: Rates are per 100,000 and standardized to the age distribution of the 2011 Canadian population.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

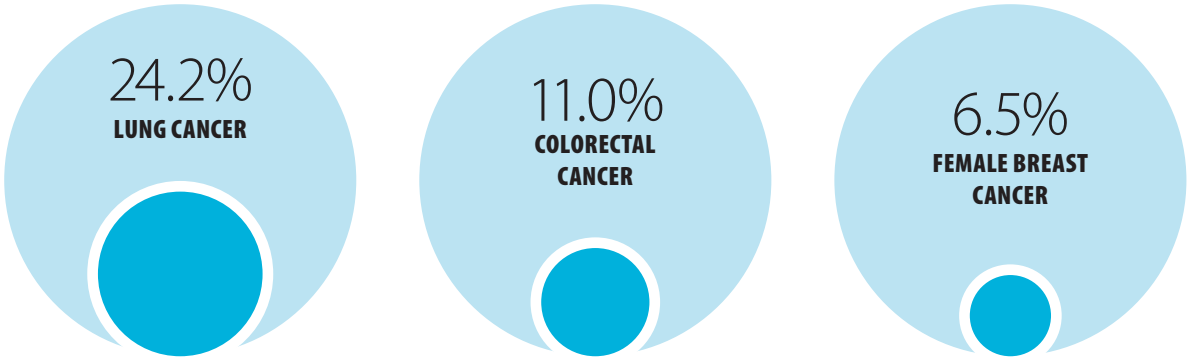
Mortality by cancer type

In 2018, the leading cause of cancer death is expected to be lung cancer, which is projected to account for almost one quarter of all cancer deaths (7,414 deaths or 24.2% of all cancer deaths). This will be followed by colorectal (3,359 deaths or 11.0%) and female breast cancer (1,977 deaths or 6.5%). Pancreatic cancer, despite having a much lower incidence, is projected to cause almost as many deaths (1,956 deaths) as breast cancer.

Lung cancer will also be the leading cause of cancer death for both males and females separately, although the ASMR is projected to be significantly higher for males (52.0 per 100,000) than females (39.6 per 100,000).

For all the cancers listed in Table 2.1, the ASMR is expected to be higher for males than females. Beyond the fact that more males than females are diagnosed with cancer (see *Chapter 1: Estimated current cancer incidence in Ontario*), which translates into higher mortality rates for males, higher male mortality rates can also be attributed to increased prevalence of risk factors such as obesity, alcohol and tobacco use among males, lower use of medical services compared to females and the influence of sex hormones.[1–5]

Leading causes of cancer death as a percentage of all cancer deaths



Pancreatic cancer, despite having a much lower incidence, is projected to cause almost as many deaths (1,956 deaths) as breast cancer.

The greatest disparities between males and females in cancer mortality in 2018 are expected to be the same as the greatest disparities in incidence:

- bladder cancer, for which the male ASMR will be more than three times that of the female rate; and
- liver cancer, for which the male ASMR will be more than twice that of the female rate.

Table 2.1 **Projected mortality counts and age-standardized rates by cancer type and sex for selected cancers, Ontario, 2018**

Cancer type	Both sexes		Males		Females	
	Deaths	ASMR	Deaths	ASMR	Deaths	ASMR
All cancers	**30,574**	**186.9**	**16,039**	**219.5**	**14,535**	**162.5**
Bladder	914	5.5	655	9.1	259	2.7
Breast (female)	—	—	—	—	1,977	23.0
Colorectal	3,359	20.4	1,811	24.9	1,548	16.8
Liver	1,299	8.0	887	11.9	412	4.5
Lung	7,414	45.1	3,865	52.0	3,549	39.6
Pancreas	1,956	11.9	977	13.2	979	10.8
Prostate	—	—	1,647	23.3	—	—

ASMR=Age-standardized mortality rate
Note: Rates are per 100,000 and standardized to the age distribution of the 2011 Canadian population.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

Mortality by age group

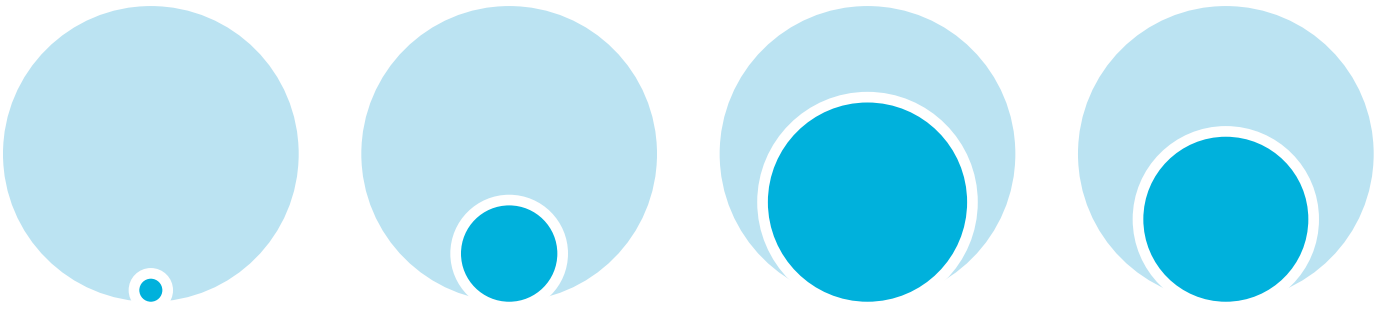
The greatest number of cancer deaths in 2018 are expected to occur in the 60 to 79 age group, with an estimated 50.3% of all deaths projected to occur in this age group (Table 2.2). The next most common age group for cancer deaths will be the 80 and older group (35.3%). The mortality rate however will be highest in the 80 and older group (1675.6 deaths per 100,000). Cancer mortality before the age of 40 will be rare with only 382 deaths expected to occur in this age group (1.2% of all cancer deaths).

Cancer mortality in 2018 is expected to increase significantly with age. The mortality rate is projected to increase from 5.5 per 100,000 in people ages 39 and younger to 1675.6 per 100,000 in people ages 80 and older. Further:

- The mortality rates for bladder, breast, colorectal, pancreas and prostate cancers will also increase significantly with age.
- The mortality rates for liver and lung cancers will increase non-significantly with age.

Cancer mortality in 2018 is expected to increase significantly with age. The mortality rate is projected to increase from 5.5 per 100,000 in people ages 39 and younger to 1675.6 per 100,000 in people ages 80 and older.

Percentage of deaths by age group



1.3%
0–39

13.1%
40–59

50.4%
60–79

35.3%
80 AND OLDER

Table 2.2 **Projected mortality counts and age-specific rates by cancer type and age group for selected cancers, Ontario, 2018**

Cancer type	Age group (years)							
	0–39		40–59		60–79		80+	
	Deaths	Age-specific rate	Deaths	Age-specific rate	Deaths	Age-specific rate	Deaths	Age-specific rate
All cancers*	**382**	**5.5**	**3,999**	**101.4**	**15,394**	**560.2**	**10,799**	**1,675.6**
Bladder*	**	**	60	1.5	380	13.8	472	73.3
Breast (female)*	43	1.3	468	23.4	839	58.4	627	161.8
Colorectal*	27	0.4	389	9.9	1,546	56.3	1,397	216.8
Liver	10	0.1	183	4.6	745	27.1	361	56.0
Lung	19	0.3	854	21.6	4,377	159.3	2,165	336.0
Pancreas*	7	0.1	266	6.7	1,053	38.3	630	97.7
Prostate*	0	0	50	2.6	648	49.5	949	368.8

*Significant increasing trend in age-specific rates with increasing age
**Supressed due to small cell counts (n<6)
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

This chapter presented an overview of projected cancer mortality frequencies and rates for 2018 for selected cancers. For more information on cancer mortality in Ontario, including data on more cancer types and trends over time, see *Chapter 5: Cancer mortality rates and trends*.

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Emerging issues in cancer control

The ability to better characterize cancer cases can help guide the improvement of prevention, screening, patient care and treatment. This chapter presents two emerging issues related to the increasing complexity of care for cancer patients: cancer comorbidities and wait time to treatment. They are important in the context of describing the burden of cancer because they can help inform improvements in the cancer system.

Part 1:

Comorbidity and cancer

Comorbidities are conditions or diseases outside of the cancer of interest but which exist simultaneously alongside it. Comorbidities are not adverse effects of cancer treatment, but exist at the time of the cancer diagnosis. The presence of other illnesses may require more complex care or lengthier treatment, and may also increase the length of time spent waiting for treatment. As such, information on comorbidity can be valuable in understanding the full burden of disease because it is an indicator of the general health of the patient—and thus an important prognostic factor for survival. Information on comorbidity is collected from Canadian hospitals through the Discharge Abstract Database (DAD) and the National Ambulatory Care Reporting System (NACRS).[1, 2]

Information on comorbidity can be valuable in understanding the full burden of cancer as it is an indicator of general health—and thus an important prognostic factor for survival.

Some comorbid conditions (such as obesity or acquired or inherited immunosuppression) may in themselves be risk factors for cancer. At the same time, some medications used to treat comorbid conditions (such as anti-inflammatories, statins or antibiotics) may decrease the risk of cancer or improve cancer prognosis.[3–5] Comorbid conditions can also have an impact on the selection of treatment type and make some treatments prohibitive.[6–8] For example, lung cancer patients with severe chronic obstructive pulmonary disease (COPD) are not good candidates for resection and therefore have a reduced chance of survival.[9, 10]

Previous findings from other jurisdictions have shown poorer survival among cancer patients with comorbidities.[11] In addition, improvements in cancer survival observed over the past few decades have not been matched among patients with comorbid conditions.[12] Comorbidity can impact survival through a number of mechanisms, including generally higher mortality among those with concurrent chronic conditions, the effect of simultaneous treatment for the comorbidity and the cancer, the likelihood of less aggressive treatment among those with a comorbidity and the impact of the comorbid condition itself on the progression of the cancer.[11, 13]

This section presents statistics on the presence of comorbidities for cancer cases diagnosed from 2011 to 2015 for seven cancer types:

- bladder
- breast
- colorectal
- kidney
- lung
- melanoma
- pancreas

While statistics presented for years beyond 2013 in other chapters of this report are based on projected data, in this chapter actual (non-projected) data were used for all analyses.

Comorbidity by cancer type

The presence of comorbidities varied by cancer type. Of the seven cancer types examined, the cancer type with the greatest proportion of patients with no comorbidity (as measured by the Charlson Comorbidity Index [CCI]) was female breast cancer, with 89.7% of patients having a CCI score of zero (Table 3.1). In contrast, pancreatic cancer had the lowest proportion of patients with no comorbidity at 52.0%.

Among those with comorbidity, patients can be divided into those with moderate comorbidities (CCI score of one or two) and those with severe comorbidities (CCI score of three or more). In summary:

- While the majority of bladder cancer patients had no comorbidities, 27.4% had moderate comorbidities and 9.5% had severe comorbidities.
- Almost 90% of female breast cancer patients had no comorbidities, 8.8% had moderate comorbidities and 1.4% had severe comorbidities.
- Among colorectal cancer patients, 67.9% had no comorbidities, 25.2% had moderate comorbidities and 7.0% had severe comorbidities.
- The majority of kidney cancer patients had no comorbidities (64.8%), 26.5% had moderate comorbidities and 8.6% had severe comorbidities.
- Of the cancers examined, lung cancer patients were among the most likely to have at least one comorbidity (43.2% of patients had a CCI score of at least one) while 10.3% had severe comorbidities.
- The vast majority of melanoma patients had no comorbidities (87.7%), with only 2.5% having severe comorbidities.
- Pancreatic cancer patients were the most likely, of the cancers examined, to have severe comorbidities, with 13.3% of patients having a CCI score of at least three.

These findings are in line with research in the United States that found that comorbidity was more common in lung cancer patients than colorectal cancer patients and more common in colorectal cancer patients than breast cancer patients.[14] However, the prevalence of comorbidities found in that study was higher than in our analysis, particularly for colorectal and lung cancers, despite the fact that we included more comorbid conditions in our modified CCI index.

The variation in the prevalence of comorbidity by cancer type is partially explained by risk factors.[15] Cancers such as lung and bladder that have risk factors in common with chronic conditions (e.g., tobacco use) are more often associated with comorbidity. Conversely, cancers that are not strongly related to such risk factors (e.g., breast, melanoma) are less likely to be associated with comorbidity.[15] In addition, comorbidity prevalence tends to increase with age, meaning patients with cancers more often diagnosed at younger ages (e.g., melanoma, breast) are less likely to have comorbidity.

Cancers more often associated with comorbidity tend to have risk factors in common with other chronic conditions.

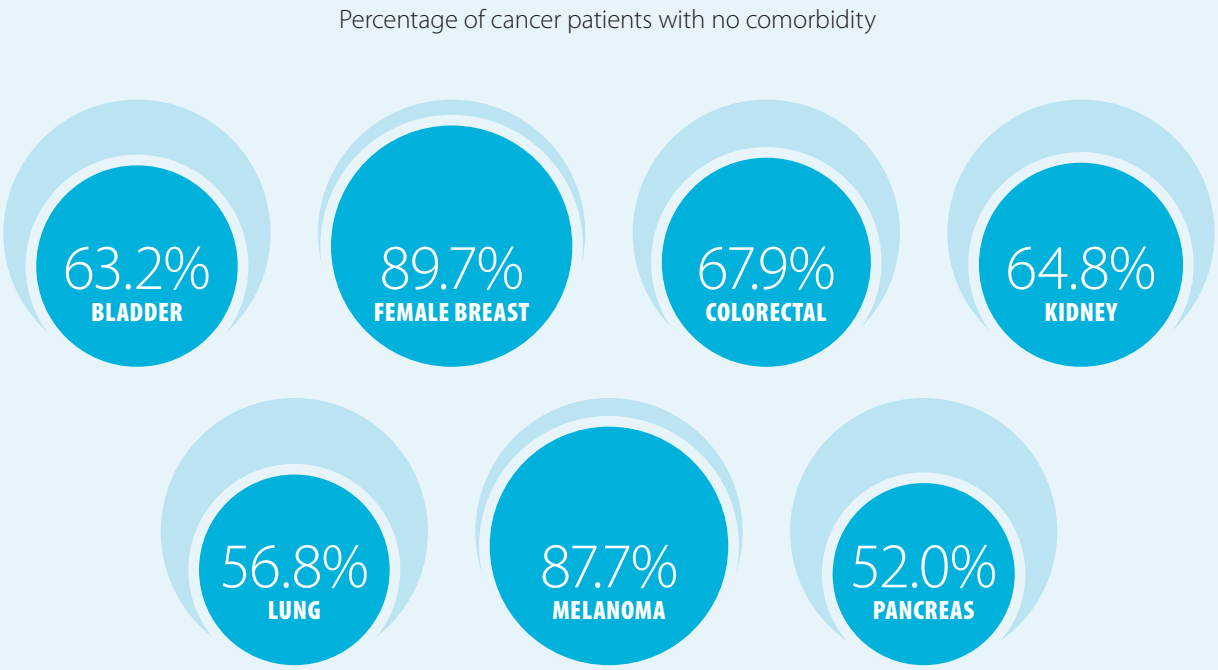


Table 3.1 **Prevalence of comorbidities by cancer type for selected cancers, Ontario, 2011–2015**

Cancer type	CCI score		
	0	1–2	3+
Bladder	6,239 (63.2%)	2,705 (27.4%)	934 (9.5%)
Breast (female)	40,934 (89.7%)	4,033 (8.8%)	656 (1.4%)
Colorectal	25,783 (67.9%)	9,561 (25.2%)	2,652 (7.0%)
Kidney	6,572 (64.8%)	2,691 (26.5%)	876 (8.6%)
Lung	24,855 (56.8%)	14,368 (32.9%)	4,509 (10.3%)
Melanoma	12,269 (87.7%)	1,363 (9.7%)	355 (2.5%)
Pancreas	4,291 (52.0%)	2,868 (34.7%)	1,096 (13.3%)

CCI=Charlson Comorbidity Index
Analysis by: Surveillance, Analytics and Informatics, CCO
Data sources: Ontario Cancer Registry (November 2016), CCO; Discharge Abstract Database; National Ambulatory Care Reporting System

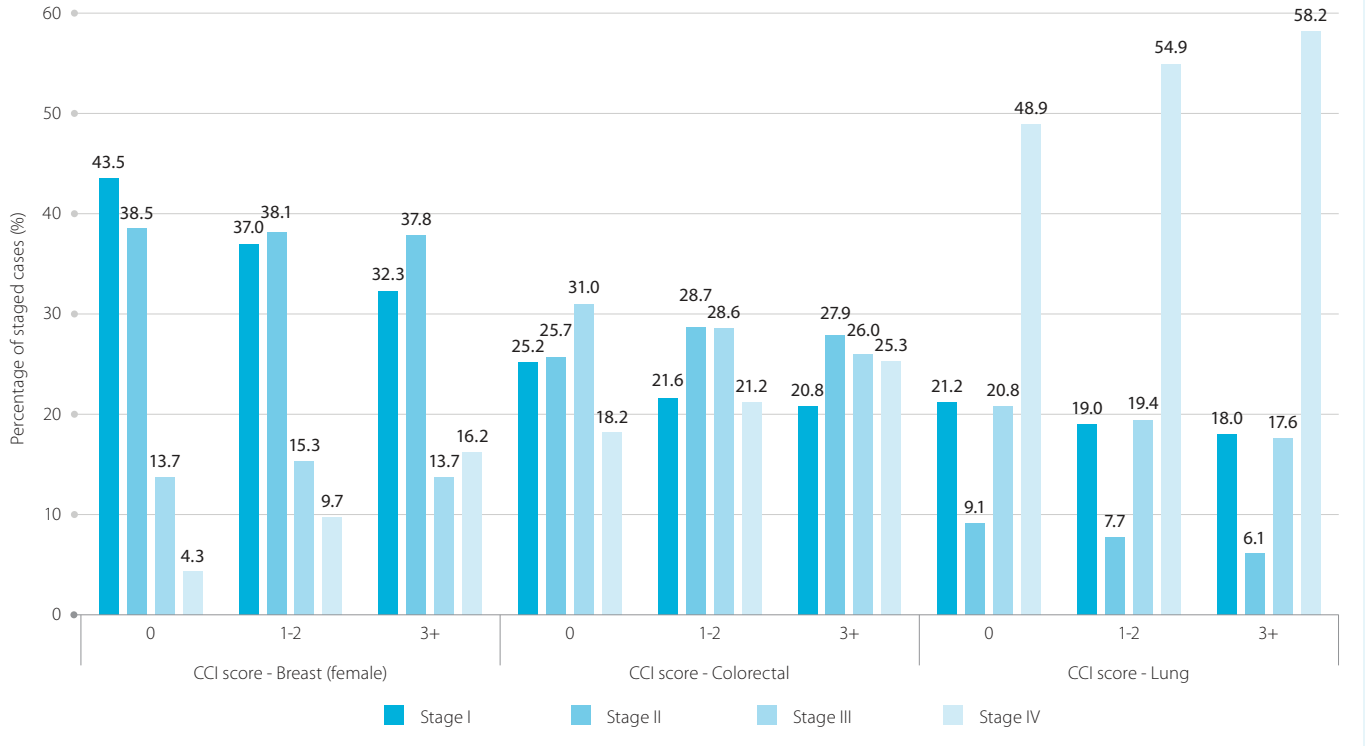
Comorbidity by stage

The prevalence of comorbidities by stage for the cancers for which stage data was available are presented in Figure 3.1. In general, for all three cancer types assessed, increasing level of comorbidity was associated with increasing likelihood of a stage IV diagnosis.

- Among breast cancer patients with no comorbidity the largest proportion were diagnosed at stage I (43.5%), while 18.0% were diagnosed at an advanced stage (stage III or stage IV). Among those with moderate comorbidities, 25.0% were diagnosed at an advanced stage, while 29.9% of those with severe comorbidities were diagnosed at an advanced stage.
- While 49.2% of colorectal cancer patients with no comorbidity were diagnosed at an advanced stage, the number was similar at 51.3% among those with severe comorbidities. However, the proportion of patients diagnosed at stage IV increased from 18.2% among those with no comorbidities to 25.3% among those with severe comorbidities.
- Among lung cancer patients, the proportion of those diagnosed at an advanced stage increased with increasing prevalence of comorbidities. However, lung cancer tends to be diagnosed at more advanced stages regardless of the prevalence of comorbidity in the patient. In 2013, 71.0% of staged lung cancer cases were diagnosed at stage III or IV (see *Chapter 4: Cancer incidence rates and trends*). A similar number (75.8%) of lung cancer patients with severe comorbidities were diagnosed at an advanced stage.

It has been argued that patients with comorbidity are more likely to be diagnosed at more advanced stages because comorbidity may mask the early symptoms of cancer.[16] Previous studies of comorbidity and stage at diagnosis have found differing results including that patients with comorbidity are more likely to be diagnosed earlier, later or at a similar stage as those without comorbidity, with the variations in

Figure 3.1 **Prevalence of comorbidities by cancer type, stage at diagnosis and CCI score for selected cancers, Ontario, 2011–2015**



CCI=Charlson Comorbidity Index
Note: Case counts are as follows: breast n = 45,623 (excludes unknown stage = 310); colorectal n = 37,996 (excludes unknown stage = 1,010); lung n = 43,732 (excludes unknown stage = 399). Cases that were not staged were excluded from this analysis.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data sources: Ontario Cancer Registry (November 2016), CCO; Discharge Abstract Database; National Ambulatory Care Reporting System

findings attributed to cancer type, comorbidity type, different populations and different healthcare systems.[15] In Ontario, at least, it appears that the possible positive implication of comorbidities (i.e., more frequent contact with the healthcare system) have not resulted in increased detection of cancer, and that those with comorbidities are more likely to be diagnosed at an advanced stage than those without comorbidities.

It should be noted that approximately 10% to 20% of breast, lung and colorectal cancer cases in the Ontario Cancer Registry are missing any information on stage at diagnosis and are therefore excluded from this analysis. We cannot be sure that the distribution of comorbidity score would be the same for these cases.

Type of comorbidity

For each of the seven cancers of interest, the five most common comorbidities measured by the CCI index are presented in Table 3.2.

For bladder, breast, colorectal and pancreatic cancers, as well as melanoma, the most common comorbidities were diabetes without complications, followed by another cancer diagnosis (other than the cancer of interest) and COPD. For kidney cancer, the third most common comorbidity was renal disease, followed by COPD. For lung cancer, COPD was the most common comorbidity.

Cardiovascular conditions (congestive heart failure and myocardial infarction) were another common comorbidity, appearing in the five most common comorbidities for all cancer types except kidney.

Table 3.2 **Five most common comorbidities by cancer type for selected cancers, Ontario, 2011–2015**

Bladder		Breast (female)		Colorectal	
Diabetes without complications	16.0%	Diabetes without complications	5.5%	Diabetes without complications	15.4%
Cancer (non-bladder)	11.7%	Cancer (non-breast)	2.0%	Cancer (non-colorectal)	6.4%
COPD	5.1%	COPD	1.3%	COPD	4.3%
Renal disease	4.4%	Congestive heart failure	0.9%	Congestive heart failure	3.9%
Congestive heart failure	3.8%	Diabetes with complications	0.6%	Myocardial infarction	2.8%
Kidney		**Lung**		**Melanoma**	
Diabetes without complications	16.4%	COPD	16.7%	Diabetes without complications	4.9%
Cancer (non-kidney)	9.4%	Diabetes without complications	14.3%	Cancer (non-melanoma)	4.5%
Renal disease	4.6%	Cancer (non-lung)	10.4%	Congestive heart failure	1.2%
COPD	4.4%	Congestive heart failure	4.9%	COPD	1.1%
Diabetes with complications	4.3%	Myocardial infarction	3.5%	Myocardial infarction	0.9%
Pancreas					
Diabetes without complications	26.9%				
Cancer (non-pancreatic)	14.0%				
COPD	4.6%				
Diabetes with complications	4.4%				
Congestive heart failure	3.0%				

COPD=Chronic obstructive pulmonary disease
Analysis by: Surveillance, Analytics and Informatics, CCO
Data sources: Ontario Cancer Registry (November 2016), CCO; Discharge Abstract Database; National Ambulatory Care Reporting System

Survival by prevalence of comorbidities

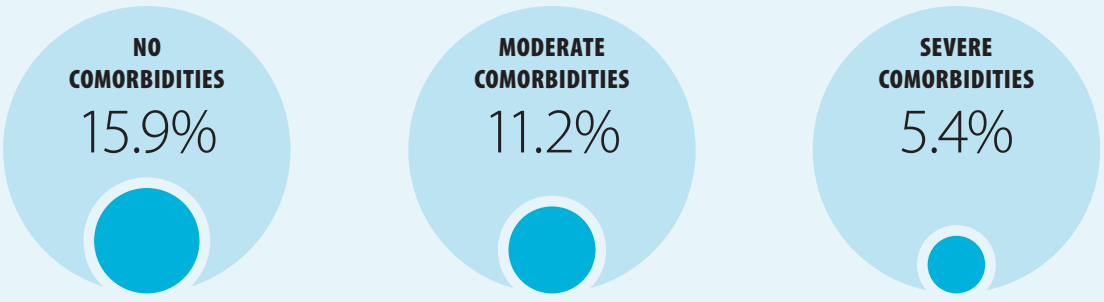
Three-year relative survival for the period 2011 to 2015 tended to decrease with increasing CCI score (Table 3.3). These findings are in line with other data that showed similar findings.[11] In this analysis, although survival for all seven cancer types decreased significantly, the level of decrease varied by cancer type. Comorbidities had the greatest effect on survival for pancreatic and lung cancers and the least effect on survival for kidney and breast cancers.

- For bladder cancer, the three-year relative survival ratio (RSR) decreased significantly from 77.6% for those with a CCI score of zero (no comorbidities) to 58.6% for those with a score of one or two (moderate comorbidities) and to 36.4% for those with a score of three or more (severe comorbidities).
- Breast cancer survival decreased less compared to the other cancers examined. Survival was very high at 94.8% for those with a CCI score of zero, although it declined to 53.1% for those with severe comorbidities. This finding is in line with previous studies, which also found that the effect of comorbidity on breast cancer survival persisted even after adjustment for age and stage at diagnosis.[17]
- Survival for colorectal cancer also declined considerably, from 80.3% for those with a score of zero to 40.5% for those with severe comorbidities.
- Kidney cancer survival decreased from high survival of 85.2% among those with a CCI score of zero to 53.4% among those with severe comorbidities.

Three-year relative survival tended to decrease with increasing CCI score. Comorbidities had the greatest effect on survival for pancreatic and lung cancers and the least effect on survival for kidney and breast cancers.

- Lung cancer survival decreased from 32.5% for those with a score of zero to just 13.5% for those with severe comorbidities. This decline may be the result of comorbid pulmonary diseases that may delay the diagnosis of lung cancer.[18] In addition, a CCI score of three or more has been shown to increase the risk of post-operative complications following therapeutic surgery for lung cancer[18] — although recent increases in the use of video-assisted thoracoscopic surgery has helped to improve safety.[19–21]
- Comorbidities had a considerable effect on survival for melanoma. While people with a score of zero had a high three-year RSR of 92.7%, this number fell to just 41.7% for those with severe comorbidities.
- Pancreatic cancer showed the lowest survival of all the cancers examined, patients with a CCI score of zero had a three-year RSR of just 15.9%. This number declined to 11.2% for those with moderate comorbidities and 5.4% for those with severe comorbidities. This decrease is particularly concerning because almost half of pancreatic cancer patients had comorbidities (Table 3.1).

Three-year relative survival ratios for patients with pancreatic cancer - the lowest survival of all cancers examined



These results are somewhat contrary to other studies that have found that comorbidity has a greater effect on survival for high survival cancers than low survival cancers.[11, 22] This analysis, on the other hand, found that pancreatic and lung cancers—both low survival cancers—showed the greatest relative change in survival with increasing comorbidity.

While this analysis highlights the importance of comorbidity as a prognostic factor for the seven cancer types discussed, it does not explain the mechanism behind this relationship. Further analysis will be required to isolate what factors lead to decreased survival in people with comorbidity. Although these results have shown that cancer patients with comorbidities in Ontario are more likely to be diagnosed at an advanced stage, comorbidity may also affect choice of treatment, adherence and response to that treatment, or the cancer or its treatment may affect the comorbidity itself. These underlying mechanisms need to be understood before interventions can be implemented to mitigate the effect of comorbidity on the burden of cancer. The prevalence of comorbidities in new cancer patients is expected to increase as Ontario's population ages, emphasizing the importance of further understanding the impact of comorbidity on patient care and outcomes.

Table 3.3 **Three-year relative survival ratios by CCI score for selected cancers, Ontario, 2011–2015**

Cancer type	RSR % (95% CI)		
	CCI score = 0	CCI score = 1–2	CCI score = 3+
Bladder	77.6 (74.0–77.2)	58.6 (55.9–61.1)	36.4 (32.3–40.6)
Breast (female)	94.8 (94.4–95.2)	79.3 (77.4–81.1)	53.1 (47.8–58.2)
Colorectal	80.3 (79.6–80.9)	63.2 (61.7–64.4)	40.5 (38.0–43.1)
Kidney	85.2 (83.9–86.3)	72.4 (70.1–74.6)	53.4 (49.0–57.7)
Lung	32.5 (31.7–33.2)	22.0 (21.1–22.9)	13.5 (12.1–14.9)
Melanoma	92.7 (91.9–93.5)	69.6 (66.0–73.0)	41.7 (34.7–48.7)
Pancreas	15.9 (14.5–17.4)	11.2 (9.8–12.8)	5.4 (3.8–7.4)

CCI=Charlson Comorbidity Index
CI=Confidence interval
RSR=Relative survival ratio
Note: Analysis was restricted to ages 15 to 99.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data sources: Ontario Cancer Registry (November 2016), CCO; Discharge Abstract Database; National Ambulatory Care Reporting System

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Part 2:

Wait time and cancer

While some wait for treatment is inevitable, because cancer may grow and spread to other parts of the body over time, a delay in initiating treatment may result in the loss of an opportunity for a cure.[1] Longer wait times result not only in delays in receiving treatment but have also been linked to inefficiencies and poorer quality of care.[2, 3] In addition, long wait times to treatment have been shown to adversely affect the patient's quality of life.[4]

This section focuses on the wait time to one particular type of cancer treatment: surgery. In the past, wait times for cancer surgery had increased over time both in Ontario[5–9] and other Canadian provinces.[10, 11] This resulted in a first minister's conference on wait times in 2004 and was a major impetus for creating the Wait Time Information System (WTIS) as well as access-to-care targets with public reporting for cancer surgery and other surgical services in Ontario.[1]

Surgery is a key component of curative treatment for most cancers. About 80% of cancer patients will have surgery at some point during their treatment.[12] Wait time is defined here as the time between the decision to treat the cancer with surgery and the first therapeutic surgery performed after diagnosis. This is known as 'Wait 2'. The decision-to-treat date is the date on which sufficient pre-treatment testing has been completed that the physician can reasonably assume that the patient will be treated, and the patient has agreed to the treatment.[1]

Statistics are presented for cases diagnosed from 2011 to 2015 for seven cancers:

- breast
- colorectal
- esophagus
- lung
- oral cavity & pharynx
- ovary
- pancreas

These cancer types were chosen because surgical treatment is often a primary method of treatment for these cancers. While this analysis includes only patients who received surgical treatment, it does not exclude patients who had other treatments as well (e.g., radiation, chemotherapy).

Wait time statistics are also examined by stage at diagnosis and age because these two factors may influence the urgency of surgery—although it is recognized that other factors such as aggressiveness of the cancer type and patient health are also important prognosticators considered by clinicians when assigning a priority level for wait. Survival by wait time is also examined.

While statistics presented for years beyond 2013 in other chapters of this report are based on projected data, in this chapter actual non-projected data were used for all analyses.

While some wait for treatment is inevitable, because cancer may grow and spread to other parts of the body over time, a delay in initiating treatment may result in the loss of an opportunity for a cure.

Wait time by cancer type and stage

Of the seven cancers examined, female breast and esophageal cancers had the shortest median wait times for surgical treatment at 16 days (Table 3.4). The longest median wait time was for oral cavity & pharynx cancers at 20 days. In addition:

- The median wait time was similar for breast cancer cases regardless of stage at diagnosis, averaging between 15 and 16 days.
- Wait time tended to decrease with increasing stage for colorectal cancer. Stage I cases had a median of 20 days while stage IV cases had a median of 15 days.
- Lung cancer wait times also decreased with increasing stage but by a greater degree, declining from a median of 20 days at stage I to nine days at stage IV.

Table 3.4 Wait time to receipt of surgical treatment by stage for selected cancers, Ontario, 2011–2015

Cancer type	Stage at diagnosis	N	Median wait time (days)	Wait time interquartile range (days)	Wait time range (days)
Breast (female)	All stages	42,882	16.0	15.0	0–1127
	I	18,328	16.0	14.0	0–1127
	II	16,737	15.0	14.0	0–750
	III	5,967	15.0	16.0	0–366
	IV	549	16.0	15.0	0–77
Colorectal	All stages	22,397	18.0	17.0	0–375
	I	4,644	20.0	17.0	0–208
	II	6,122	17.0	16.0	0–375
	III	7,636	18.0	18.0	0–373
	IV	2,822	15.0	17.0	0–373
Esophagus	All stages	1,084	16.0	15.5	0–167
Lung	All stages	9,100	17.0	15.0	0–390
	I	4,128	20.0	15.0	0–390
	II	1,868	16.0	14.0	0 - 129
	III	1,620	15.0	15.0	0–132
	IV	985	9.0	14.0	0–79
Oral cavity & pharynx	All stages	4,010	20.0	16.0	0–682
Ovary	All stages	3,015	19.0	21.0	0–229
Pancreas	All stages	1,566	17.0	18.0	0–141

Notes: 1. Analysis was restricted to cases with surgical treatment.
2. Priority level one cases were excluded.
3. Stage data was not available for esophageal, oral cavity & and pharynx, ovarian or pancreatic cancers. Stage analysis excludes the following cases with unknown stage: breast n = 1,191; colorectal n = 1,091; lung n = 491. Cases that were not staged were excluded from this analysis.
4. Dates Affecting Readiness to Treat (DART) wait time was excluded from this analysis.
5. Interquartile range is the difference between the 75th and 25th percentiles.

Analysis by: Surveillance, Analytics and Informatics, CCO
Data sources: Ontario Cancer Registry (March 2017), CCO; Wait Times Information System (March 2017), CCO

Wait time by age

The median wait time to treatment varied not only by cancer type but also by age group (Table 3.5). Other findings include:

- Among women with breast cancer the median wait time increased with increasing age, with those diagnosed under the age of 40 having a median wait time of 14 days and those diagnosed at age 80 or older having a median time of 18 days.
- Median wait time for colorectal cancer treatment ranged between 17 and 18 days regardless of the age of the patient.
- Wait time for esophageal cancer treatment was relatively short for the youngest age group (0–39 years) with a median of 10 days, although this was based on a small number of cases (n=11). After age 39, the median wait time decreased from 17 days for those ages 40–59 to 15 days for those 80 and older.
- Wait time for lung cancer surgery tended to increase with increasing age: from a median of 12 days in the youngest age group to 17 days in the oldest age group.
- As with colorectal cancer, wait time for oral cavity & pharynx cancer surgery was similar across age groups although the oldest age group experienced slightly longer wait times than younger people.
- For ovarian cancer patients median wait time was lowest for those ages 60–79 (16 days) but was higher (19 to 20 days) for those in the other age groups.
- For pancreatic cancer surgery wait time tended to decrease with increasing age, with those diagnosed before the age of 40 experiencing a median wait time of 21 days while those diagnosed at age 80 or older had a median wait time of 17 days.

Table 3.5 **Wait time to surgical treatment by age group for selected cancers, Ontario, 2011–2015**

Cancer type	Age group (years)											
	0–39			40–59			60–79			80+		
	N	Median wait time (days)	Interquartile range (days)	N	Median wait time (days)	Interquartile range (days)	N	Median wait time (days)	Interquartile range (days)	N	Median wait time (days)	Interquartile range (days)
Breast (female)	2,236	14.0	14.0	18,789	16.0	14.0	18,668	16.0	14.0	3,189	18.0	14.0
Colorectal	566	17.0	18.0	6,147	17.0	17.0	12,085	18.0	17.0	3,599	18.0	16.0
Esophagus	11	10.0	21.0	353	17.0	15.0	661	16.0	16.0	59	15.0	18.0
Lung	89	12.0	14.0	1,914	15.0	15.0	6,355	17.0	16.0	742	17.0	15.0
Oral cavity & pharynx	167	21.0	15.0	1,587	20.0	17.0	1,893	20.0	16.0	363	22.0	17.0
Ovary	238	19.0	20.0	1,275	19.0	20.0	1,369	16.0	21.0	133	20.0	21.0
Pancreas	59	21.0	33.0	470	15.5	18.0	937	18.0	17.0	100	17.0	15.5

Notes: 1. Analysis was restricted to cases with surgical treatment.
2. Priority level one cases were excluded.
3. Dates Affecting Readiness to Treat (DART) wait time was excluded from this analysis.
4. Interquartile range is the difference between the 75th and 25th percentiles.

Analysis by: Surveillance, Analytics and Informatics, CCO
Data sources: Ontario Cancer Registry (March 2017), CCO; Wait Time Information System (March 2017), CCO

Wait time by priority level

In Ontario, once the decision to treat the cancer with surgery is made, the patient is assigned a priority level that reflects the urgency of surgery. Priority level is based on the urgency of the cancer treatment and is therefore dependent on many factors including tumour stage, tumour behaviour and patient health.[13]

There are four priority levels:

- level I (surgery recommended within 24 hours);
- level II (highly aggressive malignancies, surgery recommended within 14 days);
- level III (invasive malignancies that do not meet the criteria for priority level II or IV, surgery recommended within 28 days); and
- level IV (slow growing malignancies, surgery recommended within 84 days).

Priority level I cases were excluded from this analysis due to incomplete wait time data.

These priorities are only a guide; clinical judgement, based on individual patient symptomatology and condition, take precedence. Recommended maximum wait times should be interpreted as the longest that any patient should have to wait, recognizing that some will require surgery sooner and some later within that time interval, based on the specific tumour biology.[1]

For the seven cancer types examined, the majority of cases were assigned priority level III, regardless of stage at diagnosis.

For the seven cancer types examined, the majority of cases were assigned priority level III (28 days), regardless of stage at diagnosis (Table 3.6). Other findings include:

- Breast cancer cases were the least likely to be assigned priority II of all the cancer types examined. Additionally, the proportion of breast cancer cases assigned either priority level II or IV increased with advancing stage at diagnosis. In the case of priority II level patients, this reflects the greater urgency of treatment as stage at diagnosis increases. In the case of priority level IV patients, on the other hand, this probably reflects the increased likelihood that surgery is being used for symptom management only.
- Unlike breast cancer, the proportion of colorectal cancer cases assigned priority level IV decreased with increasing stage, as would be expected. However, 17.1% of stage IV colorectal cases were still assigned priority level IV status.
- Esophageal cancer had the highest proportion of cases assigned priority level III, at 83.3%.
- The proportion of lung cancer cases assigned priority level II increased with stage at diagnosis, and almost a quarter of stage IV cases were priority level II. A similar proportion of cases were assigned priority level IV across the stages.
- Oral cavity & pharynx and pancreatic cancer cases were the most likely of the cancers examined to be assigned priority level IV with approximately a quarter of cases falling into this category.
- An equal proportion of ovarian cancer cases were assigned priority level II (8.5%) as priority level IV (8.8%).

Table 3.6 Distribution of cases by stage at diagnosis and priority level assignment for selected cancers, Ontario, 2011–2015

Cancer type	Stage	Priority level		
		II n (%)	III n (%)	IV n (%)
Breast (female)	All stages	2,310 (5.4%)	34,933 (81.5%)	5,628 (13.1%)
	I	824 (4.5%)	15,126 (82.6%)	2,373 (13.0%)
	II	941 (5.6%)	13,737 (82.1%)	2,057 (12.3%)
	III	399 (6.7%)	4,670 (78.3%)	896 (15.0%)
	IV	69 (12.6%)	376 (68.5%)	104 (18.9%)
Colorectal	All stages	2,158 (9.6%)	16,000 (71.5%)	4,223 (18.9%)
	I	303 (6.5%)	3,355 (72.3%)	980 (21.1%)
	II	618 (10.1%)	4,416 (72.2%)	1,086 (17.8%)
	III	736 (9.6%)	5,428 (71.1%)	1,468 (19.2%)
	IV	378 (13.4%)	1,958 (69.5%)	482 (17.1%)
Esophagus	All stages	78 (7.2%)	901 (83.3%)	103 (9.5%)
Lung	All stages	520 (5.7%)	7,443 (81.8%)	1,135 (12.5%)
	I	81 (2.0%)	3,515 (85.2%)	532 (12.9%)
	II	65 (3.5%)	1,591 (85.3%)	210 (11.3%)
	III	80 (4.9%)	1,360 (84.0%)	180 (11.1%)
	IV	243 (24.7%)	607 (61.6%)	135 (13.7%)
Oral cavity & pharynx	All stages	240 (6.0%)	2,741 (68.4%)	1,026 (25.6%)
Ovary	All stages	103 (8.5%)	2,492 (82.7%)	266 (8.8%)
Pancreas	All stages	103 (6.6%)	1,110 (70.9%)	353 (22.5%)

Notes: 1. Analysis was restricted to cases with surgical treatment.
2. Priority level one cases were excluded.
3. Stage data was not available for esophageal, oral cavity & pharynx, ovarian or pancreatic cancers. Stage analysis excludes the following cases with unknown stage: breast n = 1,191; colorectal n = 1,091; lung n = 491. Cases that were not staged were excluded from this analysis.
4. Dates Affecting Readiness to Treat (DART) wait time was excluded from this analysis.

Analysis by: Surveillance, Analytics and Informatics, CCO
Data sources: Ontario Cancer Registry (March 2017), CCO; Wait Time Information System (March 2017), CCO

Wait time to receipt of surgery

The majority of patients received surgery within the time recommended by their priority level (Table 3.7). The proportion of patients receiving treatment within the recommended time increased with increasing priority level. Similar results were previously reported for all cancers combined in Ontario.[13] In addition:

- Among priority level II breast cancer patients, 72.1% received surgical treatment within 14 days (as prescribed by their priority level); however, 4.9% waited more than 28 days. For priority level III patients, 87.1% received surgery within 28 days. For priority level IV patients, 98.9% received surgery within 84 days.
- Colorectal cancer patients showed a similar pattern to breast cancer patients with 76.3% of priority level II patients receiving surgery with 14 days, 82.0% of priority level III patients receiving surgery within 28 days and 97.9% of priority level IV patients receiving treatment within 84 days.
- Among esophageal cancer patients, 83.3% of priority level II patients received surgery within 14 days while 86.3% of priority level III patients received surgery within 28 days. However 13.3% of priority level III patients waited more than 28 days.
- Of the cancers examined, lung cancer patients were the most likely to receive surgical treatment within the recommended time. Among priority level II lung cancer patients, 92.7% of received surgery within 14 days. Among the priority level III patients 85.5% received treatment within 28 days. However, 1.9% of priority level IV patients waited more than 84 days for treatment.
- Oral cavity & pharynx cancer priority level II patients had a relatively low proportion meet the wait time recommendations, with just 72.5% receiving surgery within 14 days. Among priority level III patients, 78.2% received treatment within the recommended 28 days. Oral cavity & pharynx cancer patients were also the most likely to wait more than 84 days, with 3.7% of priority level IV patients falling into this category.
- Of the cancers examined, ovarian cancer patients were the least likely to receive surgery within the recommended time. Among priority II patients just 65.2% of patients received surgery within the recommended 14 days. This pattern continued with priority III patients among whom 74.5% received treatment within 28 days. Finally, 2.3% of priority IV patients had a wait time of more than 84 days.
- Priority II pancreatic cancer patients received surgery within 14 days 77.7% of the time, while 83.2% of priority III patients received surgery within 28 days.

Based on the results listed in Table 3.7, a considerable proportion of priority level II and III patients were required to wait longer than recommended. There are many possible reasons for these waits that involve both system delays and individual patient requirements. These include delays associated with obtaining additional diagnostic testing prior to surgery, treatment of comorbidities prior to surgery, scheduling surgery based on availability of a surgical oncologist and operating room, and the need to administer pre-operative chemotherapy for some cancers.

Lung cancer patients receiving surgical treatment within the recommended time

Table 3.7 Distribution of cases by wait time to surgical treatment by assigned priority level for selected cancers, Ontario, 2011–2015

Cancer type	Priority level	Wait time (days)				Total exceeding recommended wait time
		≤ 14 n (%)	15–28 n (%)	29–84 n (%)	> 84 n (%)	
Breast (female)	II	1,666 (72.1%)	529 (22.9%)	113 (4.9%)	**	**642 (27.8%)†**
	III	15,477 (44.3%)	14,938 (42.8%)	4,462 (12.8%)	56 (0.2%)	**4,518 (13.0%)**
	IV	1,656 (29.4%)	1,935 (34.4%)	1,974 (35.1%)	63 (1.1%)	**63 (1.1%)**
Colorectal	II	1,646 (76.3%)	392 (18.2%)	114 (5.3%)	6 (0.3%)	**512 (23.8%)**
	III	6,083 (38.0%)	7,037 (44.0%)	2,819 (17.6%)	61 (0.4%)	**2,880 (18.0%)**
	IV	1,049 (24.8%)	1,315 (31.2%)	1,771 (41.9%)	87 (2.1%)	**87 (2.1%)**
Esophagus	II	65 (83.3%)	10 (12.8%)	**	**	**13 (16.7%)**
	III	377 (41.8%)	401 (44.5%)	120 (13.3%)	0	**120 (13.3%)**
	IV	27 (26.2%)	31 (30.1%)	40 (38.8%)	**	**
Lung	II	482 (92.7%)	33 (6.4%)	**	**	**38 (7.3%)**
	III	2,083 (40.1%)	3377 (45.4%)	1,068 (14.4%)	15 (0.2%)	**1,083 (14.6%)**
	IV	321 (28.3%)	351 (30.1%)	441 (38.9%)	22 (1.9%)	**22 (1.9%)**
Oral cavity & pharynx	II	174 (72.5%)	49 (20.4%)	17 (7.1%)	0	**66 (27.5%)**
	III	832 (30.4%)	1,310 (47.8%)	588 (21.5%)	11 (0.4%)	**599 (21.9%)**
	IV	240 (23.4%)	333 (32.5%)	415 (40.5%)	38 (3.7%)	**38 (3.7%)**
Ovary	II	167 (65.2%)	57 (22.3%)	31 (12.1%)	**	**88 (34.4%)†**
	III	993 (39.9%)	862 (34.6%)	629 (25.2%)	8 (0.3%)	**637 (25.5%)**
	IV	85 (32.0%)	51 (19.2%)	124 (46.6%)	6 (2.3%)	**6 (2.3%)**
Pancreas	II	80 (77.7%)	18 (17.5%)	**	**	**23 (22.3%)**
	III	478 (43.1%)	450 (40.1%)	180 (16.2%)	**	**180 (16.2%)†**
	IV	101 (28.6%)	102 (28.9%)	141 (39.9%)	9 (2.6%)	**9 (2.6%)**

**Suppressed due to small cell count (n<6)
†Excludes patients who were suppressed due to small cell count
Notes: 1. Analysis was restricted to cases with surgical treatment.
2. Priority level one cases were excluded.
3. Dates Affecting Readiness to Treat (DART) wait time was excluded from this analysis.
4. Red shading indicates cases that exceeded the recommeded wait time.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data sources: Ontario Cancer Registry (March 2017), CCO; Wait Time Information System (March 2017), CCO

Survival by wait time

Because a cancer patient's prognosis can be influenced by when they receive their surgery, this section examines five-year survival in relation to wait time. Note that this section reports observed survival, unlike elsewhere in this report where relative survival statistics are presented, which are not directly comparable.

Observed survival is presented here because the study population is restricted to only those patients who underwent surgical treatment, a population for which available life tables are not applicable.

The following statistics show estimates of survival without taking into account other prognostic factors that may influence survival. As a result, these estimates should be interpreted with caution and with the understanding that this descriptive analysis did not control for these other factors. Future research on this topic is planned which will investigate these other variables and address some of the other limitations of this analysis.

Five-year observed survival by actual wait time to receipt of surgery and stage at diagnosis is presented in Table 3.8.

Breast cancer five-year observed survival did not change with increasing wait time to treatment:

- Patients who waited less than 15 days and patients who waited more than 84 days showed no significant difference in survival. There was similarly no difference in survival by wait time when survival was examined by stage at diagnosis.
- This is positive when compared to results from the United States, which found that increased wait time to breast cancer surgery in American patients resulted in decreased survival, particularly among stage I and II cases.[14] The American study, however, used a different methodology and controlled for a number of possible confounders that could not be included in this analysis. These differences in study design may explain the discordant results. Another study also found that increased wait time to treatment (all treatment types) decreased survival for breast cancer patients.[3] However, other studies found no association between wait time to treatment and breast cancer survival.[2, 15, 16]

Survival for colorectal cancer on the other hand did vary by wait time:

- Five-year survival for those that received treatment within 14 days (61.9%) was significantly lower than those who received treatment between 15 days and 28 days (68.8%) or 29 days to 84 days (69.5%).
- A significant difference in survival was found among stage I patients when the data were broken down by stage. Stage I patients who waited 14 days or less experienced significantly lower survival (78.0%) compared to those who waited 15 days to 28 days (83.8%) or 29 days to 84 days (84.3%).
- One UK study also found increased colorectal cancer mortality among patients with shorter wait times.[17] Other analyses have tended to find no association between wait times to colorectal cancer treatment and survival.[18–21]

Survival from esophageal cancer did not vary significantly by wait time, with patients showing similar five-year survival regardless of how long they waited for treatment. This finding is not surprising because esophageal cancer is one cancer type for which most studies have not found an association between wait time to treatment and survival.[22–25]

As with colorectal cancer, lung cancer patients who waited 14 days or less showed significantly lower five-year survival (37.8%) compared to those who waited more than 14 days.

- This finding agrees with previous studies of lung cancer which also found that shorter wait times were associated with poorer prognoses.[26, 27] However, other studies found no association between wait time to treatment and lung cancer outcomes.[28–30]
- In this analysis, when lung cancer survival was examined by stage, no significant differences by wait time were observed for any stage. A previous Ontario study of the effect of wait time to surgical treatment for non-small cell lung cancer found no difference in survival among stage I patients but lower survival among stage II patients who waited 29 days to 56 days compared to those who waited 14 days or less. [31]

Five-year observed survival for colorectal cancer:

Patients who waited 29 days to 84 days for oral cavity & pharynx surgery showed significantly higher survival (65.1%) compared to those who waited 14 days or less (55.5%) and 15 days to 28 days (57.0%).

- Previous studies have found conflicting results, with some finding longer wait times for head and neck cancer treatment being associated with increased risk of mortality[32, 33] and others finding no association.[34]

Ovarian cancer patients who waited 29 days to 84 days showed significantly higher survival (51.6%) compared to those who waited 14 days or less (35.7%), but no significant difference compared to those who waited 15 days to 28 days.

Pancreatic cancer patients who waited 29 days to 84 days showed significantly higher survival (30.1%) than those who waited 14 days or less (18.1%) or 15 to 28 days (16.3%). There was no significant difference in survival between those who waited 14 days or less and those who waited 15 to 28 days. Most studies have found no significant association between pancreatic wait times and survival.[35, 36]

The results of this survival analysis found no evidence that increased wait time to surgical cancer treatment is associated with decreased survival in Ontario.

Without controlling for potentially confounding factors, wait time to surgical treatment for breast and esophageal cancer showed no effect on five-year observed survival. For colorectal, lung, oral cavity & pharynx, ovarian and pancreatic cancers, wait time does appear to affect survival—but not in the direction expected. For these cancers, when survival differed significantly by wait time, it was the patients with the shortest wait time who experienced lower survival compared to patients who waited longer. There are a number of possible explanations for this finding. One theory, which has been advanced by other researchers, is that this may be caused by selection bias, with patients with the more severe symptoms or aggressive disease being prioritized for surgery.[26] Patients may have also been prioritized for surgery due to factors external to the disease, including comorbidity and other personal risk factors. As a result, the lower survival in patients with shorter wait times may just be a reflection of generally lower survival among those with more advanced or aggressive disease and not the effect of wait time. This phenomenon has been termed the "waiting time paradox".[37] The results of this survival analysis found no evidence that increased wait time to surgical cancer treatment is associated with decreased survival in Ontario, supporting the appropriateness of the current wait time prioritization approach.

Table 3.8 Observed five-year survival by wait time and stage for selected cancers, Ontario, 2011

Cancer type	Stage	Wait time (days)			
		≤ 14 OS % (95% CI)	15 to 28 OS % (95% CI)	29 to 84 OS % (95% CI)	> 84 OS % (95% CI)
Breast (female)	All stages	86.3 (85.4–87.1)	86.1 (85.2–86.9)	84.7 (83.4–86.1)	84.5 (70.4–92.3)
	I	94.3 (93.3–95.1)	93.3 (92.3–94.2)	93.7 (92.2–95.1)	95.3 (71.3–99.3)
	II	86.1 (84.6–87.5)	84.6 (82.9–86.1)	83.7 (81.1–85.9)	**
	III	68.9 (65.7–71.8)	69.8 (66.3–73.0)	64.8 (59.8–69.4)	**
	IV	18.6 (10.8–28.1)	28.3 (19.2–38.0)	34.9 (20.7–49.4)	**
Colorectal	All stages	61.9 (60.3–63.5)	68.8 (67.2–70.0)	69.5 (67.3–71.6)	69.2 (57.3–78.4)
	I	78.0 (73.9–81.4)	83.8 (80.7–86.4)	84.3 (80.4–87.5)	**
	II	75.7 (72.9–78.4)	75.7 (72.6–78.5)	71.6 (67.0–75.2)	**
	III	63.4 (60.8–66.1)	66.0 (63.1–68.7)	66.2 (62.5–68.7)	**
	IV	15.3 (12.3–18.5)	18.7 (14.3–23.4)	20.9 (12.3–23.4)	**
Esophagus	All stages	23.7 (18.0–29.8)	32.0 (25.2–38.9)	24.1 (15.6–33.6)	**
Lung	All stages	37.8 (35.3–40.3)	50.2 (47.2–53.0)	47.3 (43.3–51.1)	**
	I	62.8 (57.3–67.8)	69.2 (64.6–73.3)	62.8 (56.6–68.4)	**
	II	46.2 (40.5–51.7)	45.2 (38.0–51.3)	40.7 (32.4–48.9)	**
	III	25.8 (20.9–30.9)	26.3 (20.7–32.2)	24.2 (17.1–32.2)	**
	IV	4.6 (2.7–7.1)	9.0 (4.7–15.1)	9.6 (4.4–20.0)	**
Oral cavity & pharynx	All stages	55.5 (50.6–60.0)	57.0 (52.9–60.1)	65.1 (60.5–69.2)	**
Ovary	All stages	35.7 (30.5–41.0)	43.5 (37.5–49.5)	51.6 (46.7–56.3)	**
Pancreas	All stages	18.1 (12.9–22.6)	16.3 (11.8–21.6)	30.1 (23.1–37.5)	**

CI=Confidence interval
OS=Observed survival
**Suppressed due to high variance
Notes: 1. Analysis was restricted to cases with surgical treatment.
2. Analysis was restricted to patients ages 15 to 99.
3. Stage data was not available for esophageal, oral cavity & pharynx, ovarian or pancreatic cancers. Stage analysis excludes the following cases with unknown stage: breast n = 1,191; colorectal n = 1,091; lung n = 491. Cases that were not staged were excluded from this analysis.
4. Dates Affecting Readiness to Treat (DART) wait time was excluded from this analysis.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data sources: Ontario Cancer Registry (March 2017), CCO; Wait Time Information System (March 2017), CCO

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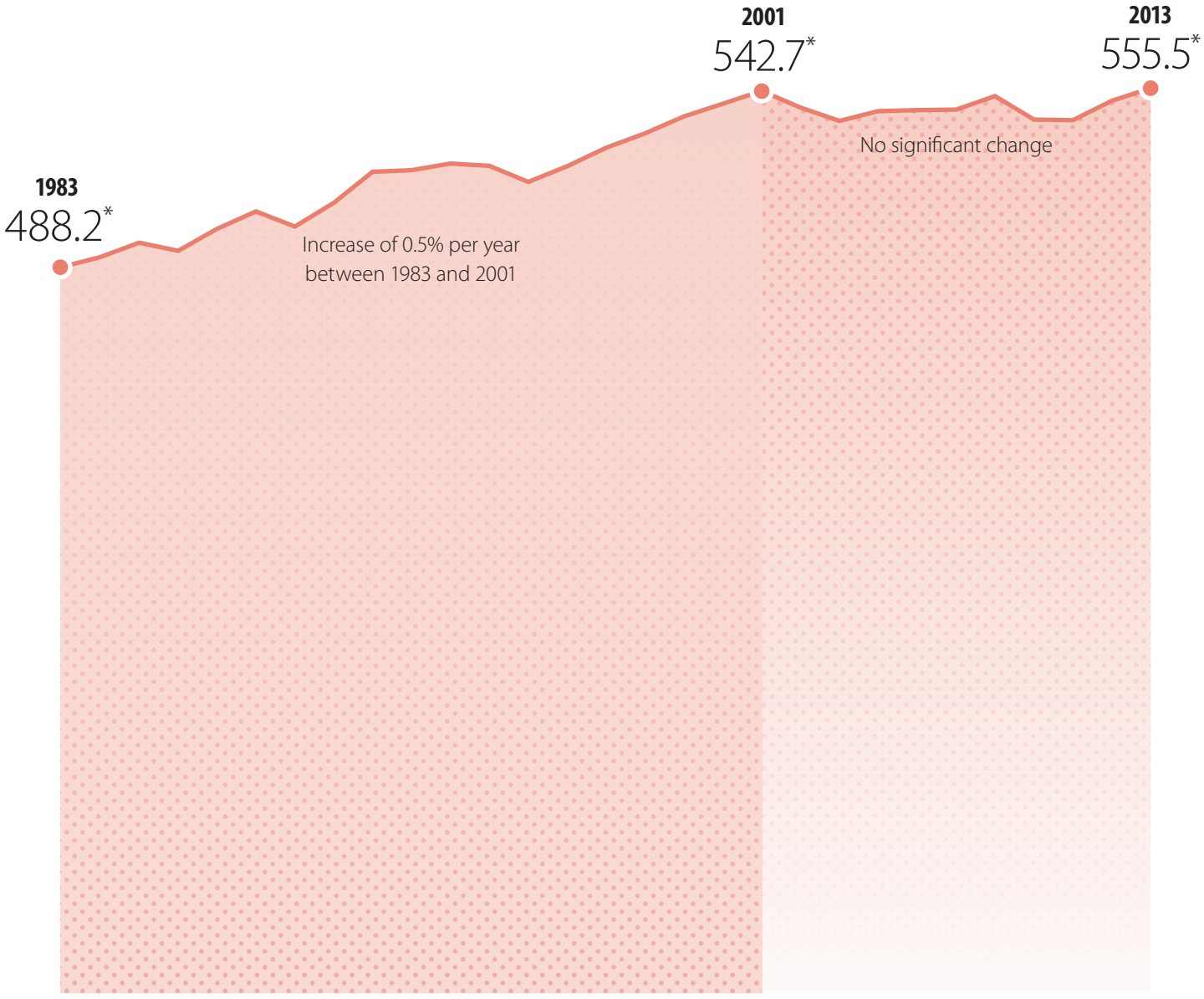
Chapter 4

Cancer incidence rates and trends

Cancer incidence measures the number of new cases of cancer diagnosed within a specific time period. This chapter presents cancer incidence rates and trends over time.

Age-standardized incidence rates

"The cancer incidence rate in Ontario has been stable since 2001, following two decades of increase."



* per 100,000 persons

Cancer incidence measures the number of new cases of cancer diagnosed within a specific time period. This chapter presents non-projected incidence rates and trends. The cancer incidence statistics in this chapter are based on counts deemed complete as of the latest available year.

In 2013, there were 77,088 new cases of cancer diagnosed in Ontario, resulting in an age-standardized incidence rate (ASIR) of 555.5 per 100,000 (Table 4.2). This was a slight decrease compared to 2012, when 77,941 cases were diagnosed for an ASIR of 578.1 per 100,000.

The most commonly diagnosed cancers were breast (10,269 or 13.3% of all new cases), lung (9,757 or 12.7%) and colorectal (8,759 or 11.4%).

Distribution of new cases for selected cancers, 2013

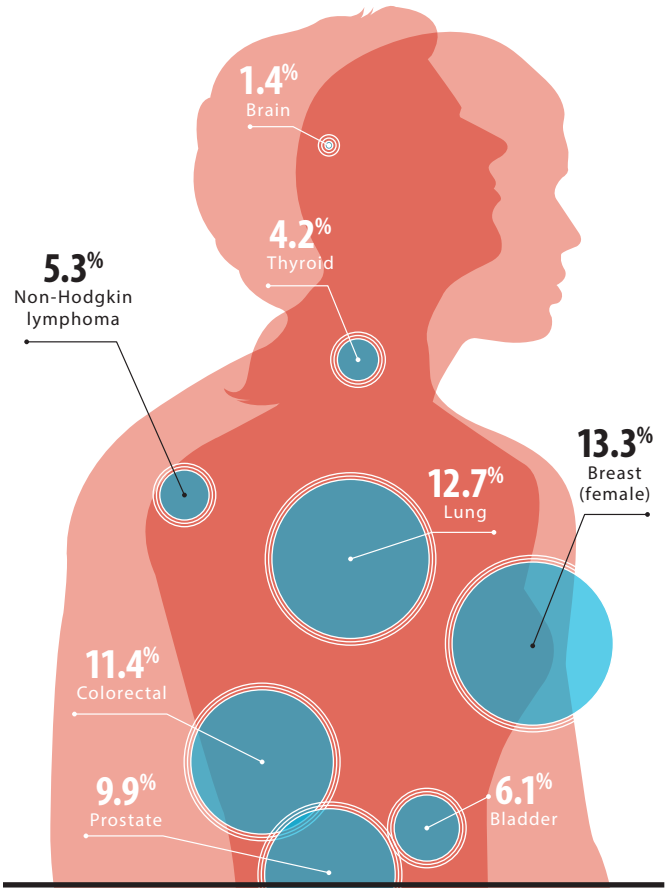


Table 4.1 Cumulative probability of developing cancer by age group and sex, Ontario, 2010–2013

Age group (years)	Both sexes	Males	Females
0–4	0.1%	0.1%	0.1%
5–9	0.2%	0.2%	0.2%
10–14	0.3%	0.3%	0.3%
15–19	0.4%	0.4%	0.4%
20–24	0.6%	0.6%	0.6%
25–29	0.9%	0.8%	0.9%
30–34	1.3%	1.1%	1.5%
35–39	2.0%	1.6%	2.5%
40–44	3.1%	2.3%	3.9%
45–49	4.7%	3.4%	5.9%
50–54	7.0%	5.5%	8.5%
55–59	10.4%	8.9%	11.9%
60–64	15.1%	14.1%	16.1%
65–69	20.9%	20.8%	21.1%
70–74	27.4%	28.1%	26.7%
75–79	33.6%	35.1%	32.2%
80–84	39.0%	41.0%	37.3%
85+	46.7%	48.4%	45.2%

Analysis by: Surveillance, Analytics and Informatics, CCO
Data sources: Ontario Cancer Registry (January 2017), CCO; Statistics Canada. Table 102-0564 - Leading causes of death, total population, by sex, Canada, provinces and territories (age standardization using 2011 population), annual, CANSIM (database); Statistics Canada. Table 051-0001 - Estimates of population, by age group and sex for July 1, Canada, provinces and territories, annual (persons unless otherwise noted), CANSIM (database).

Probability of developing cancer

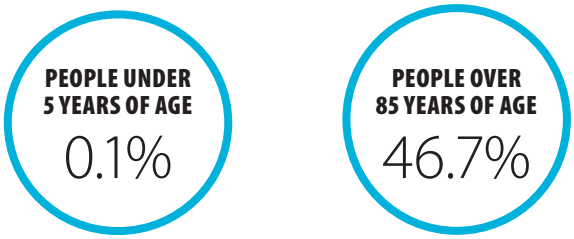
The probability of developing cancer refers to the average chance of being diagnosed with cancer over the course of a lifetime.

The probability of developing a specific type of cancer depends on many factors, including the population's characteristics (e.g., demographics), the prevalence of risk factors (e.g., smoking, obesity) and current life expectancy. Furthermore, these probabilities reflect the average risks for the overall population and do not take into account personal risk factors. In other words, an individual's risk may be higher or lower than the numbers reported here.

The probability of developing cancer for the 2009–2012 time period was 1 in 2.1 (47.5%). The probability was slightly higher for males at 1 in 2.0 than females at 1 in 2.2.[1]

For the period 2010–2013, the probability of developing cancer in Ontario increased with age, going from 0.1% for those under the age of five to 46.7% once a person reaches age 85 (Table 4.1). The probabilities were generally equal between males and females until the age of 25. After age 25, the probabilities were higher for females until the age of 69. The higher probabilities for females are probably the result of higher female rates of cancers common in this age group, such as thyroid and breast cancers. After age 69, the probability of developing cancer was higher for males.

For the period 2010–2013, the probability of developing cancer in Ontario increased with age



Incidence by sex and cancer type

In 2013, the ASIR for all cancers combined was significantly higher in males (605.1 per 100,000) than in females (523.3 per 100,000) (Table 4.2). The most commonly diagnosed cancers for males were prostate (7,647 or 19.9% of all new male cases), lung (4,954 or 12.9%) and colorectal (4,772 or 12.4%). In females, the leading cancer types were breast (10,269 or 26.6% of all new female cases), lung (4,803 or 12.4%) and colorectal (3,987 or 10.3%).

Table 4.2 **Cancer incidence counts and rates by cancer type and sex, Ontario, 2013**

	Both sexes				
Cancer type	New cases	% of new cases	Crude rate	ASIR[†]	ASIR 95% CI
All cancers	**77,088**	**100.0%**	**568.9**	**555.5**	**551.6–559.4**
Bladder	4,737	6.1%	35.0	33.8	32.9–34.8
Brain	1,079	1.4%	8.0	7.9	7.4–8.3
Breast (female)	10,269	13.3%	148.9	141.5	138.8–144.3
Cervix	523	0.7%	7.6	7.5	6.9–8.2
Colorectal	8,759	11.4%	64.6	62.9	61.5–64.2
Esophagus	800	1.0%	5.9	5.7	5.4–6.2
Hodgkin lymphoma	386	0.5%	2.8	2.8	2.6–3.1
Kidney	2,241	2.9%	16.5	16.2	15.5–16.9
Larynx	422	0.5%	3.1	3.0	2.7–3.3
Leukemia	2,414	3.1%	17.8	17.4	16.7–18.1
Liver	1,243	1.6%	9.2	8.9	8.5–9.5
Lung	9,757	12.7%	72.0	69.8	68.4–71.2
Melanoma	3,409	4.4%	25.2	24.7	23.8–25.5
Myeloma	1,235	1.6%	9.1	8.8	8.4–9.3
Non-Hodgkin lymphoma	4,088	5.3%	30.2	29.5	28.6–30.4
Oral cavity & pharynx	1,939	2.5%	14.3	14.0	13.4–14.7
Ovary	1,192	1.5%	17.3	16.3	15.4–17.3
Pancreas	1,878	2.4%	13.9	13.5	12.9–14.1
Prostate	7,647	9.9%	114.9	118.4	115.8–121.1
Stomach	1,497	1.9%	11.0	10.7	10.2–11.3
Testis	407	0.5%	6.1	6.1	5.5–6.7
Thyroid	3,219	4.2%	23.8	23.8	23.0–24.6
Uterus	2,409	3.1%	34.9	33.2	31.9–34.5

Table 4.2 *(Cont'd)* **Cancer incidence counts and rates by cancer type and sex, Ontario, 2013**

Males					
Cancer type	New cases	% of new cases	Crude rate	ASIR[†]	ASIR 95% CI
All cancers	**38,453**	**100.0%**	**577.7**	**605.1**	**599.0–611.2**
Bladder	3,627	9.4%	54.5	58.3	56.4–60.3
Brain	609	1.6%	9.1	9.3	8.6–10.1
Colorectal	4,772	12.4%	71.7	75.8	73.7–78.0
Esophagus	592	1.5%	8.9	9.3	8.5–10.0
Hodgkin lymphoma	206	0.5%	3.1	3.1	2.7–3.6
Kidney	1,428	3.7%	21.5	22.1	21.0–23.3
Larynx	356	0.9%	5.3	5.6	5.0–6.2
Leukemia	1,408	3.7%	21.2	22.3	21.2–23.5
Liver	845	2.2%	12.7	13.2	12.3–14.1
Lung	4,954	12.9%	74.4	78.6	76.4–80.9
Melanoma	1,858	4.8%	27.9	29.4	28.0–30.7
Myeloma	731	1.9%	11.0	11.7	10.9–12.6
Non-Hodgkin lymphoma	2,223	5.8%	33.4	35.1	33.7–36.6
Oral cavity & pharynx	1,337	3.5%	20.1	20.6	19.5–21.7
Pancreas	957	2.5%	14.4	15.1	14.2–16.1
Prostate	7,647	19.9%	114.9	118.4	115.8–121.1
Stomach	914	2.4%	13.7	14.5	13.6–15.5
Testis	407	1.1%	6.1	6.1	5.5–6.7
Thyroid	737	1.9%	11.1	11.2	10.4–12.0

Table 4.2 *(Cont'd)* **Cancer incidence counts and rates by cancer type and sex, Ontario, 2013**

Females					
Cancer type	New cases	% of new cases	Crude rate	ASIR[†]	ASIR 95% CI
All cancers	**38,635**	**100.0%**	**560.3**	**523.3**	**518.1–528.6**
Bladder	1,110	2.9%	16.1	14.4	13.6–15.3
Brain	470	1.2%	6.8	6.6	6.0–7.2
Breast	10,269	26.6%	148.9	141.5	138.8–144.3
Cervix	523	1.4%	7.6	7.5	6.9–8.2
Colorectal	3,987	10.3%	57.8	52.3	50.7–54
Esophagus	208	0.5%	3.0	2.7	2.4–3.1
Hodgkin lymphoma	180	0.5%	2.6	2.6	2.2–3.0
Kidney	813	2.1%	11.8	11.0	10.3–11.8
Larynx	66	0.2%	1.0	0.9	0.7–1.1
Leukemia	1,006	2.6%	14.6	13.5	12.7–14.4
Liver	398	1.0%	5.8	5.2	4.7–5.7
Lung	4,803	12.4%	69.7	63.6	61.8–65.4
Melanoma	1,551	4.0%	22.5	21.3	20.2–22.4
Myeloma	504	1.3%	7.3	6.6	6.1–7.2
Non-Hodgkin lymphoma	1,865	4.8%	27.0	24.9	23.7–26.0
Oral cavity & pharynx	602	1.6%	8.7	8.2	7.6–8.9
Ovary	1,192	3.1%	17.3	16.3	15.4–17.3
Pancreas	921	2.4%	13.4	11.9	11.2–12.7
Stomach	583	1.5%	8.5	7.6	7.0–8.3
Thyroid	2,482	6.4%	36.0	35.9	34.5–37.3
Uterus	2,409	6.2%	34.9	33.2	31.9–34.5

ASIR=Age-standardized incidence rate
CI=Confidence interval
[†]Rates standardized to the 2011 Canadian population
Note: Rates are per 100,000.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

The incidence rate was higher in males than females for almost all cancers. The one exception was thyroid cancer, for which the ASIR for females was 35.9 per 100,000 compared to just 11.2 per 100,000 in males. A number of possible reasons for the higher incidence of thyroid cancer in females have been proposed. For example, females have an increased likelihood of diagnostic investigation because they are more likely to have thyroid disease,[2] as well as a greater tendency to seek medical attention and participate more actively in medical visits.[3–5] Biological differences in the hormone levels of males and females (such as thyroid stimulated hormone and sex steroids) may also be a reason for the higher rate among females.[6–8]

While the incidence of less aggressive types such as papillary thyroid cancer has been observed to be higher for females than males in a number of jurisdictions, the rate of more aggressive types (such as anaplastic and medullary thyroid cancers) are generally similar between the sexes.[2, 9] The result of this is similar thyroid mortality rates between the sexes (see *Chapter 5: Cancer mortality rates and trends).*

Thyroid cancer was the only cancer type that was more commonly diagnosed in females than males in 2013.

Incidence rates were higher in males for all other cancer types. The greatest disparity in incidence between male and female incidence was in bladder, esophageal and oral cavity & pharynx cancers. Specifically:

- For bladder cancer, the male rate was more than four times that of the female rate. One of the risk factors for bladder cancer is a history of smoking, with smokers two to three times more likely to develop bladder cancer than non-smokers.[10, 11] Because a history of tobacco use is more common in males, this may be one of the reasons bladder cancer incidence is so much higher among males.[12]
- For esophageal cancer, the male rate was more than three times that of the female rate. Like bladder cancer, smoking is a key risk factor for esophageal cancer and may also contribute to the disparity between males and females for this cancer type. Alcohol use and obesity—also more common in males—are other risk factors for esophageal cancer.[13]
- For oral cavity & pharynx cancer, the male rate was more than twice that of the female rate. Tobacco and alcohol use are also important risk factors for oral cavity & pharynx cancer.[14]

Incidence by age

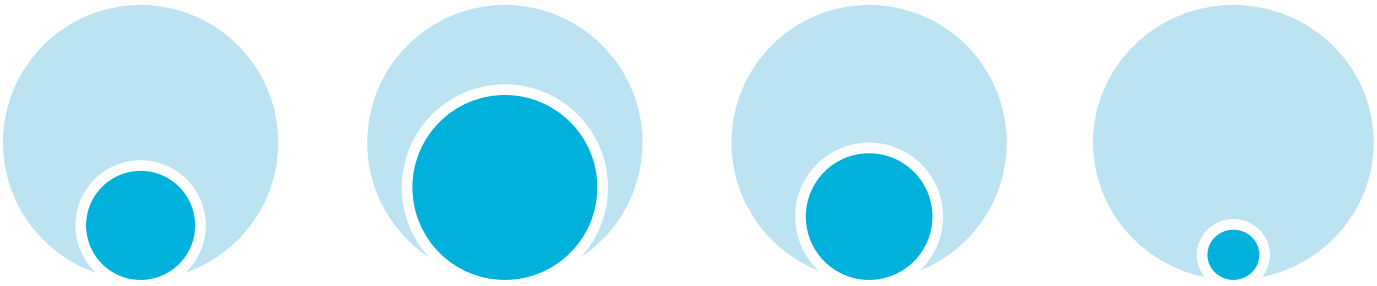
In 2013, more than half of all newly diagnosed cancer cases were in people ages 60 to 79 (Table 4.3). The distribution of incident cases by age group was as follows:

- 19.1% of all new cases occurred in people 80 years of age or older, with prostate and female breast the leading cancers;
- 50.8% of all new cases occurred in people 60 to 79 years of age, with prostate and female breast the leading cancers;
- 25.1% of all new cases occurred in people 40 to 59 years of age, with prostate and female breast the leading cancers; and
- 5.0% of all new cases occurred in people under the age of 40, with female breast and thyroid the leading cancers.

People ages 60 to 79 were the most likely to be diagnosed with the most common cancers accounting for 45.5% of all new cases of breast cancer, 67.5% of new cases of prostate cancer, 50.8% of new cases of lung cancer and 60.6% of new cases of colorectal cancer.

Nearly half of all new cases of thyroid cancer occurred among people ages 40 to 59 and 20.8% of new cervical cancer cases occurred in females ages 40 to 59. The under-40 age group accounted for the majority of new cases of Hodgkin lymphoma and testicular cancer, accounting for 55.4% and 68.8%, respectively.

Distribution of newly diagnosed cancer cases by age group



80 YEARS OF AGE OR OLDER
19.1%

60–79 YEARS OF AGE
50.8%

40–59 YEARS OF AGE
25.1%

UNDER THE AGE OF 40
5.0%

Table 4.3 Incidence counts and age-specific rates by cancer type and age group, Ontario, 2013

Cancer type	Age group (years)					
	0–39			40–59		
	Count	Age-specific rate	95% CI	Count	Age-specific rate	95% CI
All cancers*	**3,888**	**57.7**	**55.9–59.6**	**19,311**	**486.6**	**479.7–493.5**
Bladder	49	0.7	0.5–1.0	647	16.3	15.1–17.6
Brain*	222	3.3	2.9–3.8	343	8.6	7.8–9.6
Breast (female)	425	12.7	11.5–14.0	3,846	192.2	186.2–198.4
Cervix	130	3.9	3.2–4.6	255	12.7	11.2–14.4
Colorectal*	193	2.9	2.5–3.3	1,817	45.8	43.7–47.9
Esophagus	7	0.1	0.0–0.2	197	5.0	4.3–5.7
Hodgkin lymphoma	214	3.2	2.8–3.6	94	2.4	1.9–2.9
Kidney	84	1.2	1.0–1.5	681	17.2	15.9–18.5
Larynx	**	**	**	99	2.5	2.0–3.0
Leukemia*	287	4.3	3.8–4.8	464	11.7	10.7–12.8
Liver	23	0.3	0.2–0.5	283	7.1	6.3–8.0
Lung	48	0.7	0.5–0.9	1,522	38.3	36.4–40.3
Melanoma*	297	4.4	3.9–4.9	985	24.8	23.3–26.4
Myeloma	7	0.1	0.0–0.2	226	5.7	5.0–6.5
Non-Hodgkin lymphoma*	254	3.8	3.3–4.3	953	24.0	22.5–25.6
Oral cavity & pharynx	71	1.1	0.8–1.3	694	17.5	16.2–18.8
Ovary	75	2.2	1.8–2.8	394	19.7	17.8–21.7
Pancreas	24	0.4	0.2–0.5	323	8.1	7.3–9.1
Prostate	**	**	**	1,445	73.4	69.7–77.3
Stomach*	17	0.3	0.1–0.4	311	7.8	7.0–8.8
Testis	280	8.3	7.3–9.3	115	5.8	4.8–7.0
Thyroid	767	11.4	10.6–12.2	1,582	39.9	37.9–41.9
Uterus	60	1.8	1.4–2.3	809	40.4	37.7–43.3

Table 4.3 *(Cont'd)* **Incidence counts and age-specific rates by cancer type and age group, Ontario, 2013**

Cancer type	Age group (years)					
	60–79			80+		
	Count	Age-specific rate	95% CI	Count	Age-specific rate	95% CI
All cancers*	**39,141**	**1,706.60**	**1,689.7–1,723.6**	**14,748**	**2,656.7**	**2,614.0–2,699.9**
Bladder	2,700	117.7	113.3–122.2	1,341	241.6	228.8–254.8
Brain*	405	17.7	16.0–19.5	109	19.6	16.1–23.7
Breast (female)	4,676	388.3	377.3–399.6	1,322	385.0	364.5–406.3
Cervix	109	9.1	7.4–10.9	29	8.4	5.7–12.1
Colorectal*	4,449	194.0	188.3–199.8	2,300	414.3	397.6–431.6
Esophagus	433	18.9	17.1–20.7	163	29.4	25.0–34.2
Hodgkin lymphoma	63	2.7	2.1–3.5	15	2.7	1.5–4.5
Kidney	1,145	49.9	47.1–52.9	331	59.6	53.4–66.4
Larynx	251	10.9	9.6–12.4	70	12.6	9.8–15.9
Leukemia*	1,104	48.1	45.3–51.1	559	100.7	92.5–109.4
Liver	679	29.6	27.4–31.9	258	46.5	41.0–52.5
Lung	5,913	257.8	251.3–264.5	2,274	409.6	393.0–426.8
Melanoma*	1,467	64.0	60.7–67.3	660	118.9	110.0–128.3
Myeloma	670	29.2	27.0–31.5	332	59.8	53.5–66.6
Non-Hodgkin lymphoma*	1,991	86.8	83.0–90.7	890	160.3	150.0–171.2
Oral cavity & pharynx	928	40.5	37.9–43.2	246	44.3	38.9–50.2
Ovary	547	45.4	41.7–49.4	176	51.3	44.0–59.4
Pancreas	1,039	45.3	42.6–48.1	492	88.6	81.0–96.8
Prostate	5,164	474.1	461.2–487.2	1,037	489.8	460.4–520.5
Stomach*	779	34.0	31.6–36.4	390	70.3	63.5–77.6
Testis	10	0.9	0.4–1.7	**	**	**
Thyroid	797	34.8	32.4–37.2	73	13.2	10.3–16.5
Uterus	1,293	107.4	101.6–113.4	247	71.9	63.2–81.5

CI=Confidence interval
*Significant increasing trend in age-specific rate with increasing age
**Suppressed due to small cell count (n<6)
Notes: 1. Rates are per 100,000.
2. Excludes cases of unknown age.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

Cancer incidence increased significantly with age—from a rate of 57.7 per 100,000 in those diagnosed at age 39 or younger to 2,656.7 per 100,000 in those diagnosed at age 80 or older. Incidence rates for:

- cancers of the brain, colorectum and stomach, as well as leukemia, melanoma and non-Hodgkin lymphoma, all increased significantly with age;
- cancers of the bladder, esophagus, kidney, larynx, liver, lung, oral cavity & pharynx, ovary, pancreas and prostate, as well as myeloma, increased non-significantly with age;
- testicular cancer decreased non-significantly with age;
- breast and uterine cancer peaked in those ages 60 to 79;
- cervical and thyroid cancer peaked in those ages 40 to 59; and
- Hodgkin lymphoma peaked in those ages 39 or younger, declined among people ages 40 to 59 and then increased slightly in those 60 and older.

Incidence trends by cancer type

From 1983 to 2001, the cancer incidence rate for all cancers combined increased by 0.5% per year and then remained stable until 2013 (Table 4.4). Among males, the incidence rate increased by 0.4% per year from 1983 to 2001 followed by a decrease of 0.7% per year from 2001 to 2013. While the cancer incidence rate among males has been decreasing in recent years, the incidence rate among females has increased by 0.4% per year since 1983.

Table 4.4 **Annual percent change in age-standardized incidence rates by cancer type and sex, Ontario, 1983–2013**

Cancer type	Both Sexes			Males			Females		
	Period	APC (%)		Period	APC (%)		Period	APC (%)	
All cancers	**1983–2001**	**0.5**	↑	**1983–2001**	**0.4**	↑	**1983–2013**	**0.4**	↑
	2001–2013	**–0.1**		**2001–2013**	**–0.7**	↓			
Bladder†	1989–2013	–1.0	↓	1989–2013	–1.0	↓	1989–2003	–0.6	
							2003–2013	–2.5	↓
Brain	1983–2013	–0.3	↓	1983–2013	–0.3	↓	1983–2013	–0.4	↓
Breast (female)							1983–1992	2.0	↑
							1992–2013	–0.2	↓
Cervix							1983–2005	–2.1	↓
							2005–2013	–0.3	
Colorectal	1983–1997	–0.9	↓	1983–2008	–0.3	↓	1983–1996	–1.4	↓
	1997–2000	2.1		2008–2013	–2.1	↓	1996–1999	2.3	
	2000–2013	–1.2	↓				1999–2013	–1.1	↓
Esophagus	1983–2013	0.3	↑	1983–2013	0.6	↑	1983–2013	–0.6	↓
Hodgkin lymphoma	1983–2013	–0.5	↓	1983–2013	–0.7	↓	1983–2013	–0.2	
Kidney	1983–1989	4.9	↑	1983–1989	4.6	↑	1983–2013	1.3	↑
	1989–1995	–1.0		1989–2000	–0.2				
	1995–2013	1.6	↑	2000–2013	2.1	↑			
Larynx	1983–2013	–2.3	↓	1983–2013	–2.4	↓	1983–2013	–2.4	

Table 4.4 *(Cont'd)* **Annual percent change in age-standardized incidence rates by cancer type and sex, Ontario, 1983–2013**

Cancer type	Both Sexes			Males			Females		
	Period	APC (%)		Period	APC (%)		Period	APC (%)	
Leukemia	1983–2013	0.2	↑	1983–2013	0.2		1983–2013	0.2	
Liver	1983–2007	4.1	↑	1983–2013	4.5	↑	1983–2007	3.4	↑
	2007–2013	6.9	↑				2007–2013	10.4	↑
Lung	1983–1990	0.6		1983–2008	–1.8	↓	1983–1995	2.4	↑
	1990–2008	–0.8	↓	2008–2013	0.0		1995–2013	0.7	↑
	2008–2013	0.9							
Melanoma	1983–1987	6.2	↑	1983–2013	2.1	↑	1983–1994	–0.1	
	1987–1992	–1.7					1994–2013	2.2	↑
	1992–2013	2.2	↑						
Myeloma	1983–2004	0.6	↑	1983–2004	0.6	↑	1983–2013	0.3	↑
	2004–2008	–2.6		2004–2007	–4.9				
	2008–2013	5.0	↑	2007–2013	5.5	↑			
Non-Hodgkin lymphoma	1983–1998	2.0	↑	1983–2009	1.4	↑	1983–1998	2.1	↑
	1998–2009	0.6	↑	2009–2013	4.2	↑	1998–2009	0.3	
	2009–2013	5.1	↑				2009–2013	4.9	↑
Oral cavity & pharynx	1983–2003	–1.6	↓	1983–2003	–2.1	↓	1983–2004	–0.9	↓
	2003–2013	1.6	↑	2003–2013	1.8	↑	2004–2013	1.1	↑
Ovary							1983–2002	0.4	↑
							2002–2013	–1.2	↓
Pancreas	1983–2006	–0.7	↓	1983–2004	–1.3	↓	1983–2006	–0.3	↓
	2006–2013	2.8	↑	2004–2013	2.4	↑	2006–2013	2.4	↑
Prostate				1983–1993	5.4	↑			
				1993–2007	1.2	↑			
				2007–2013	–6.0	↓			
Stomach	1983–2007	–1.9	↓	1983–2008	–1.9	↓	1983–1999	–2.6	↓
	2007–2013	1.4		2008–2013	1.2		1999–2013	0.1	
Testis				1983–2013	1.2	↑			
Thyroid	1983–1998	4.8	↑	1983–2013	6.5	↑	1983–1998	4.9	↑
	1998–2002	13.3	↑				1998–2002	15.0	↑
	2002–2013	6.3	↑				2002–2013	6.0	↑
Uterus							1983–1989	–2.7	↓
							1989–2005	0.6	↑
							2005–2013	3.5	↑

APC=Annual percent change
†Bladder cancer trend begins at 1989 due to classification changes and excludes carcinomas *in situ*
Notes: 1. Statistically significant changes in trend and their direction are indicated by corresponding arrows.
2. IARC/IACR multiple primary rules used when presenting trends over time.
3. Rates are standardized to the 2011 Canadian population.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

Changes in trend were observed among the four most commonly diagnosed cancers:

BREAST

The ASIR for breast cancer increased by 2.0% per year during the 1980s and early 1990s. This increase in the incidence rate was likely due to a rise in both opportunistic and then programmatic mammography screening through the Ontario Breast Screening Program (OBSP) that began in 1990.[15]

Since 1992, the ASIR for breast cancer in females in Ontario has been steadily decreasing at 0.2% per year. An abrupt rise and fall in the incidence rate is common when a new method of early diagnosis is introduced; this may explain the decline in the breast cancer incidence rate in the 1990s. In addition, the use of hormone replacement therapy (HRT) began to decline in the 2000s.[16, 17] As HRT is associated with an increased risk of breast cancer among post-menopausal females, this may also have contributed to the decline in the breast cancer incidence rate after 2000.

COLORECTAL

The colorectal cancer rate among males declined gradually from 1983 to 2008 by 0.3% per year and then more steeply by 2.1% per year from 2008 to 2013. Individually, incidence rates for both colon and rectal cancers also declined during this period (data not shown).[1]

Among females the rate fell by 1.4% per year from 1983 to 1996, was stable from 1996 to 1999, and then decreased again after 1999 at a rate of 1.1% per year. These fluctuations reflect an increase in rectal cancer from 1996 to 1999, and a steady decrease in colon cancer from 1983 to 2013 in females (data not shown).[1]

LUNG

In males, the ASIR for lung cancer decreased by 1.8% per year from 1983 to 2008, and then stabilized. The incidence rate among females has been increasing since the 1980s—although the upward trend has slowed since 1995.

The long-term decline in the lung cancer incidence rate in males and the slowing increase in the incidence rate in females over the last two decades reflects differences in historical smoking rates between the sexes.[12] While tobacco use is the primary cause of lung cancer, other causes include exposure to radon, asbestos, environmental tobacco smoke and air pollution.

PROSTATE

The ASIR for prostate cancer rose by 5.4% per year from 1983 to 1993. The increase in the later years of this period is probably due to the introduction of prostate-specific antigen (PSA) testing in 1988. From 1993 to 2007, the ASIR increased more slowly at 1.2% per year and then fell by 6.0% per year from 2007 to 2013. An abrupt rise and fall in the incidence rate is common when a new method of early diagnosis is introduced. The decrease after 2007 is also probably a reflection of recommendations from the U.S. Preventive Services Task Force against using prostate-specific antigen (PSA) testing for the routine screening of healthy males.[18]

Notable changes in trend were also observed for the following cancers:

LIVER

Incidence rates for liver cancer increased steeply from 1983 to 2013. Among males, the ASIR increased at a rate of 4.5% per year from 1983 onward. The increasing trend in the incidence rate of liver cancer was even more pronounced among females, with the ASIR increasing by 3.4% per year from 1983 to 2007 and then by 10.4% per year from 2007 onward.

A rising incidence rate of liver cancer may be the result of increasing immigration from countries where certain risk factors (e.g., hepatitis B and C infections, exposure to aflatoxins) are more common.[19] A higher prevalence of hepatitis C infection caused by needle sharing as well as the increasing prevalence of obesity and diabetes may also have contributed to the incidence rate.[20]

MYELOMA

The ASIR for myeloma increased by 5.0% per year from 2008 to 2013. This increase was driven mainly by the increased ASIR in males, which went up by 5.5% per year from 2007 to 2013. The rate for females increased by 0.3% per year from 1983 to 2013. Increasing trends in other jurisdictions suggest the rise in myeloma rates may be due to improvements in diagnostics and better case ascertainment.[21]

THYROID

The ASIR for thyroid cancer increased significantly throughout the time period. The greatest increase occurred among females from 1998 to 2002, growing by 15.0% per year during this period. The incidence rate continued to increase from 2002 to 2013 but at a slower pace of 6.0% per year. Among males, the ASIR increased by 6.5% per year from 1983 onward.

This rising incidence rate has been attributed to improved diagnostic technology, including the use of ultrasound and fine-needle aspiration, which may have allowed for the detection of subclinical tumours.[22–25]

Changes in incidence rates from 1983 to 2013 for other cancer types are provided in Table 4.4.

Thirty-year trend in incidence

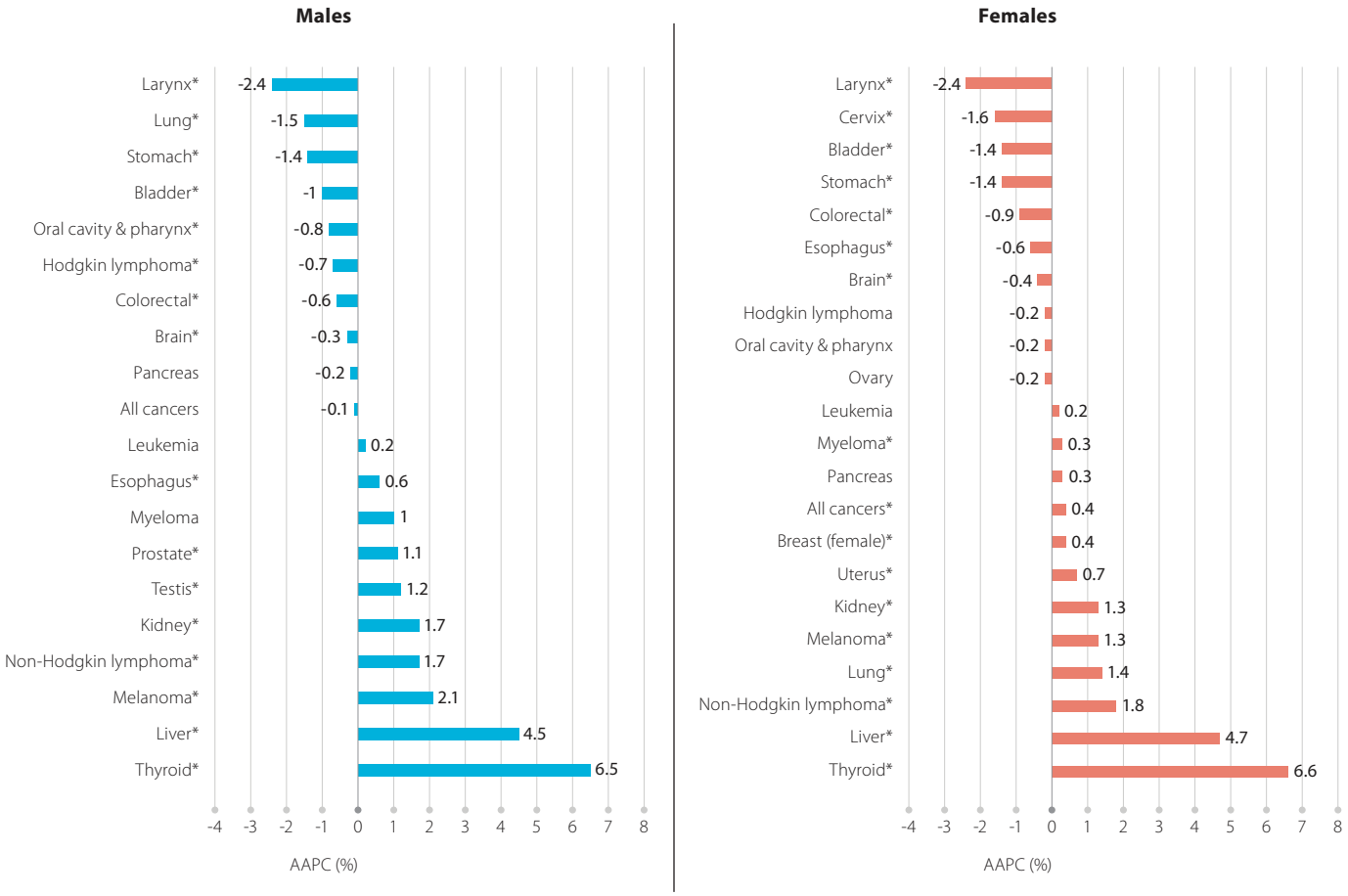
Over the last thirty years (1983 to 2013) the average annual percent change (AAPC) in ASIR for males (Figure 4.1):

- decreased most for laryngeal (2.4% per year), lung (1.5%) and stomach (1.4%) cancers;
- increased most for thyroid (6.5%) and liver (4.5%) cancers and melanoma (2.1%); and
- remained stable for pancreatic cancer, leukemia and myeloma.

For females, the AAPC:

- decreased most for laryngeal (2.4% per year), cervical (1.6%), bladder (1.4%) and stomach (1.4%) cancers;
- increased most for thyroid (6.6%) and liver (4.7%) cancers as well as non-Hodgkin lymphoma (1.8%); and
- remained stable for oral cavity & pharynx, ovarian and pancreatic cancers as well as Hodgkin lymphoma and leukemia.

Figure 4.1 **Average annual percent change in age-standardized incidence rates by cancer type and sex, Ontario, 1983–2013**



AAPC=Average annual percent change
*Statistically significant AAPC
Notes: 1. Bladder cancer trend begins at 1989 due to classification changes and excludes carcinomas *in situ*; therefore, AAPC is for the period 1989–2013.
2. IARC/IACR multiple primary rules used when presenting trends over time.
3. Rates standardized to the 2011 Canadian population.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

Incidence trends by age

Over the past 30 years, cancer incidence rates have been increasing among younger and middle-aged people and decreasing among the elderly.

Among people under the age of 39, the cancer incidence rate increased by 0.5% per year from 1983 to 2001 and then by 1.5% per year from 2001 to 2013 (Figure 4.2). Differential trends were seen in males and females. Among males, the rate increased from 1983 to 1990, remained stable until 2005 and then increased until 2013; for females, the rate was stable from 1983 to 1993 and then increased from 1993 to 2013. This increase in incidence among females is probably due to their increased rates of thyroid cancer, which is the second most common cancer in this age group.

Among people ages 40 to 59, the rate of cancer increased by 0.4% per year from 1983 to 2013. While the trend among females was the same, the male rate decreased by 1.9% per year after 2008.

For those ages 60 to 79, the rate increased by 0.7% per year from 1983 to 2001 and then declined by 0.5% per year from 2001 to 2013. The rate among males was similar, although the increase ceased in 1992 and the rate did not begin to decline until 2007. Females in this age group had no decrease in incidence; their rate increased by 0.6% per year from 1983 to 1999, and then remained stable from 1999 to 2006 before rising again from 2006 to 2013 at a rate of 0.8% per year.

In the oldest age group (those 80 and older), the incidence rate declined slightly by 0.2% per year until 2007, after which it remained stable. While the male rate declined steadily throughout the time period, the female rate has been increasing slowly since 1987 following five years of stability.

Figure 4.2 **Annual percent change in age-standardized incidence rates by age group and sex for all cancers combined, Ontario, 1983–2013**

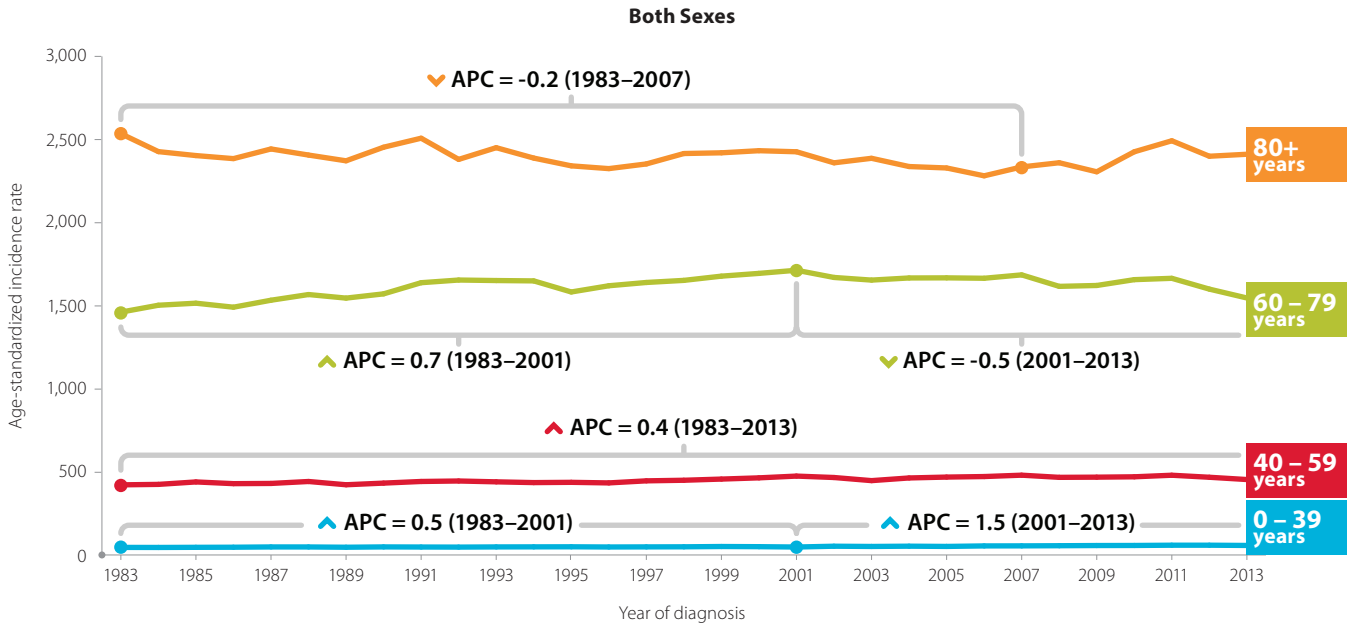


Figure 4.2 *(Cont'd)* **Annual percent change in age-standardized incidence rates by age group and sex for all cancers combined, Ontario, 1983–2013**

APC=Annual percent change
Notes: 1. Rates are per 100,000 and standardized to the age distribution of the 2011 Canadian population.
2. IARC/IACR multiple primary rules used when presenting trends over time.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

Incidence by stage

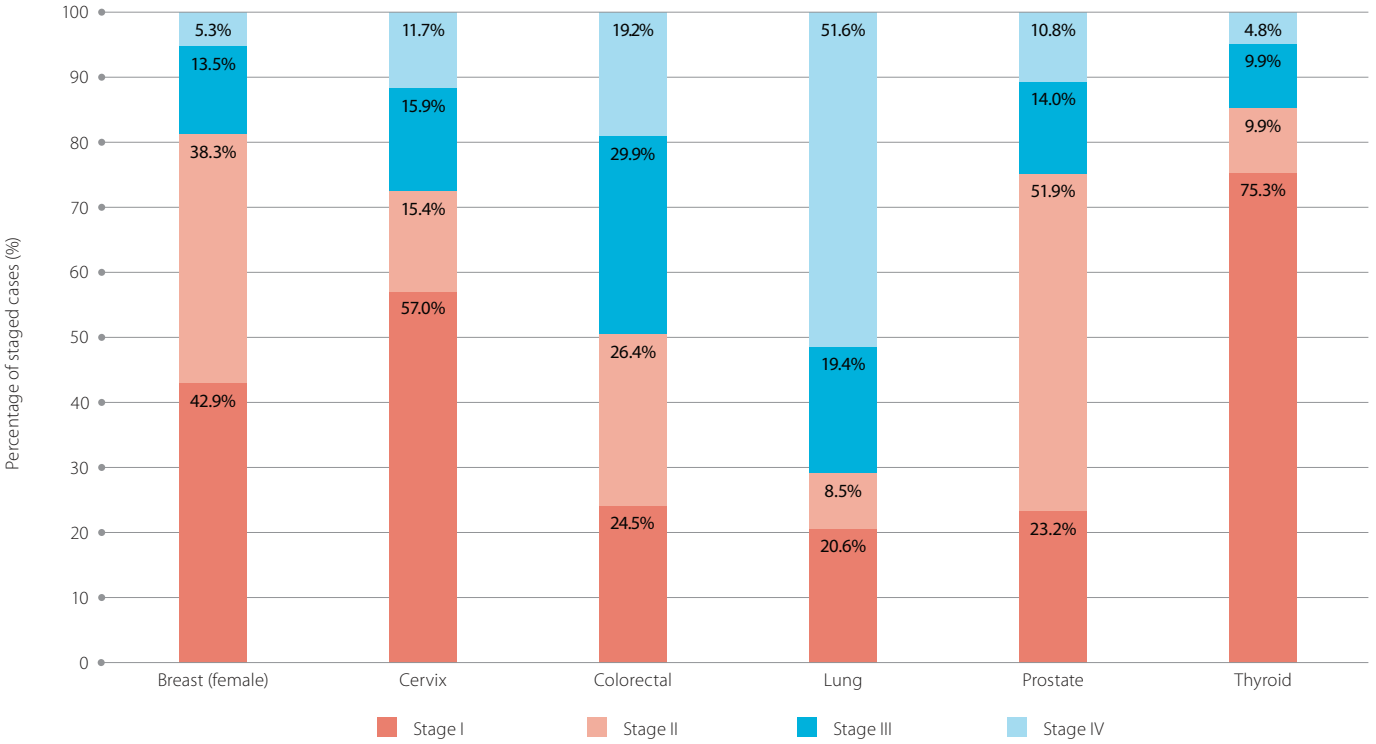
"Stage" is defined as the classification of people with cancer into prognostically similar groups according to the extent of the disease. "Stage at diagnosis" is the extent of the disease at the time of initial diagnosis. Knowing the stage of the disease helps physicians plan appropriate treatment and determine the likely outcome or course of the disease. A cancer diagnosed at an early stage is more likely to be treated successfully. If the cancer has spread, treatment becomes more difficult and a person's chances of survival are generally much lower.

Information about stage at diagnosis is one of the most important prognostic factors for cancer. High-quality stage data at the population level supports healthcare providers, administrators, researchers and decision-makers in planning, evaluating, enhancing quality of care and improving treatment outcomes.

Stage at diagnosis data for Ontario are currently available for six cancers: female breast, prostate, colorectal, lung, cervix and thyroid. The majority of breast, colorectal, prostate, cervical and thyroid cancers were diagnosed at stage I or II. This may partly be the result of the availability of screening for breast, colorectal and cervical cancers, which increases the likelihood of detecting these cancers at early stages. More specifically:

- The majority of staged breast cancer cases were diagnosed at stage I (42.9%) or stage II (38.3%) in 2013 (Figure 4.3)
- Cervical cancer was even more likely to be diagnosed at stage I (57.0%) than breast cancer. Despite the successes of screening programs in decreasing cervical cancer incidence and mortality, 11.7% of cases were still not diagnosed until stage IV. Females who are diagnosed at a later stage are less likely to have been routinely screened.[26]

Figure 4.3 **Incidence distribution by cancer type and stage for selected cancers, Ontario, 2013**



Note: Case counts are as follows: prostate n = 6,735 (excludes unknown stage = 42); breast n = 9,446 (excludes unknown stage = 85); colorectal n = 7,029 (excludes unknown stage = 233); lung n = 8,212 (excludes unknown stage = 101); cervix n = 479 (excludes unknown stage = 10); thyroid n = 2,887 (excludes unknown stage = 97). Cases that were not staged were excluded from this analysis.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

- The majority of staged colorectal cancer cases were diagnosed at stage II (26.4%) or stage III (29.9%).
- Prostate cancer cases were most likely to be diagnosed at stage II (51.9%) followed by stage I (23.2%).
- Lung cancer cases were the most likely to be diagnosed at stage IV, accounting for 51.6% of all staged lung cancer cases.
- Thyroid cancer was the most likely to be diagnosed at stage I with 75.3% of staged cases diagnosed at this early stage. Only 4.8% of thyroid cases were diagnosed at stage IV.

It should be noted that approximately 10% to 20% of breast, colorectal, lung and prostate cancer cases in the Ontario Cancer Registry are missing any information on stage at diagnosis and are therefore excluded from this analysis. We cannot be sure that the distributions would be the same for these cases.

The majority of breast, colorectal, prostate, cervical and thyroid cancers were diagnosed at stage I or II.

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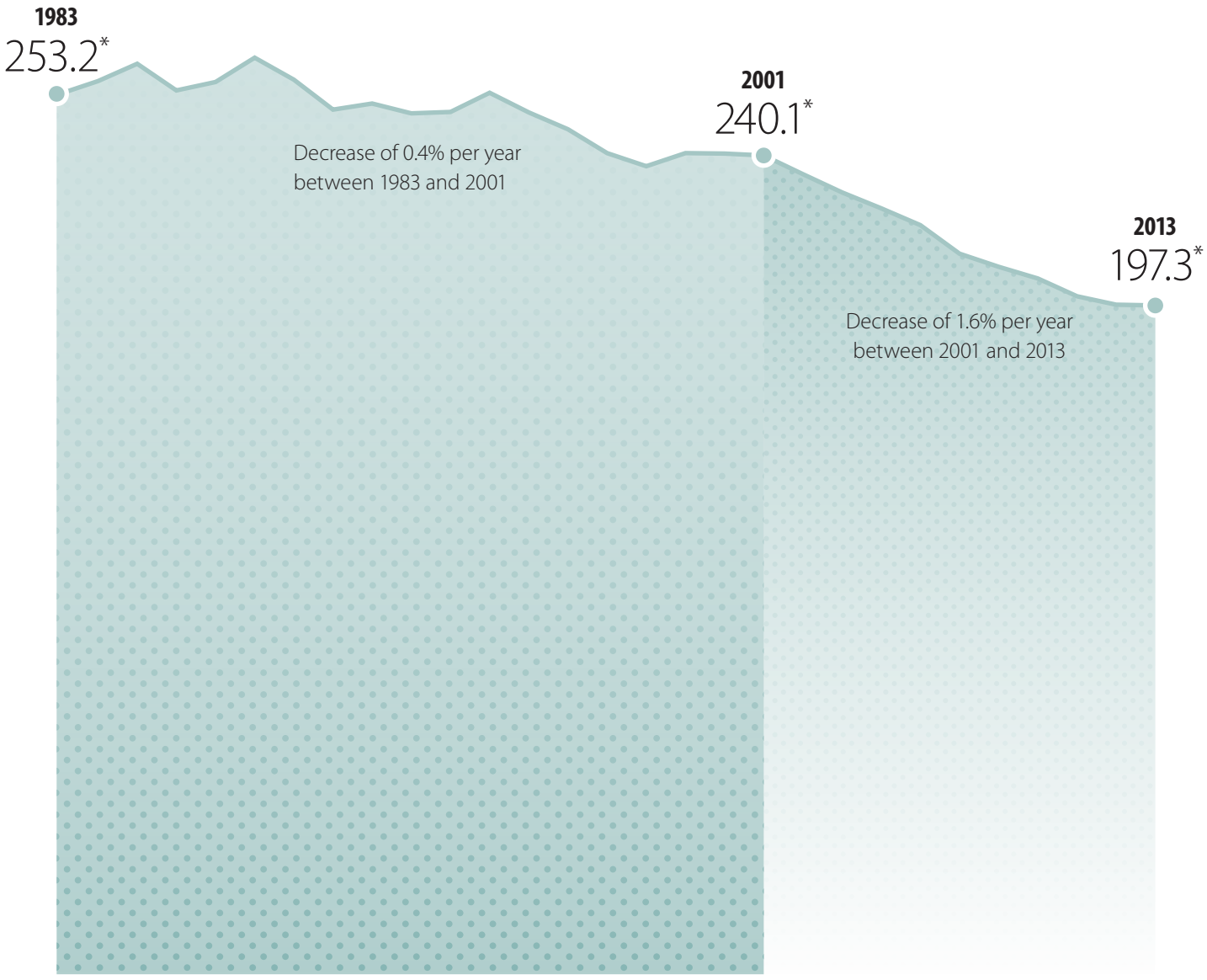
Chapter 5

Cancer mortality rates and trends

Mortality measures the number of deaths caused by cancer. This chapter presents cancer mortality rates and trends over time.

Age-standardized mortality rates

"Cancer mortality in Ontario has been declining over the past three decades with the rate of decrease accelerating after 2001."



* per 100,000 persons

Cancer as a leading cause of death

In 2013, 29.6% of all deaths in Ontario were attributable to cancer, making it the province's leading cause of death (Figure 5.1).[1] Cancer caused almost as many deaths as the next three leading causes of death combined: cardiovascular disease, cerebrovascular disease and accidents.

From 2000 to 2013, the number of deaths caused by cancer increased by nearly 19% (Figure 5.2). In comparison, the number of deaths caused by cardiovascular disease and cerebrovascular disease—the next two leading causes of death in 2013—decreased over the same time period, by 11.1% and 19.7% respectively.

In 2013, 29.6% of all deaths in Ontario were attributable to cancer, making it the province's leading cause of death.

Distribution of deaths for selected cancers, 2013

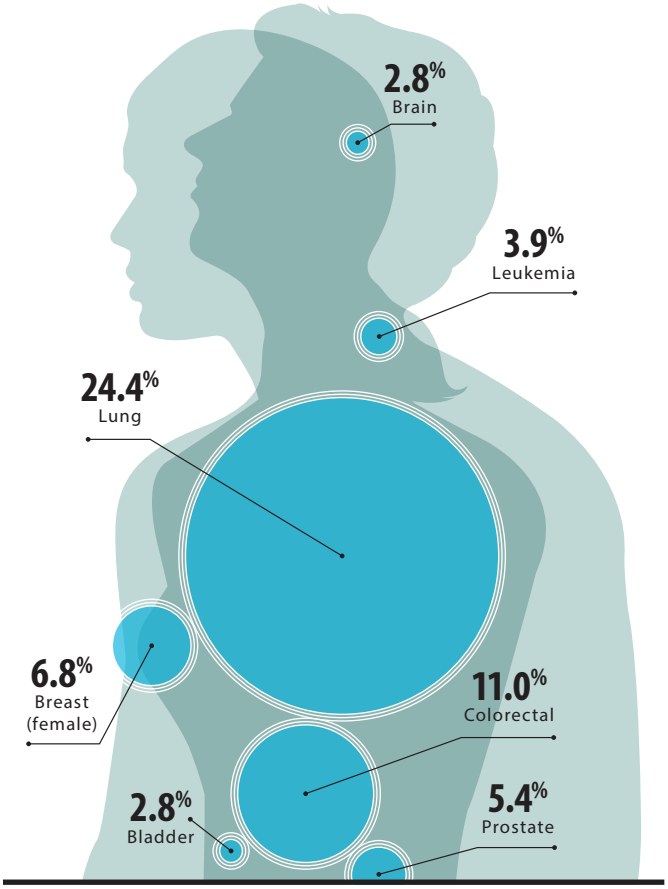
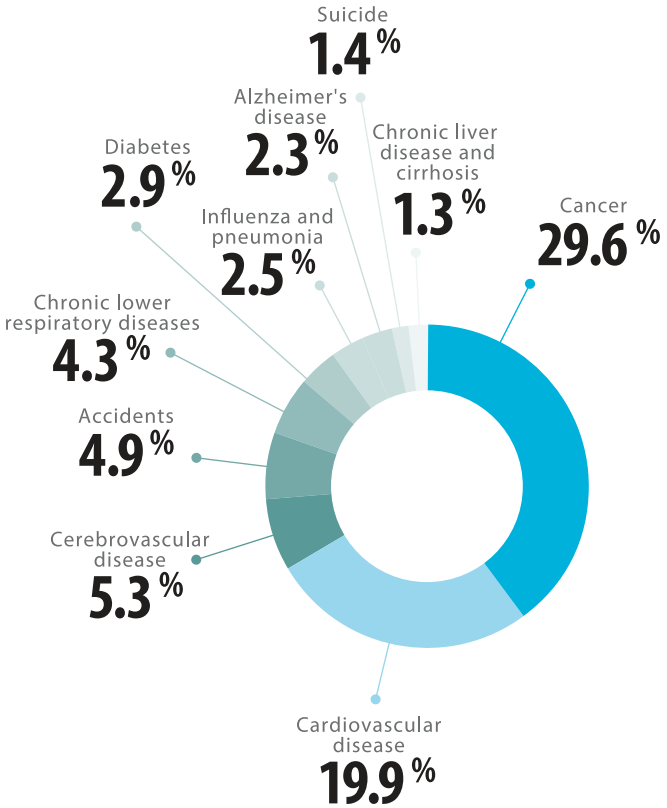


Figure 5.1 Leading* causes of death, Ontario, 2013



*As this figure only highlights the leading causes of death and not all causes of death, the numbers will not add up to 100%
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Statistics Canada. Table 102-0564 - Leading causes of death, total population, by sex, Canada, provinces and territories (age standardization using 2011 population), annual, CANSIM (database).

Change in the percentage of deaths caused, from 2000 to 2013:

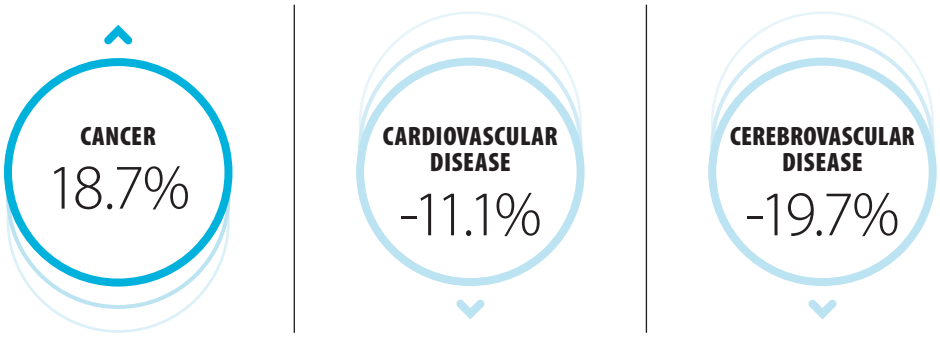
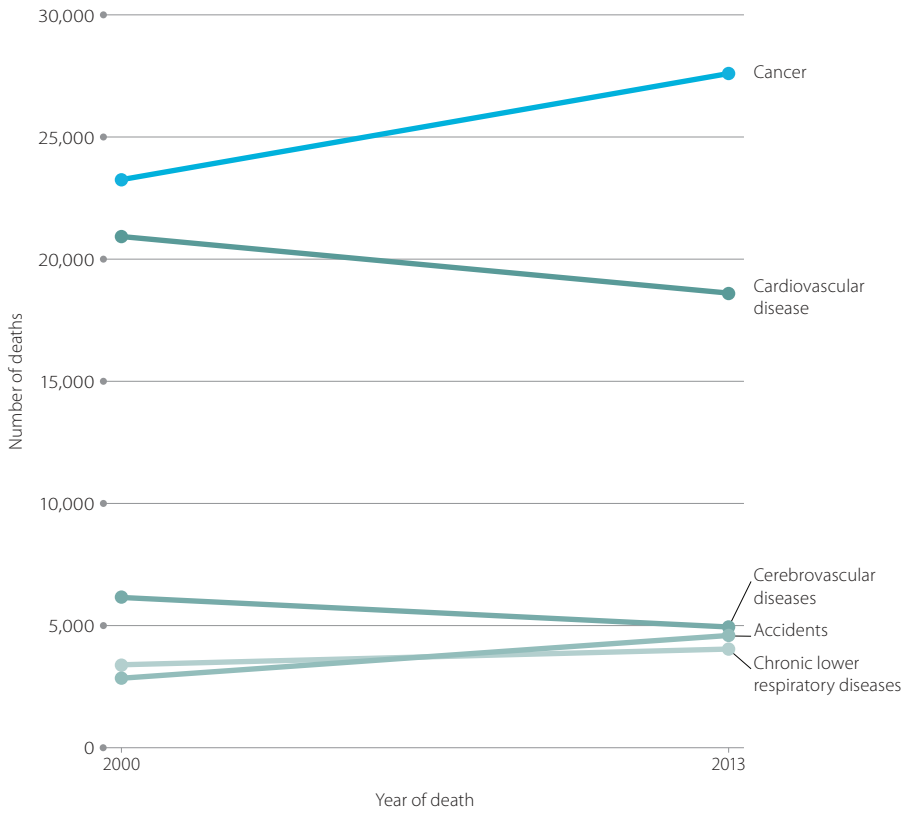


Figure 5.2 **Changes in the leading causes of death, Ontario, 2000 and 2013**



Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Statistics Canada. Table 102-0564 - Leading causes of death, total population, by sex, Canada, provinces and territories (age standardization using 2011 population), annual, CANSIM (database).

Probability of dying from cancer

The probability of dying from cancer represents the average chance of dying from cancer. This probability depends on many factors, including the population's characteristics (e.g., demographics), the prevalence of risk factors (e.g., smoking, obesity), current life expectancy and the treatment options available. Further, these probabilities 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, the probability of dying of cancer for the time period 2009–2012 was 1 in 3.8 (26.0%).[2] The probability was slightly higher for males at 1 in 3.5 than females at 1 in 4.2.

The probability of dying from cancer, for the time period 2010–2013, increased with age—from being virtually non-existent under the age of 15 to 26.0% at age 85 (Table 5.1). The probability was equal between the sexes until age 35, when the probability becomes higher for females. This continues until the age of 60, when the probability becomes higher for males.

Table 5.1 Cumulative probability of dying from cancer by age group and sex, Ontario, 2010–2013

Age group (years)	Both sexes	Male	Female
0–4	0.0%	0.0%	0.0%
5–9	0.0%	0.0%	0.0%
10–14	0.0%	0.0%	0.0%
15–19	0.1%	0.1%	0.0%
20–24	0.1%	0.1%	0.1%
25–29	0.1%	0.1%	0.1%
30–34	0.2%	0.2%	0.2%
35–39	0.2%	0.2%	0.3%
40–44	0.4%	0.4%	0.5%
45–49	0.7%	0.7%	0.8%
50–54	1.4%	1.3%	1.4%
55–59	2.4%	2.4%	2.4%
60–64	4.0%	4.1%	3.8%
65–69	6.3%	6.7%	5.9%
70–74	9.5%	10.3%	8.7%
75–79	13.5%	14.8%	12.2%
80–84	17.9%	19.9%	16.1%
85+	26.0%	28.5%	24.0%

Analysis by: Surveillance, Analytics and Informatics, CCO
Data sources: Ontario Cancer Registry (January 2017), CCO; Statistics Canada. Table 102-0564 - Leading causes of death, total population, by sex, Canada, provinces and territories (age standardization using 2011 population), annual, CANSIM (database); Statistics Canada. Table 051-0001 - Estimates of population, by age group and sex for July 1, Canada, provinces and territories, annual (persons unless otherwise noted), CANSIM (database).

Mortality by sex and cancer type

In 2013, there were 27,634 cancer deaths in Ontario, resulting in an age-standardized mortality rate (ASMR) of 197.3 per 100,000 (Table 5.2). The highest ASMR, for both sexes combined, were for lung (48.1 per 100,000), female breast (24.5 per 100,000) and colorectal (21.6 per 100,000) cancers.

The four most commonly diagnosed cancers (lung, colorectal, breast and prostate) were responsible for almost 50% of all cancer mortality in 2013. However, some of the less commonly diagnosed cancers made a relatively large contribution to mortality due to their poor prognosis and low survival rates. For example, pancreatic cancer accounted for 6.2% of all cancer deaths in 2013 — more than prostate cancer and almost as much as breast cancer.

The ASMR for all cancers combined was significantly higher for males (236.7 per 100,000) than females (169.5 per 100,000). Among males, the highest ASMR were for lung (57.7 per 100,000), prostate (26.3 per 100,000) and colorectal (26.0 per 100,000) cancers. For females, the highest ASMR were for lung (41.1 per 100,000), breast (24.5 per 100,000) and colorectal (18.2 per 100,000) cancers.

Males had a consistently higher mortality rate than females for each type of cancer. The exception was thyroid cancer, for which the mortality rates between the sexes were equal.

The greatest disparities between male and female mortality were seen in:

- laryngeal cancer, for which the male rate was almost six times the female rate;
- esophageal cancer, for which the male rate was four times the female rate;
- bladder cancer, for which the male rate was nearly four times the female rate; and
- oral cavity & pharynx cancer, for which the male rate was close to three times the female rate.

Tobacco use is a major risk factor for all of these cancers. As such, the higher mortality rates observed in males are likely the result of historically higher rates of tobacco use among males.[3]

The four most commonly diagnosed cancers (lung, colorectal, breast and prostate) were responsible for almost 50% of all cancer mortality in 2013.

Table 5.2 Cancer mortality counts and rates by cancer type and sex, Ontario, 2013

Both sexes					
Cancer type	Deaths	% of deaths	Crude rate	ASMR†	ASMR 95% CI
All cancers	**27,634**	**100.0%**	**203.9**	**197.3**	**195.0–199.7**
Bladder	764	2.8%	5.6	5.4	5.0–5.8
Brain	771	2.8%	5.7	5.6	5.2–6.0
Breast (female)	1,870	6.8%	27.1	24.5	23.4–25.6
Cervix	144	0.5%	2.1	2.0	1.7–2.3
Colorectal	3,030	11.0%	22.4	21.6	20.8–22.4
Esophagus	768	2.8%	5.7	5.5	5.1–5.9
Hodgkin lymphoma	49	0.2%	0.4	0.4	0.3–0.5
Kidney	628	2.3%	4.6	4.5	4.1–4.8
Larynx	133	0.5%	1.0	1.0	0.8–1.1
Leukemia	1,086	3.9%	8.0	7.7	7.3–8.2
Liver	1,051	3.8%	7.8	7.5	7.1–8.0
Lung	6,736	24.4%	49.7	48.1	47.0–49.3
Melanoma	519	1.9%	3.8	3.7	3.4–4.1
Myeloma	545	2.0%	4.0	3.9	3.6–4.2
Non-Hodgkin lymphoma	1,025	3.7%	7.6	7.3	6.9–7.8
Oral cavity & pharynx	558	2.0%	4.1	4.0	3.7–4.4
Ovary	655	2.4%	9.5	8.6	8.0–9.3
Pancreas	1,711	6.2%	12.6	12.2	11.6–12.8
Prostate	1,499	5.4%	22.5	26.3	25.0–27.7
Stomach	719	2.6%	5.3	5.1	4.8–5.5
Testis	13	0.0%	0.2	0.2	0.1–0.3
Thyroid	81	0.3%	0.6	0.6	0.5–0.7
Uterus	441	1.6%	6.4	5.7	5.2–6.3

Table 5.2 *(Cont'd)* **Cancer mortality counts and rates by cancer type and sex, Ontario, 2013**

Males					
Cancer type	Deaths	% of deaths	Crude rate	ASMR[†]	ASMR 95% CI
All cancers	**14,465**	**100.0%**	**217.3**	**236.7**	**232.8–240.6**
Bladder	559	3.9%	8.4	9.6	8.8–10.4
Brain	440	3.0%	6.6	6.9	6.2–7.5
Colorectal	1,572	10.9%	23.6	26.0	24.7–27.4
Esophagus	587	4.1%	8.8	9.2	8.5–10
Hodgkin lymphoma	30	0.2%	0.5	0.5	0.3–0.7
Kidney	401	2.8%	6.0	6.6	5.9–7.2
Larynx	109	0.8%	1.6	1.7	1.4–2.1
Leukemia	653	4.5%	9.8	10.9	10.0–11.7
Liver	640	4.4%	9.6	10.2	9.4–11.1
Lung	3,589	24.8%	53.9	57.7	55.8–59.6
Melanoma	341	2.4%	5.1	5.5	5.0–6.2
Myeloma	311	2.2%	4.7	5.1	4.5–5.7
Non-Hodgkin lymphoma	569	3.9%	8.5	9.3	8.6–10.1
Oral cavity & pharynx	391	2.7%	5.9	6.1	5.5–6.8
Pancreas	874	6.0%	13.1	14.0	13.1–14.9
Prostate	1,499	10.4%	22.5	26.3	25.0–27.7
Stomach	415	2.9%	6.2	6.7	6.1–7.4
Testis	13	0.1%	0.2	0.2	0.1–0.3
Thyroid	35	0.2%	0.5	0.6	0.4–0.8

Table 5.2 *(Cont'd)* **Cancer mortality counts and rates by cancer type and sex, Ontario, 2013**

Females					
Cancer type	Deaths	% of deaths	Crude rate	ASMR†	ASMR 95% CI
All cancers	**13,169**	**100.0%**	**191.0**	**169.5**	**166.6–172.5**
Bladder	205	1.6%	3.0	2.5	2.2–2.9
Brain	331	2.5%	4.8	4.5	4.0–5.0
Breast	1,870	14.2%	27.1	24.5	23.4–25.6
Cervix	144	1.1%	2.1	2.0	1.7–2.3
Colorectal	1,458	11.1%	21.1	18.2	17.3–19.2
Esophagus	181	1.4%	2.6	2.3	2.0–2.7
Hodgkin lymphoma	19	0.1%	0.3	0.3	0.2–0.4
Kidney	227	1.7%	3.3	2.8	2.5–3.2
Larynx	24	0.2%	0.3	0.3	0.2–0.5
Leukemia	433	3.3%	6.3	5.5	5.0–6.1
Liver	411	3.1%	6.0	5.2	4.7–5.8
Lung	3,147	23.9%	45.6	41.1	39.6–42.5
Melanoma	178	1.4%	2.6	2.3	2.0–2.7
Myeloma	234	1.8%	3.4	3.0	2.6–3.4
Non-Hodgkin lymphoma	456	3.5%	6.6	5.8	5.2–6.3
Oral cavity & pharynx	167	1.3%	2.4	2.2	1.9–2.5
Ovary	655	5.0%	9.5	8.6	8.0–9.3
Pancreas	837	6.4%	12.1	10.7	10.0–11.4
Stomach	304	2.3%	4.4	3.9	3.5–4.4
Thyroid	46	0.3%	0.7	0.6	0.4–0.8
Uterus	441	3.3%	6.4	5.7	5.2–6.3

ASMR=Age-standardized mortality rate
CI=Confidence interval
†Rates standardized to the 2011 Canadian population
Note: Rates are per 100,000.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

Mortality by age

In 2013, more than 80% of all cancer deaths in Ontario occurred in people 60 years of age or older (Table 5.3). Mortality was distributed by age group as follows:

- 34.7% of all cancer deaths occurred in people 80 years of age or older (compared to 19.1% of all new cases), with lung and colorectal cancers the leading causes;
- 49.1% of all cancer deaths occurred in people 60 to 79 years of age (compared to 50.8% of all new cases), with lung and colorectal cancers the leading causes;
- 14.6% of all cancer deaths occurred in people 40 to 59 years of age (compared to 25.1% of all new cases), with breast and lung cancers the leading causes; and
- 1.5% of all cancer deaths occurred in people younger than 40 years of age (compared to 5.0% of all new cases), with brain cancer and leukemia the leading causes.

The greatest proportion of cancer deaths in 2013 occurred in people ages 60 to 79 for all but four of the 23 types of cancer examined. The greatest proportion of deaths from breast (42.9%), colorectal (45.2%) and lung (58.2%) cancers occurred in this age group. While prostate cancer was diagnosed most frequently in males ages 60 to 79, most deaths caused by prostate cancer occurred in males 80 years or older, reflecting 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 6.0 per 100,000 in those ages 39 or younger to a rate of 1,729.3 per 100,000 in those ages 80 or older. Mortality rates for:

- cancers of the bladder, brain, breast, colorectum, kidney, larynx, liver, ovary, prostate, stomach and thyroid, as well as leukemia, melanoma, myeloma and non-Hodgkin lymphoma, all increased significantly with age;
- cancers of the cervix, esophagus, lung, oral cavity & pharynx, pancreas and uterus increased non-significantly with age;
- Hodgkin lymphoma were the same for those ages 60 to 79 and 80 or older; and
- testicular cancer were highest in those under the age of 40.

Distribution of cancer deaths by age group

80 YEARS OF AGE OR OLDER
34.7%

60–79 YEARS OF AGE
49.1%

40–59 YEARS OF AGE
14.6%

UNDER THE AGE OF 40
1.5%

Table 5.3 Mortality counts and age-specific rates by cancer type and age group, Ontario, 2013

Cancer type	Age group (years)					
	0–39			40–59		
	Count	Age-specific rate	95% CI	Count	Age-specific rate	95% CI
All cancers*	**407**	**6.0**	**5.5–6.7**	**4,045**	**101.9**	**98.8–105.1**
Bladder*	**	**	**	41	1.0	0.7 – 1.4
Brain*	79	1.2	0.9–1.5	225	5.7	5.0 – 6.5
Breast (female)*	43	1.3	0.9-1.7	451	22.5	20.5 – 24.7
Cervix	8	0.2	0.1–0.5	63	3.1	2.4 – 4.0
Colorectal*	22	0.3	0.2–0.5	356	9.0	8.1–10.0
Esophagus	**	**	**	180	4.5	3.9–5.2
Hodgkin lymphoma	**	**	**	14	0.4	0.2–0.6
Kidney*	**	**	**	94	2.4	1.9–2.9
Larynx*	**	**	**	23	0.6	0.4 – 0.9
Leukemia*	51	0.8	0.6–1.0	111	2.8	2.3–3.4
Liver*	13	0.2	0.1–0.3	168	4.2	3.6–4.9
Lung	24	0.4	0.2–0.5	876	22.1	20.6 – 23.6
Melanoma*	20	0.3	0.2–0.5	101	2.5	2.1 – 3.1
Myeloma*	**	**	**	68	1.7	1.3–2.2
Non-Hodgkin lymphoma*	16	0.2	0.1–0.4	141	3.6	3.0 – 4.2
Oral cavity & pharynx	**	**	**	143	3.6	3.0 – 4.2
Ovary*	7	0.2	0.1–0.4	139	6.9	5.8 – 8.2
Pancreas	9	0.1	0.1–0.3	239	6.0	5.3 – 6.8
Prostate*	**	**	**	59	3.0	2.3 – 3.9
Stomach*	11	0.2	0.1–0.3	121	3.0	2.5–3.6
Testis	8	0.2	0.1–0.5	**	**	**
Thyroid*	**	**	**	13	0.3	0.2–0.6
Uterus	**	**	**	52	2.6	1.9–3.4

Table 5.3 *(Cont'd)* **Mortality counts and age-specific rates by cancer type and age group, Ontario, 2013**

Cancer type	Age group (years)					
	60–79			80+		
	Count	Age-specific rate	95% CI	Count	Age-specific rate	95% CI
All cancers*	**13,582**	**592.2**	**582.3–602.2**	**9,600**	**1,729.3**	**1,694.9–1,764.3**
Bladder*	333	14.5	13.0 – 16.2	388	69.9	63.1 – 77.2
Brain*	349	15.2	13.7–16.9	118	21.3	17.6–25.5
Breast (female)*	803	66.7	62.2–71.5	573	166.9	153.5 – 181.1
Cervix	51	4.2	3.2–5.6	22	6.4	4.0–9.7
Colorectal*	1,371	59.8	56.7–63.0	1,281	230.8	218.3–243.7
Esophagus	407	17.7	16.1–19.6	176	31.7	27.2–36.7
Hodgkin lymphoma	24	1.0	0.7–1.6	6	1.1	0.4–2.4
Kidney*	282	12.3	10.9–13.8	249	44.9	39.5–50.8
Larynx*	72	3.1	2.5–4.0	37	6.7	4.7–9.2
Leukemia*	481	21.0	19.1–22.9	443	79.8	72.5–87.6
Liver*	548	23.9	21.9–26.0	322	58.0	51.8–64.7
Lung	3,918	170.8	165.5–176.3	1,918	345.5	330.2–361.3
Melanoma*	246	10.7	9.4–12.2	152	27.4	23.2–32.1
Myeloma*	268	11.7	10.3–13.2	208	37.5	32.5–42.9
Non-Hodgkin lymphoma*	472	20.6	18.8–22.5	396	71.3	64.5–78.7
Oral cavity & pharynx	280	12.2	10.8–13.7	131	23.6	19.7–28.0
Ovary*	329	27.3	24.4 – 30.4	180	52.4	45.0 – 60.7
Pancreas	924	40.3	37.7–43.0	539	97.1	89.1–105 .6
Prostate*	556	51.0	46.9 – 55.5	884	417.5	390.4 – 446.0
Stomach*	334	14.6	13.0–16.2	253	45.6	40.1–51.6
Testis	**	**	**	**	**	**
Thyroid*	37	1.6	1.1–2.2	30	5.4	3.6–7.7
Uterus	243	20.2	17.7 – 22.9	143	41.6	35.1 – 49.1

CI=Confidence interval
*Significant increasing trend in age-specific rate with increasing age
**Suppressed due to small cell count (n<6)
Note: The table excludes cases of unknown age.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

Mortality trends by cancer type

The cancer mortality rate for all cancers combined in Ontario has been decreasing over the past few decades, with the decline accelerating in recent years. From 1983 to 2001, the ASMR decreased by 0.4% per year and fell a further 1.6% per year from 2001 to 2013 (Table 5.4).

From 1983 to 1988, male mortality was stable while female mortality declined. Since 1988, the declines in mortality have been greater for males than females. For males, the mortality rate declined by 0.9% per year from 1988 to 2001 and then by 1.8% per year from 2001 to 2013. For females, the rate declined by 0.2% per year from 1983 to 2002 and then declined by 1.6% per year from 2002 to 2013.

The cancer mortality rate for all cancers combined in Ontario has been decreasing over the past few decades, with the decline accelerating in recent years.

Among the four cancer types with the highest mortality rates, the following changes in trend were observed:

BREAST

The ASMR for breast cancer has been declining since the early 1980s. From 1983 to 1994, it decreased by 0.6% per year. The decrease accelerated to 2.6% per year from 1994 to 2013.

This decrease in the mortality rate is likely due to greater regular participation in mammography screening, especially after the introduction of Ontario's organized breast screening program.[4, 5] In addition, improved treatment and the use of more effective therapies following breast cancer surgery likely also contributed to the improvement in the mortality rate.[6, 7]

COLORECTAL

The colorectal cancer ASMR has consistently declined in both sexes since 1983. In males, the mortality rate decreased by 1.4% per year from 1983 to 2005, followed by an accelerated decline of 3.5% per year from 2005 to 2013. The rate decreased similarly among females: from 1983 to 2004, it fell by 1.7% per year and then by 2.7% per year from 2004 onward.

These strong declines may be due to changes in risk and protective factors, earlier diagnosis due to greater uptake of screening and improvements in treatment.[8]

LUNG

In males, the ASMR for lung cancer began to level off in the late 1980s, followed by a decline of 2.2% per year from 1989 to 2013. Among females, the mortality rate continued to increase throughout the 1980s and 1990s by 2.1% per year; it peaked in 2000 before beginning to decrease by 0.5% per year onward.

Decreases in lung cancer mortality are largely attributable to decreased tobacco use, which began to decline in the late 1950s for males and in the mid-1970s for females.[3, 9] This approximately 15-year gap in peak smoking rates between males and females corresponds to the gap in the stabilization of lung cancer mortality rates between the sexes.

PROSTATE

The prostate cancer ASMR increased by 1.6% per year from 1983 to 1994 and then decreased by 2.8% per year from 1994 to 2013. Evidence indicates that the cause of the decline is likely due to improved treatment,[10,11] with early detection through screening potentially playing a role.[12, 13]

Notable changes in trend were also observed for the following cancers:

LIVER

The liver cancer ASMR has been increasing significantly since 1983. From 1983 to 1994, it increased by 5.2% per year, slowing to 1.7% per year from 1994 to 2007 and then increasing more rapidly at 4.6% per year from 2007 onward. This increase was probably at least partially driven by the rise in the incidence rate over the same time period.

OVARIAN

In contrast to liver cancer, the ASMR for ovarian cancer has decreased significantly in recent years. The mortality rates declined gradually from 1983 to 2003 at 0.4% per year and then more rapidly at 2.2% per year from 2003 onward. This parallels the decrease in the ovarian cancer incidence rate since 2002.

Declines in ovarian cancer incidence and mortality are likely due to changes in exposure to risk factors including the use of oral contraceptives.[14] Declines in mortality may also be a reflection of increasing survival due to improvements in treatment.[15]

STOMACH

From 1983 to 2013, the stomach cancer ASMR decreased by 2.7% per year. This decline has been attributed to decreased exposure to *Helicobacter pylori (H.pylori)* infection, improvements in food preservation and refrigeration, lifestyle changes and better treatment.[16]

Changes in mortality rates from 1983 to 2013 for other cancer types are provided in Table 5.4.

Annual percent change in the lung cancer age-standardized mortality rate from 1983 to 2013

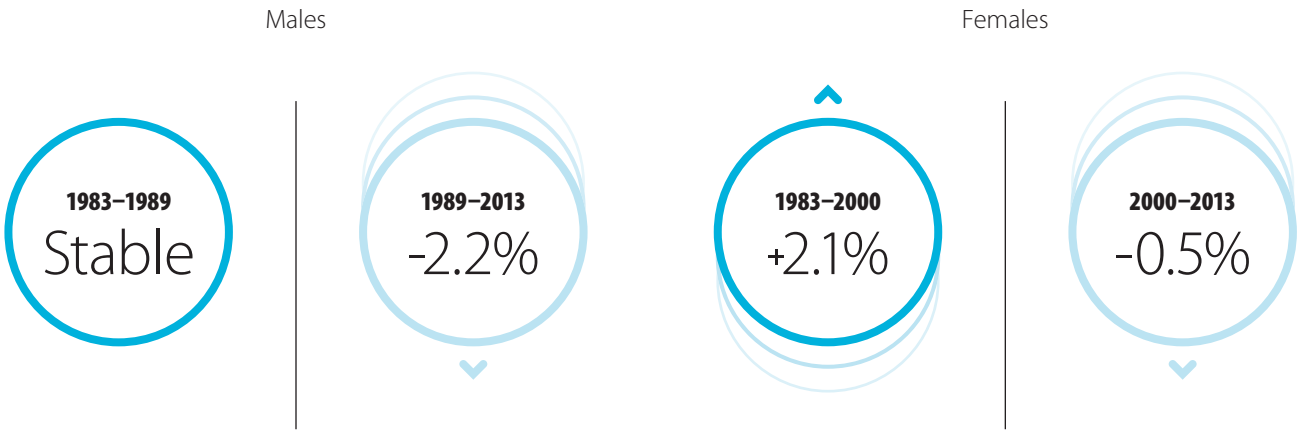


Table 5.4 Annual percent change in age-standardized mortality rates by cancer type and sex, Ontario, 1983–2013

Cancer type	Both Sexes			Males			Females		
	Period	APC (%)		Period	APC (%)		Period	APC (%)	
All cancers	**1983–2001**	**–0.4**	↓	**1983–1988**	**0.3**		**1983–2002**	**–0.2**	↓
	2001–2013	**–1.7**	↓	**1988–2001**	**–0.9**	↓	**2002–2013**	**–1.6**	↓
				2001–2013	**–1.8**	↓			
Bladder	1983–2013	–0.5	↓	1983–2013	–0.7	↓	1983–2013	–0.4	↓
Brain	1983–2006	–1.1	↓	1983–1997	–1.7	↓	1983–2006	–1.2	↓
	2006–2009	6.0		1997–2013	0.7	↑	2006–2013	3.0	↑
	2009–2013	–0.8							
Breast (female)							1983–1994	–0.6	↓
							1994–2013	–2.6	↓
Cervix							1983–2013	–3.0	↓
Colorectal	1983–2005	–1.5	↓	1983–2005	–1.4	↓	1983–2004	–1.7	↓
	2005–2013	–3.1	↓	2005–2013	–3.5	↓	2004–2013	–2.7	↓
Esophagus	1983–2013	0.0		1983–2013	0.2		1983–2013	–0.8	↓
Hodgkin lymphoma	1983–1987	–11.9	↓	1983–2013	–3.9	↓	1983–2013	–3.2	↓
	1987–2013	–2.9	↓						
Kidney	1983–2013	–0.3	↓	1983–2013	–0.4	↓	1983–2013	–0.4	↓
Larynx	1983–1988	5.9		1983–1988	6.0		1983–2013	–2.6	↓
	1988–2013	–3.3	↓	1988–2013	–3.4	↓			
Leukemia	1983–2013	–0.8	↓	1983–1987	3.0		1983–2013	–1.0	↓
				1987–2013	–0.9	↓			
Liver	1983–1994	5.2	↑	1983–2013	2.9	↑	1983–1991	6.2	↑
	1994–2007	1.7	↑				1991–2008	1.4	↑
	2007–2013	4.6	↑				2008–2013	7.2	↑
Lung	1983–1993	0.2		1983–1989	–0.3		1983–2000	2.1	↑
	1993–2013	–1.1	↓	1989–2013	–2.2	↓	2000–2013	–0.5	↓
Melanoma	1983–2013	1.0	↑	1983–2013	1.3	↑	1983–2013	0.5	↑

Table 5.4 *(Cont'd)* **Annual percent change in age-standardized mortality rates by cancer type and sex, Ontario, 1983–2013**

Cancer type	Both Sexes			Males			Females		
	Period	APC (%)		Period	APC (%)		Period	APC (%)	
Myeloma	1983–1999	0.4		1983–2013	−0.5	↓	1983–1999	0.5	
	1999–2013	−1.4	↓				1999–2013	−1.9	↓
Non-Hodgkin lymphoma	1983–2000	1.8	↑	1983–2000	1.9	↑	1983–1998	2.2	↑
	2000–2013	−2.5	↓	2000–2013	−2.3	↓	1998–2013	−2.3	↓
Oral cavity and pharynx	1983–2013	−1.6	↓	1983–2009	−2.2	↓	1983–2013	−1.4	↓
				2009–2013	3.6				
Ovary							1983–2003	−0.4	↓
							2003–2013	−2.2	↓
Pancreas	1983–2006	−0.7	↓	1983–2005	−1.2	↓	1983–2013	−0.1	
	2006–2013	1.0	↑	2005–2013	1.0				
Prostate				1983–1994	1.6	↑			
				1994–2013	−2.8	↓			
Stomach	1983–2013	−2.7	↓	1983–2013	−2.9	↓	1983–2013	−2.5	↓
Testis				1983–2013	−2.9	↓			
Thyroid	1983–2013	−0.5		1983–2013	0.4		1983–2013	−1.0	↓
Uterus							1983–1988	−6.0	↓
							1988–2013	0.9	↑

APC=Annual percent change
Notes: 1. Statistically significant changes in trend and their direction are indicated by corresponding arrows.
2. Rates are standardized to the 2011 Canadian population.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

Thirty-year trend in mortality

Over the most recent 30-year period — 1983 to 2013 (Figure 5.3) — the average annual percent change (AAPC) in the ASMR for males:

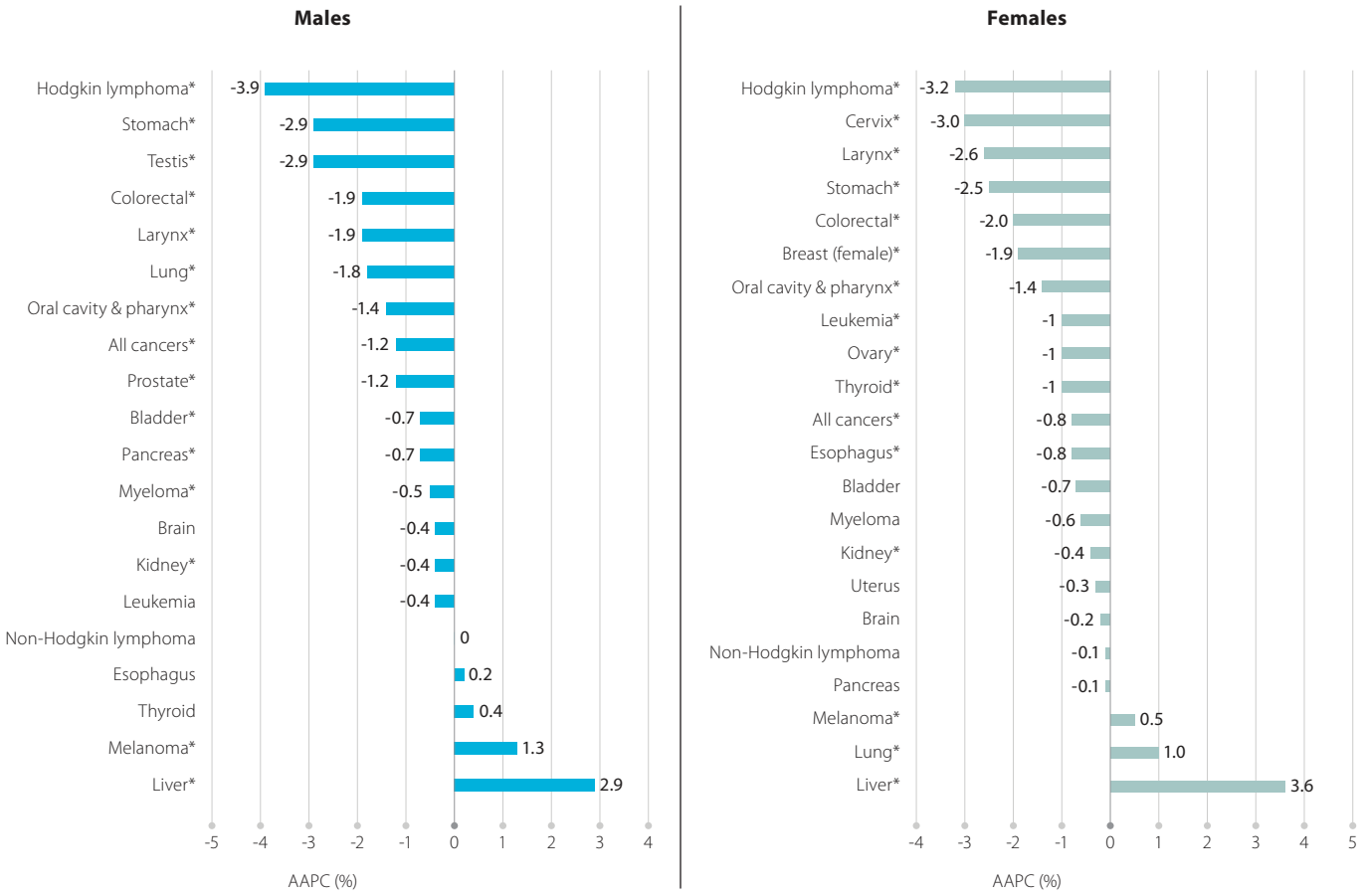
- decreased for most types of cancer, including Hodgkin lymphoma (3.9% per year), stomach cancer (2.9%) and testicular cancer (2.9%);
- increased for liver cancer (2.9%) and melanoma (1.3%); and
- was stable for thyroid, brain and esophageal cancers as well as non-Hodgkin lymphoma and leukemia.

Over the same period, the AAPC in the ASMR for females:

- decreased for most cancer types, including Hodgkin lymphoma (3.2% per year) as well as cervical (3.0%) and laryngeal (2.6%) cancers;
- increased for liver (3.6%) and lung (1.0%) cancers as well as melanoma (0.5%); and
- was stable for pancreatic, brain, uterine and bladder cancers as well as non-Hodgkin lymphoma and myeloma.

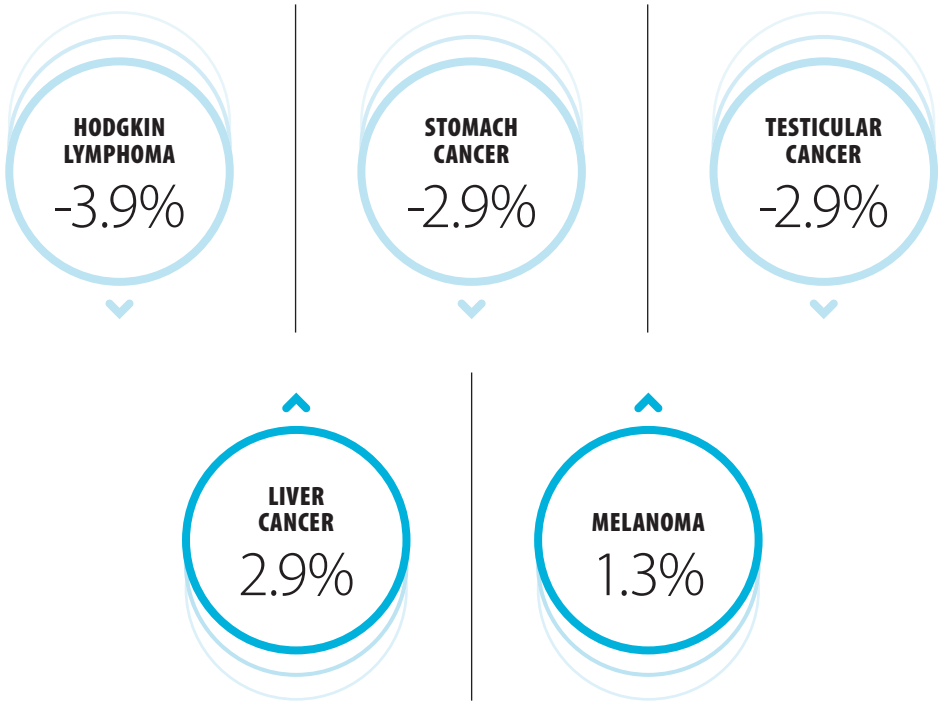
For some cancers, such as liver cancer and melanoma, the increases in mortality rates are likely reflective of increases in incidence rates.

Figure 5.3 **Average annual percent change in age-standardized mortality rates by cancer type and sex, Ontario, 1983–2013**



AAPC=Average annual percent change
*Statistically significant AAPC
Note: Rates are standardized to the 2011 Canadian population.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

Largest average annual percent changes in male mortality over the most recent 30-year period (1983 to 2013)



Mortality trends by age

Mortality across all age groups has declined significantly over the last decade. While mortality declines in younger people have been fairly equal between the sexes, the declines among people ages 60 or older have been greater among males (Figure 5.4).

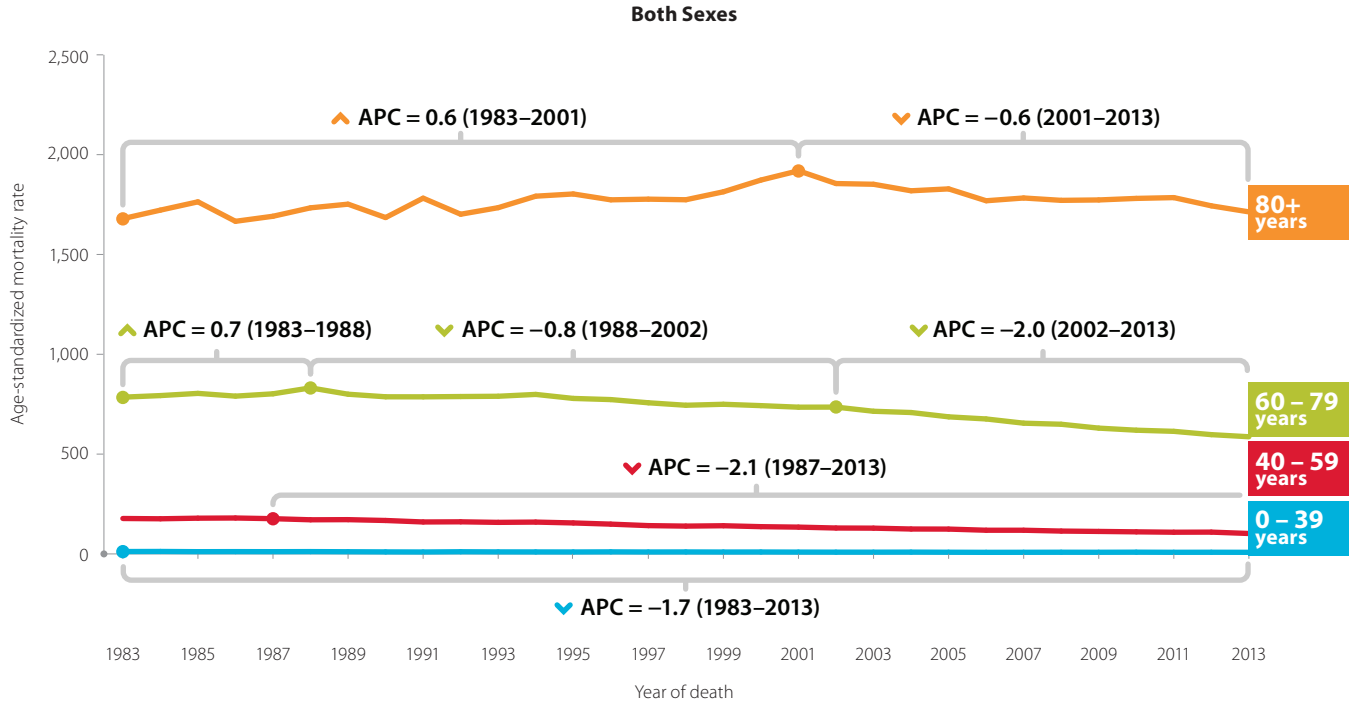
While incidence rates have been increasing among younger people, mortality rates have been falling. Among people under the age of 40, the mortality rate declined by 1.7% per year from 1983 to 2013.

For people ages 40 to 59, the mortality rate was stable until 1987, when it started to decline by 2.1% per year until 2013. Similar trends were seen for males and females separately.

Among those ages 60 to 79, the mortality rate increased until 1988, after which it decreased by 0.8% per year until 2002. From 2002 to 2013, the rate decreased by 2.0% per year. The rate of decrease was greater for males (2.3% per year) than females (1.8% per year).

Similar to people ages 60 to 79, mortality among those 80 or older increased by 0.6% per year between 1983 and 2001, followed by a decrease of 0.6% per year from 2001 to 2013. The decline in mortality was greater for males at 1.2% per year after 2001. Among females, the mortality rate was stable until 1992, after which it increased until 2001 before finally declining by 0.5% per year since.

Figure 5.4 Annual percent change in age-standardized mortality rates by age group and sex for all cancers combined, Ontario, 1983–2013



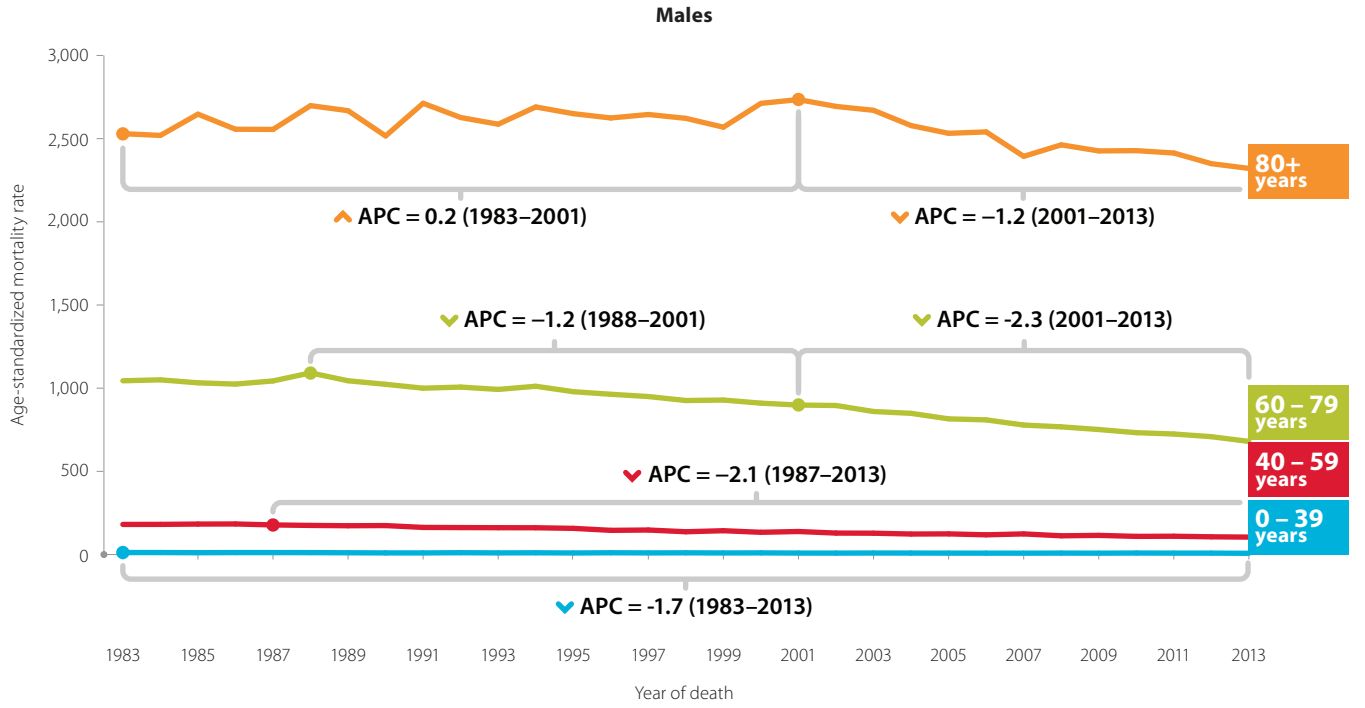
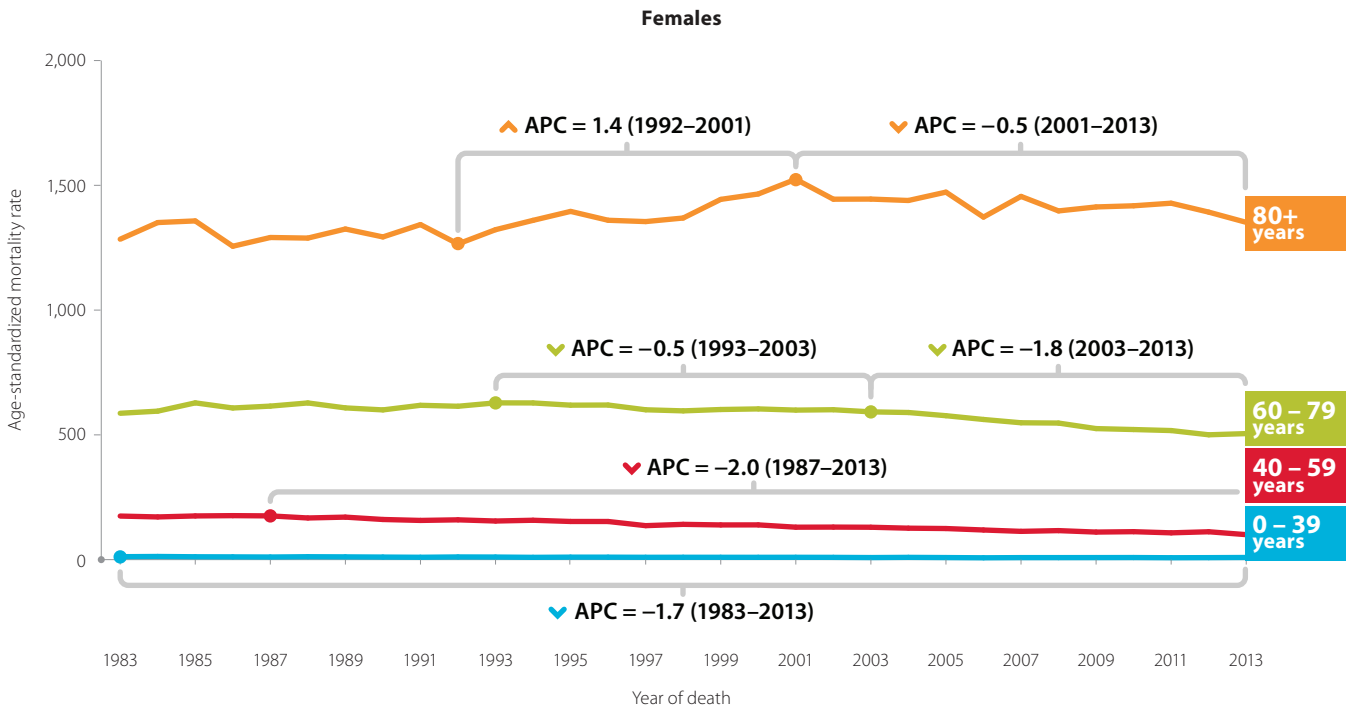


Figure 5.4 *(Cont'd)* **Annual percent change in age-standardized mortality rates by age group and sex for all cancers combined, Ontario, 1983–2013**



APC=Annual percent change
Note: Rates are per 100,000 and standardized to the age distribution of the 2011 Canadian population.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

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Chapter 6

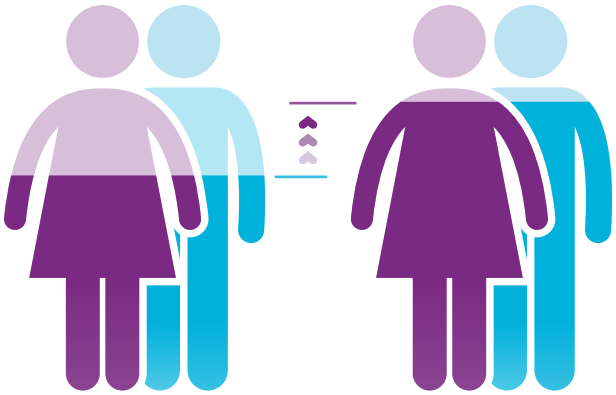
Cancer survival

Relative survival measures the likelihood of a person who has been diagnosed with cancer surviving for a specified period of time, compared to similar people in the general population. This chapter presents current and historical statistics on cancer survival in Ontario.

5-year relative survival ratios

"The greatest improvements in survival have been made in those diagnosed between the ages of 40 and 79 years."

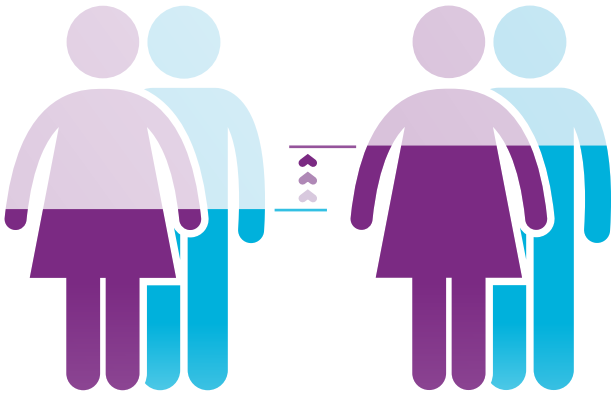
Age 40–59



1984–1988
55.8%

2009–2013
74.9%

Age 60–79



1984–1988
47.0%

2009–2013
63.4%

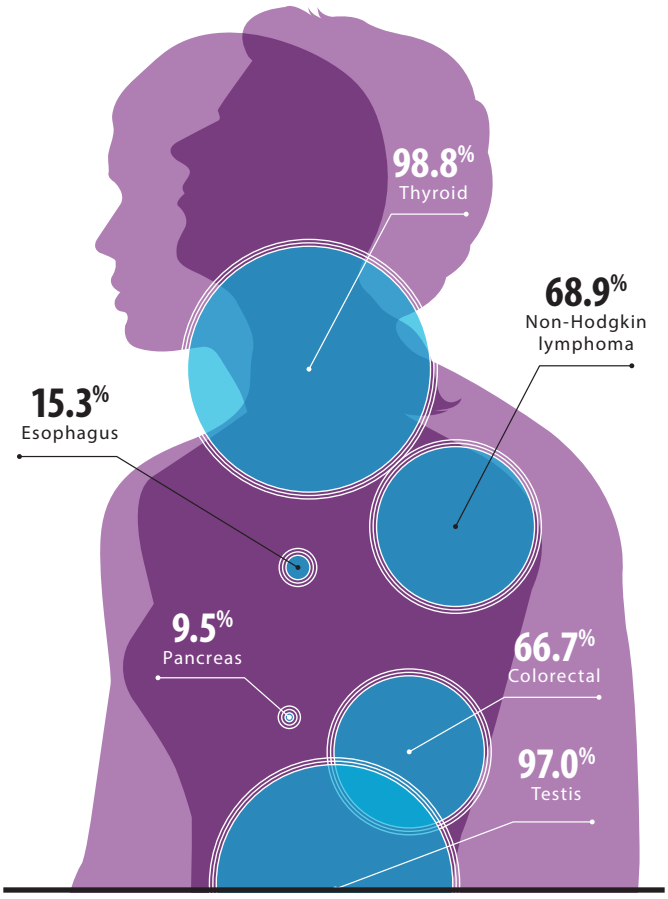
Survival statistics are a key indicator of the effectiveness of cancer treatment and control programs.[1] Relative survival ratios (RSRs) indicate the likelihood of surviving for a certain amount of time (e.g., one, three or five years) after diagnosis compared to similar people (i.e., people of the same age and sex) in the general population.

The first five years after diagnosis are a critical period for examining survival. This is when someone is most likely to access healthcare services, including primary treatment and close clinical assessment for recurrence. After five years, use of the healthcare system and the chance of recurrence both decrease. Accordingly, this chapter focuses mainly on five-year relative survival for the period of 2009 to 2013.

Cancer survival depends on several factors, including the cancer type (including its morphology), sex, age at diagnosis, stage at diagnosis and the type of treatment received. While RSRs represent the typical survival expectation for the population of people with a certain type of cancer, these statistics may not reflect the prognosis of an individual, whose 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 they may not reflect the impact of more recent advances in cancer detection and treatment.

Improvements in survival over time can be attributed to better methods for (and the greater use of) early detection as well as more effective treatments. Even small improvements in survival can reflect a large number of avoided premature deaths at the population level.[2] Improvements in survival may also be artefactual: that is, the result of increased incidence through improved early detection.[3] For improvements in survival to be considered signs of progress, they should be accompanied by decreases in incidence and/or mortality.

Five-year relative survival ratios for selected cancers, 2009–2013



Relative survival by cancer type and sex

From 2009 to 2013, the five-year RSR for all cancers combined was 64.7% (Table 6.1). This means those diagnosed with cancer during this period were 64.7% as likely to survive for five years after diagnosis compared to similar people in the general population. Survival has improved over time with the age-standardized five-year RSR increasing from 47.6% in 1983–1987 to 63.9% in 2009–2013.[4]

Male survival for 2009–2013 was significantly lower than female: 63.0% compared to 66.4%. This disparity is likely a result of generally higher survival rates in females compared to males for cancer types that are common in both sexes—particularly lung cancer, which is the leading cause of cancer death in Ontario.

For cancer types that occur in both sexes:

- Five-year survival was highest for thyroid cancer (98.8%), Hodgkin lymphoma (86.9%) and melanoma (86.6%).
- Five-year survival was lowest for pancreatic (9.5%), esophageal (15.3%), lung (20.0%) and liver (20.4%) cancers. Low survival rates for these cancers are largely attributed to the fact that most cases are diagnosed at an advanced stage, when the cancer has metastasized beyond the primary site.[5,6]

It should be noted that relative survival estimates for high-mortality cancers (particularly pancreatic cancer) are generally higher in Ontario than in other provinces and may be overestimated. The reason for this overestimation is likely due to survival methodology, which assumes patients lost to follow-up are still alive at the cut-off date (which, in the case of five-year RSRs, is five years after diagnosis).[7] For high-mortality cancers, this is very unlikely. This is particularly a problem for Ontario because there is evidence that Ontario has a higher loss to follow-up rate than other provinces, although the reasons for this are still unclear. Therefore, survival estimates for pancreatic, esophageal, liver and lung cancers should be interpreted with caution, especially when comparing them to other jurisdictions.

For males, five-year survival was:

- highest for testicular (97.0%), thyroid (97.0%) and prostate (95.4%) cancers; and
- lowest for pancreas (9.7%), esophageal (15.3%) and lung (17.0%) cancers.

For females, five-year survival was:

- highest for thyroid cancer (99.3%), melanoma (90.3%) and breast cancer (88.9%); and
- lowest for pancreas (9.4%), esophageal (15.5%) and liver (18.7%) cancers.

There were significant differences in five-year survival between males and females for the following cancer types. Specifically:

- Lung cancer survival was significantly higher in females (23.3%) than males (17.0%). Possible reasons for lower lung cancer survival among males include a greater proportion of more aggressive histological lung cancer types in males and a higher propensity for males to be diagnosed at a later stage.[4,8,9]
- Survival for melanoma was significantly higher in females (90.3%) than males (83.5%). Lower survival among males has been attributed to tumour–host interaction that leads to a higher chance of metastasis in males than in females.[10–12] Recent research has also pointed toward the possible role of the expression of the PR70 protein which may act as an X-chromosome linked melanoma tumour suppressor.[13]
- Oral cavity & pharynx cancer survival was significantly higher in females (65.8%) than males (60.2%).
- Bladder cancer was the one cancer for which male survival was significantly higher than female (66.3% in males versus 57.4% in females). Lower survival in females may be the result of their typically more advanced stage at diagnosis compared to males, differences in their ability to metabolize carcinogens and a greater presence of sex steroids in females that could affect the progression of cancer.[14, 15]

Table 6.1 Five-year relative survival ratios by cancer type and sex, Ontario, 2009–2013

Cancer type	Both Sexes		Males		Females	
	RSR (%)	95% CI	RSR (%)	95% CI	RSR (%)	95% CI
All cancers	**64.7**	**64.4–64.9**	**63.0**	**62.6–63.4**	**66.4**	**66.1–66.8**
High survival (80%–100%)						
Thyroid	98.8†	98.3–99.2	97.0†	95.2–98.1	99.3†	98.7–99.6
Testis	—	—	97.0†	95.5–98.1	—	—
Prostate	—	—	95.4†	94.8–95.9	—	—
Breast (female)	—	—	—	—	88.9	88.3–89.4
Hodgkin lymphoma	86.9†	84.4–89.1	85.9†	82.2–88.9	86.8†	82.9–89.9
Melanoma	86.6	85.4–87.7	83.5	81.7–85.2	90.3	88.7–91.7
Uterus	—	—	—	—	83.2	82.0–84.4
Average survival (40%–79%)						
Kidney	74.3	72.8–75.8	73.6	71.7–75.5	75.4†	73.0–77.7
Cervix	—	—	—	—	73.2	70.7–75.5
Non-Hodgkin lymphoma	68.9	67.7–70.1	67.6	65.9–69.2	70.5†	68.7–72.2
Colorectal	66.7	65.9–67.5	66.5	65.3–67.6	66.8	65.6–68.0
Bladder	64.2	62.5–65.8	66.3	64.3–68.2	57.4†	54.0–60.6
Oral cavity & pharynx	62.0	60.3–63.7	60.2	58.1–62.2	65.8	62.8–68.6
Larynx	59.9	56.2–63.3	60.6	56.6–64.3	56.2	47.1–64.3
Leukemia	58.1	56.5–59.6	58.0	56.0–60.0	58.1	55.8–60.4
Ovary	—	—	—	—	46.9	44.9–48.8
Myeloma	44.0	41.7–46.3	43.2	40.0–46.3	45.0	41.5–48.4
Low survival (<40%)						
Stomach	31.4	29.6–33.2	31.6	29.3–34.0	30.9	28.1–33.7
Brain	29.9†	27.1–30.7	27.0†	24.7–29.4	31.2†	28.5–33.9
Liver	20.4	18.8–22.1	21.1	19.1–23.2	18.7	15.8–21.8
Lung	20.0	19.5–20.6	17.0	16.2–17.8	23.3	22.4–24.2
Esophagus	15.3	13.6–17.1	15.3	13.3–17.4	15.5†	12.1–19.1
Pancreas	9.5	8.6–10.5	9.7	8.3–11.1	9.4	8.1–10.8

CI=Confidence interval
RSR=Relative survival ratio
†The RSR has increased over a prior interval and has been adjusted
Note: Analysis was restricted to people ages 15 to 99.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

Survival by age group

The five-year RSR for all cancers combined decreased with age. For 2009–2013, the five-year RSR was 87.1% for people diagnosed between the ages of 15 and 39 but just 44.7% for those diagnosed between 80 and 99 years of age (Figure 6.1).

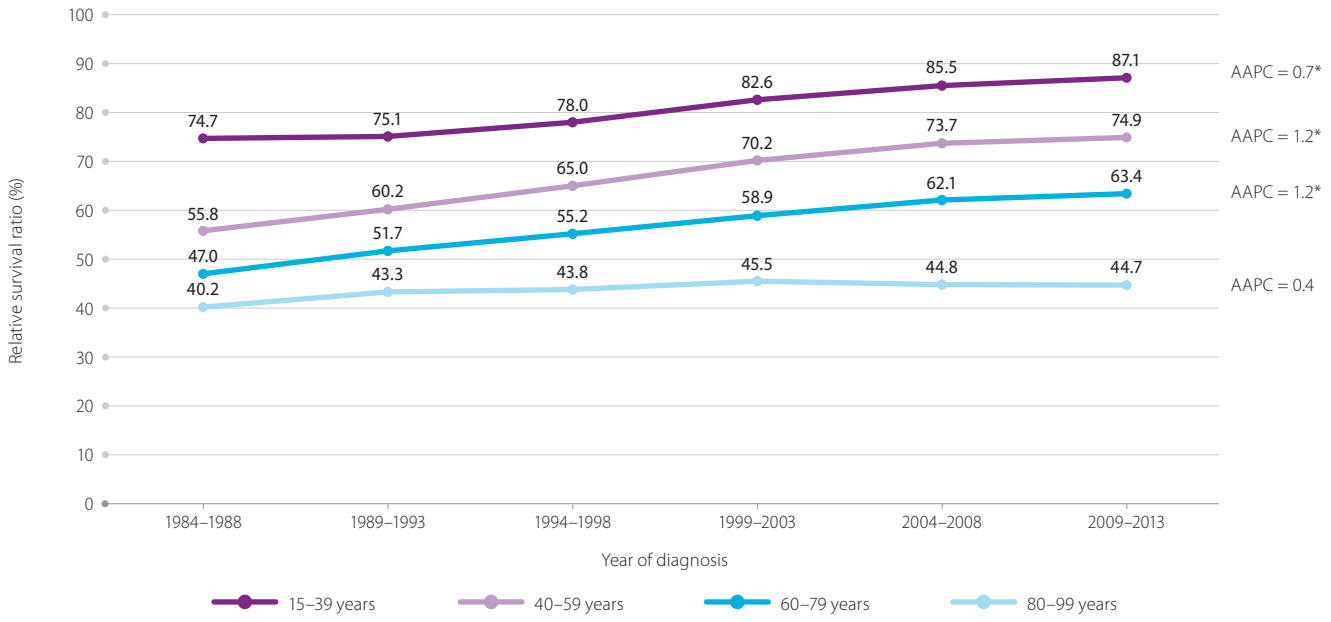
Since the 1984–1988 period, people ages 15 to 79 have seen significant increases in five-year survival, with the greatest increase occurring in the 40 to 59 age group (with an average annual percent change [AAPC] of 1.2%) and the 60 to 79 age group (with an AAPC of 1.2%).

People diagnosed between the ages of 15 and 39 also had a significant increase in survival; however, the increase was approximately half that of the two older age groups (an AAPC of 0.7%). The smaller improvement in survival among people ages 15 to 39 likely reflects the fact that the most common cancers in this age group (e.g., testicular, thyroid) already have high survival, meaning there is less room for improvement.

The increase in survival that did occur in this age group may be partially an artifact of increased early detection. This is evidenced by the increase in incidence that occurred in this age group—especially after 2001 (Figure 4.2).

People diagnosed between the ages of 80 to 99 have seen no significant improvement in five-year survival since the 1984–1988 period. As a result, the gap in survival between this age group and the younger age groups has widened over time. During the 1984–1988 period, those diagnosed between the ages of 60 and 79 had a five-year RSR that was seven percentage points greater than those diagnosed at age 80 or older. By the 2009–2013 period, this disparity had increased to almost 20 percentage points. The greater improvements in survival among people ages 40 to 79 may be the result of greater participation in screening programs (e.g., mammography) by this age group and improved treatments.[16]

Figure 6.1 **Five-year relative survival ratios by age group and time period for all cancers combined, Ontario, 1984–2013**



AAPC=Average annual percent change
*Statistically significant AAPC
Notes: 1. Analysis was restricted to ages 15 to 99.
2. Cohort method was used for time periods 1984–1988 to 2004–2008. Period method was used for the 2009–2013 time period.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

Survival by duration

For 2009–2013, the RSR for all cancers combined was 78.3% after one year, 64.7% after five years, 60.7% after 10 years and 58.4% after 15 years (Figure 6.2). As with most individual cancers, overall cancer survival declined most during the first year after diagnosis, followed by progressively smaller decreases in survival as the time from diagnosis increased.

For the four most common cancers, the following was observed for relative survival by duration:

- For breast cancer, the RSR one year after diagnosis was very high at 97.1%. After five years, the RSR fell by almost 10 percentage points to 88.9%. It then fell by approximately five percentage points between five and 10 years post-diagnosis and by another five percentage points between 10 and 15 years post-diagnosis.
- For colorectal cancer, the RSR one year after diagnosis was 82.5% but fell to 66.8% after five years—a greater decrease than for breast cancer. There was no significant difference between the 10 and 15-year RSR for colorectal cancer.
- The greatest decrease in survival between one and five years post-diagnosis was for lung cancer, which fell from 43.9% to 20.0%. Survival decreased significantly at 10 years (14.9%) and 15 years (12.1%).
- Prostate cancer survival decreased by a small, but significant, amount between one year and five years post-diagnosis, but there was no significant difference between five-year, 10-year and 15-year survival. In fact, the five-year and 10-year RSRs were exactly the same (95.4%). Survival for prostate cancer was so high that the 15-year RSR was higher than the five-year RSR for all major cancer types except testis and thyroid.

People diagnosed with cancer were 64.7% as likely to survive for five years after diagnosis compared to similar people in the general population.

For 2009–2013, the relative survival ratio for all cancers combined was

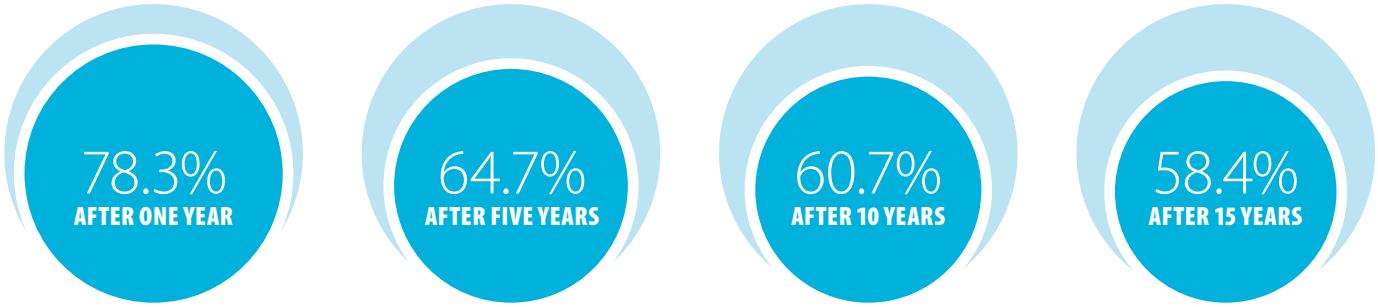
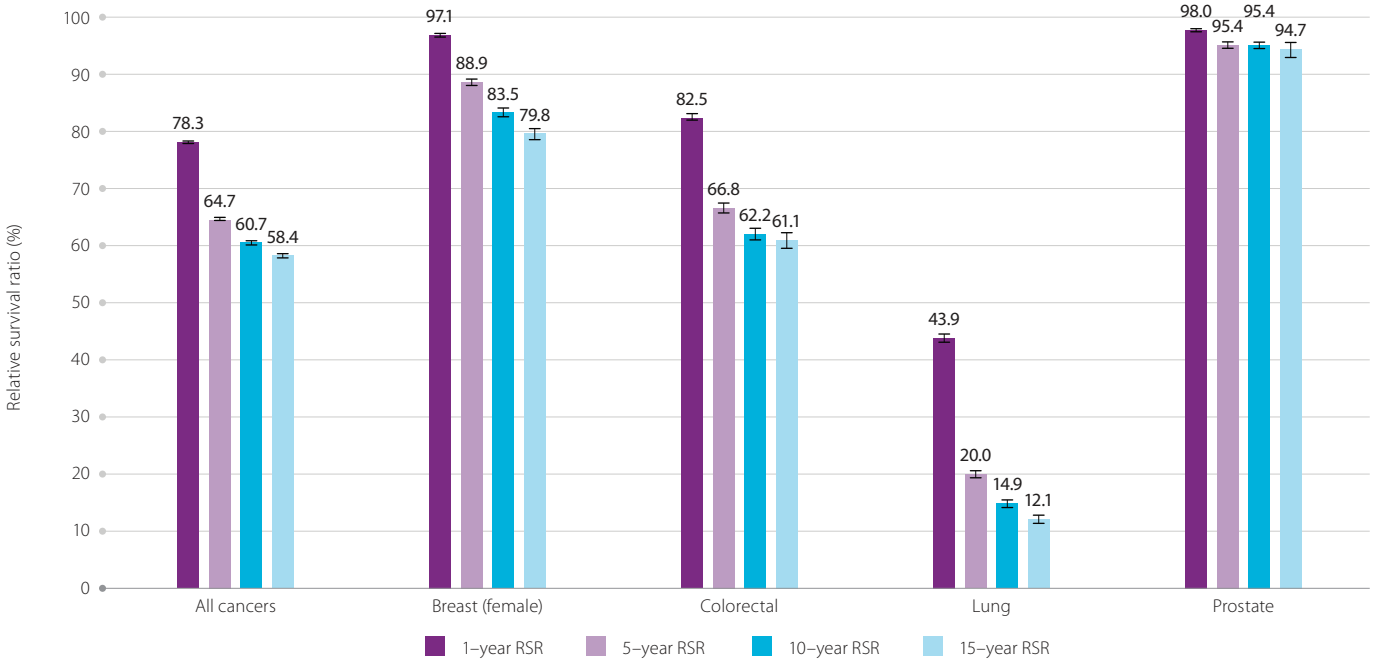


Figure 6.2 **Relative survival ratios by cancer type and survival duration for selected cancers, Ontario, 2009–2013**



RSR=Relative survival ratio
Note: Analysis was restricted to ages 15 to 99.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

Survival by stage

Stage at diagnosis is one of the most important predictors of cancer survival. Population-level stage data in Ontario is available from 2010 onward for the most common cancers (breast, colorectal, lung and prostate) and cervical cancer, and for a limited number of years for thyroid cancer and melanoma. This section focuses on the most common cancers.

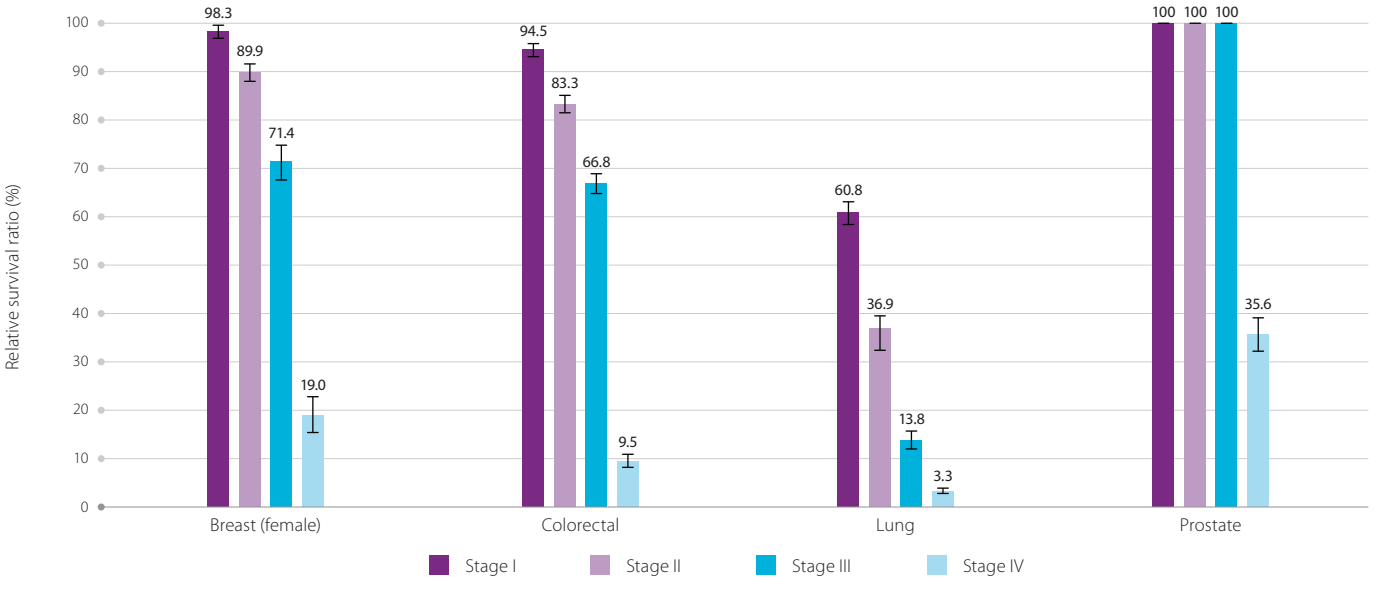
Five year relative survival for 2010–2013 tended to decrease as stage at diagnosis increased; however the level of decrease varied by cancer type (Figure 6.3). Specifically:

- While breast cancer cases diagnosed at stage I had a five-year RSR of 98.3%, the RSR decreased to just 19.0% for cases diagnosed at stage IV. Breast cancer was most commonly diagnosed at stage I in 2013 while only 5.3% of cases were diagnosed at stage IV (see *Chapter 4: Cancer incidence rates and trends*).
- Colorectal cancer cases diagnosed at stage I had a five-year RSR of 94.5%, which declined to 83.3% for cases diagnosed at stage II, 66.8% at stage III and just 9.5% at stage IV. A considerable amount of colorectal cases were stage IV cancers, with 19.1% of cases diagnosed at this stage.

Five year relative survival for 2010–2013 tended to decrease as stage at diagnosis increased; however the level of decrease varied by cancer type.

- Of the four most common cancers, lung cancer had the lowest survival at every stage. Even at stage I, five-year survival was just 60.8%, declining to 3.3% at stage IV. This low RSR is particularly concerning because 51.6% of lung cases were diagnosed at stage IV in 2013.
- Stage at diagnosis had the least effect on prostate cancer. Five-year survival for stages I to III was 100%; however, survival dipped to 35.6% for cases diagnosed at stage IV—which accounted for 10.8% of prostate cases in 2013.

Figure 6.3 **Five-year relative survival ratios by cancer type and stage at diagnosis for selected cancers, Ontario, 2010–2013**



Notes: 1. Analysis was restricted to ages 15 to 99.
2. Case counts are as follows: breast n = 27,310 (excludes unknown stage = 206); colorectal n = 24,614 (excludes unknown stage = 824); lung n = 28,173 (excludes unknown stage = 232); prostate n = 26,078 (excludes unknown stage = 162). Cases that were not staged were excluded from this analysis.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

Conditional survival

Relative survival ratios represent the likelihood of surviving a specific number of years after diagnosis. However, sometimes it may be useful to measure survival starting at a point in time other than the date of diagnosis. Because most mortality occurs in the first year following diagnosis, survival after the first year may be very different from survival measured at diagnosis. Table 6.2 presents five-year RSRs conditional on surviving zero (the equivalent of non-conditional survival), one, two, three and four years after diagnosis.

The following was observed:

- While the five-year RSR measured from diagnosis for all cancers combined for 2009–2013 was 64.7%, the RSR increased to 82.7% for those who survived the first year after diagnosis. The five-year RSR increased for each year survived until four years after diagnosis, when the RSR was 97.7%.
- Because most mortality occurs in the first year following diagnosis, the one-year conditional RSR showed the greatest increases over the non-conditional RSR (zero survived years) for all cancers. The lower survival cancers (e.g., pancreas, esophagus, lung) showed the greatest increases in one-year conditional survival over non-conditional survival. While the five-year RSR for pancreatic cancer was only 9.5% at diagnosis, it increased to 34.7% for those who survived one year.
- The high survival cancers (e.g., thyroid, testis, prostate) showed the smallest improvements in one year conditional RSRs because there was less room for improvement. For these high-survival cancers, the one-year conditional RSR tended to not be significantly higher than the non-conditional RSR.

Five-year conditional relative survival ratios for all cancers combined

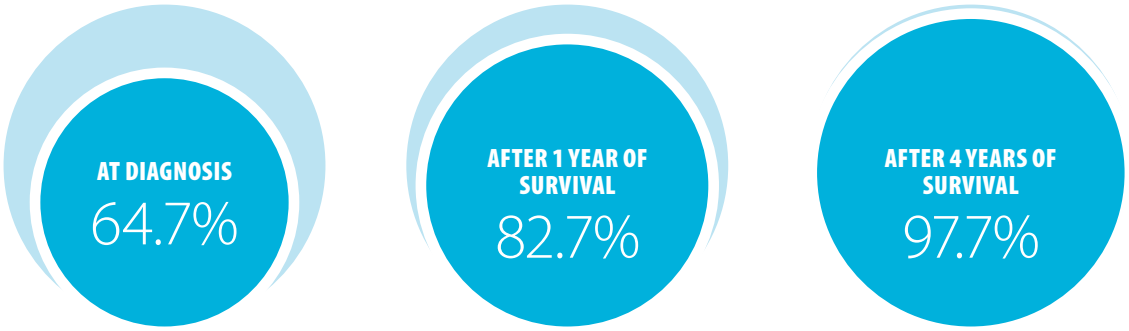


Table 6.2 Conditional five-year relative survival ratios by cancer type and years survived, Ontario, 2009–2013

Cancer type	Survived years				
	0† RSR % (95% CI)	1 RSR % (95% CI)	2 RSR % (95% CI)	3 RSR % (95% CI)	4 RSR % (95% CI)
All cancers	**64.7 (64.4–64.9)**	**82.7 (82.5–83.0)**	**90.2 (89.9–90.4)**	**94.5 (94.3–94.7)**	**97.7 (97.6–97.8)**
Bladder	64.2 (62.5–65.8)	78.1 (76.3–79.8)	87.1 (85.5–88.6)	92.4 (90.9–93.6)	96.5 (95.3–97.4)
Brain	29.9 (27.1–30.7)	54.6 (51.9–57.2)	76.9 (74.0–79.4)	87.3 (84.9–89.4)	95.5 (93.8–96.8)
Breast (female)	88.9 (88.3–89.4)	91.5 (91.0–92.0)	93.6 (93.1–94.1)	95.8 (95.3–96.1)	98.2 (97.9–98.5)
Cervix	73.2 (70.7–75.5)	84.1 (81.8–86.1)	90.2 (88.2–91.9)	94.4 (92.6–95.7)	97.2 (95.8–98.2)
Colorectal	66.7 (65.9–67.5)	80.6 (79.8–81.4)	87.6 (86.8–88.3)	93.2 (92.6–93.8)	97.0 (96.5–97.4)
Esophagus	15.3 (13.6–17.1)	36.1 (32.4–39.8)	59.3 (54.1–64.2)	77.6 (72.0–82.2)	92.0 (87.0–95.2)
Hodgkin lymphoma	86.9 (84.4–89.1)	92.3 (90.0–94.1)	94.0 (92.9–96.4)	96.3 (94.5–97.6)	98.3 (98.8–99.1)
Kidney	74.3 (72.8–75.8)	87.3 (85.8–88.6)	92.4 (91.1–93.5)	95.2 (94.0–96.1)	97.7 (96.8–98.3)
Larynx	59.9 (56.2–63.3)	72.5 (68.8–75.9)	82.1 (78.3–85.2)	89.0 (85.6–91.6)	95.4 (92.7–97.1)
Leukemia	58.1 (56.5–59.6)	80.5 (78.9–82.0)	88.3 (86.8–89.6)	92.5 (91.2–93.7)	95.9 (94.8–96.7)
Liver	20.4 (18.8–22.1)	48.5 (45.0–51.8)	66.1 (62.1–69.8)	80.0 (76.0–83.4)	90.3 (86.9–92.8)
Lung	20.0 (19.5–20.6)	45.6 (44.5–46.8)	64.7 (63.2–66.0)	79.8 (78.4–81.2)	90.3 (89.1–91.3)
Melanoma	86.6 (85.4–87.7)	90.9 (89.8–91.9)	93.9 (92.9–94.8)	96.3 (95.5–97.1)	98.9 (98.1–99.2)
Myeloma	44.0 (41.7–46.3)	58.8 (55.9–61.5)	68.0 (64.9–70.8)	76.7 (73.6–79.4)	88.0 (85.4–90.2)
Non-Hodgkin lymphoma	68.9 (67.7–70.1)	85.0 (83.8–86.2)	90.3 (89.2–91.3)	93.3 (92.3–94.2)	97.0 (96.2–97.6)
Oral cavity & pharynx	62.0 (60.3–63.7)	75.5 (73.9–77.3)	85.8 (84.2–87.3)	92.7 (91.2–93.9)	96.7 (95.6–97.5)
Ovary	46.9 (44.9–48.8)	62.6 (60.4–64.8)	74.7 (72.4–76.8)	85.5 (83.4–87.3)	94.2 (92.7–95.5)
Pancreas	9.5 (8.6–10.5)	34.7 (31.6–37.8)	62.9 (58.3–67.1)	79.1 (74.4–83.0)	92.2 (88.3–94.9)
Prostate	95.4 (94.8–95.9)	97.3 (96.8–97.8)	98.8 (98.3–99.1)	99.4 (99.0–99.6)	99.8 (99.5–99.9)
Stomach	31.4 (29.6–33.2)	58.8 (56.0–61.5)	77.4 (74.3–80.1)	87.9 (85.0–90.3)	94.7 (92.3–96.3)
Testis	97.0 (95.5–98.1)	98.6 (97.2–99.3)	99.5 (98.0–99.9)	99.7 (98.1–100.0)	99.9 (98.2–100.0)
Thyroid	98.8 (98.3–99.2)	99.6 (99.0–99.8)	99.8 (99.2–99.9)	99.8 (99.4–100.0)	100
Uterus	83.2 (82.0–84.4)	89.4 (88.3–90.5)	94.4 (93.4–95.2)	97.0 (96.1–97.7)	98.7 (98.0–99.2)

CI=Confidence interval
RSR=Relative survival ratio
†Zero years survived is the equivalent of non-conditional survival
Note: Analysis was restricted to ages 15 to 99.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

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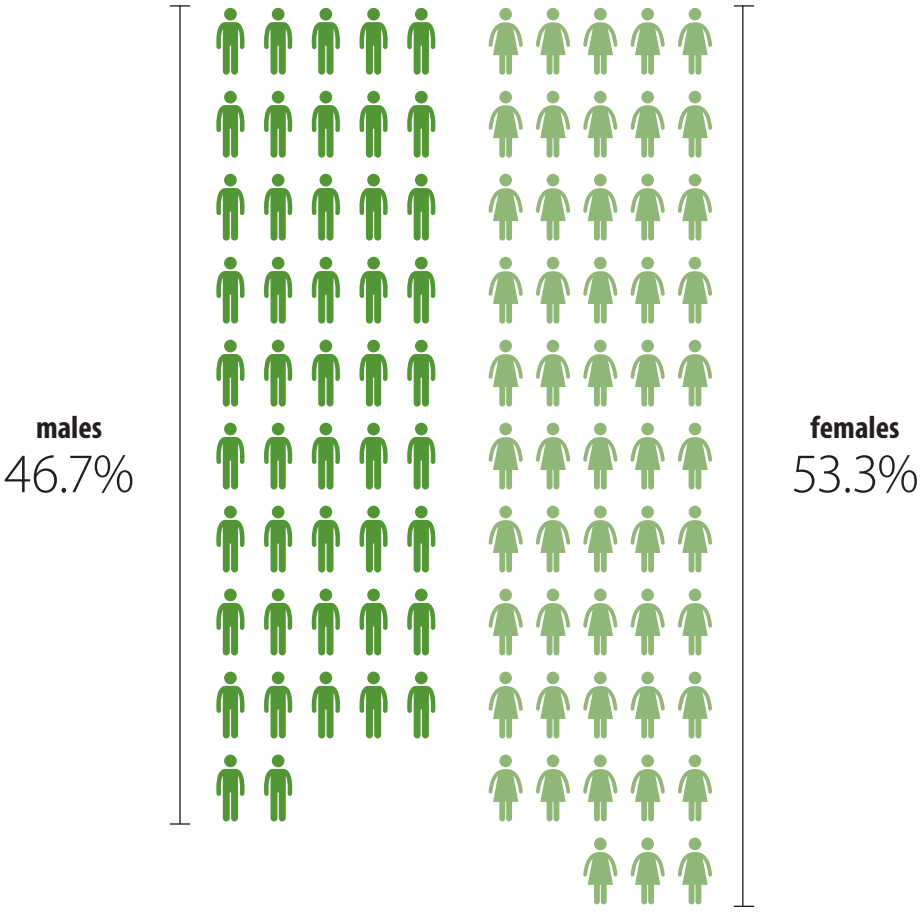
Chapter 7

Cancer prevalence

Prevalence measures the number of people diagnosed with cancer who are still alive. This chapter presents current and historical statistics on cancer prevalence in Ontario.

Living with cancer

"In Ontario, 585,016 people are living with a diagnosis of cancer in the past 30 years, 311,759 females and 273,257 males."



There are currently more people living with a diagnosis of cancer in Ontario than there were 20 years ago. Cancer prevalence—the number of people previously diagnosed with a malignant cancer who are alive at a given point in time—is a function of the incidence of and survival from cancer. As both incidence and survival rates have been increasing in Ontario, prevalence over time has also been increasing.

Trends in cancer prevalence reflect the increase, decrease or stability of cancer incidence and mortality rates in the population. As a result, they can be used to help determine the allocation of diagnostic, treatment and care resources.[1]

This chapter presents limited-duration, person-based prevalence counts. Limited-duration cancer prevalence describes the number of people alive on a certain date (i.e., the index date) who were diagnosed with cancer within a specified previous number of years (e.g., two years, five years, 10 years, 30 years). This report uses an index date of January 1, 2014.

Cancer cases diagnosed in the previous 10 years represent the greatest impact on the healthcare system. In the first two years after diagnosis, healthcare services used would likely include primary treatment; during the next three years, they would include close clinical assessment for recurrence; and in the next five years, they would consist mainly of follow-up.

Prevalence by cancer type and sex

At the index date of January 1, 2014, an estimated 370,713 people living in Ontario had been diagnosed with cancer in the previous 10 years (i.e., since 2003) (Table 7.1). Of those diagnosed during the past 30 years, it is estimated that more than half a million people (585,016) were still alive at the end of 2013. Of these Ontarians, 51.0% of 10-year prevalent cases and 53.3% of 30-year prevalent cases were female even though cancer incidence rates were higher among males (see *Chapter 1: Estimated current cancer incidence in Ontario* and *Chapter 4: Cancer incidence rates and trends*). This largely reflects the higher prevalence of thyroid and lung cancers in female survivors due to greater incidence (for thyroid) and survival (for lung) of these cancers in females compared to males.

Prostate cancer was the largest contributor to 10-year prevalence, accounting for 75,610 prevalent cases (Figure 7.1). This reflects the high incidence and survival of prostate cancer. Female breast (69,412) and colorectal (45,346) cancers were the next most prevalent types. Lung cancer, despite being the third most commonly diagnosed cancer, only ranked sixth in prevalence; it was superseded by higher-survival thyroid cancer and melanoma.

Slightly different patterns were observed in 30-year prevalence. Breast cancer was the leading contributor to 30-year prevalence, accounting for 121,658 cases, followed by prostate (111,759) and colorectal (69,966) cancers. In the context of 30-year prevalence, lung cancer fell even further down the rankings, with other cancers (non-Hodgkin lymphoma and uterine cancer) being more prevalent despite the higher incidence of lung cancer.

Number of 10-year prevalent cases for selected cancers, 2013

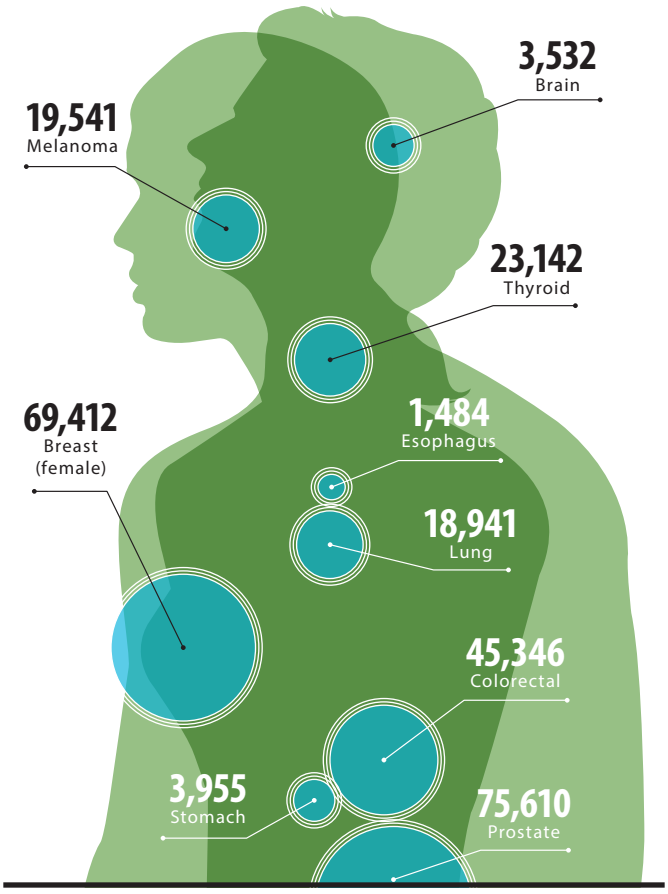
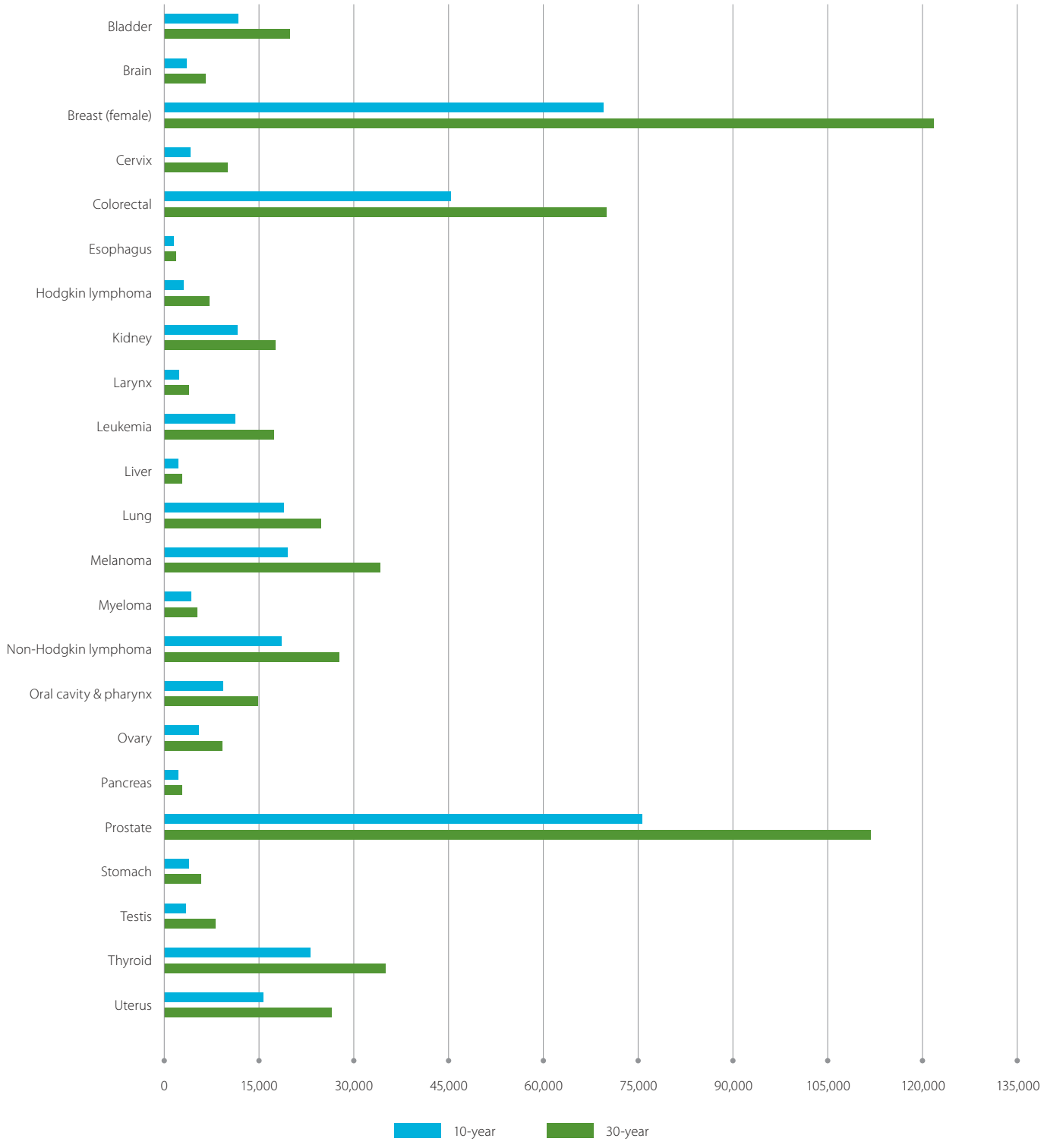


Figure 7.1 **Limited duration prevalence by cancer type, Ontario, 2013**



Note: Prevalence counts are based on IARC/IACR rules for counting multiple primaries.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

The leading 10-year prevalent cancers among males were prostate (75,610) and colorectal (24,594) cancers and melanoma (9,945). For females, the leading prevalent cancers were breast (69,412), colorectal (20,752) and thyroid (18,302) cancers (Table 7.1). Other notable differences in 10-year prevalence between the sexes include the following:

- Bladder cancer accounted for 8,996 prevalent cases among males but only 2,735 cases among females. The higher prevalence of this type of cancer in males is partly due to the higher incidence rate in males. Bladder cancer survival is also higher in males compared to females.
- The prevalence of head and neck cancers was higher among males than females. Oral cavity & pharynx cancer accounted for 6,229 prevalent cases among males compared to 3,124 among females, while there were 1,963 prevalent cases of laryngeal cancer among males and just 366 among females. Like bladder cancer, the incidence of oral cavity and laryngeal cancers was higher among males.
- Conversely, thyroid cancer was more prevalent among females (18,302) than males (4,840) due to higher incidence and survival among females.
- Lung cancer was the only other cancer more prevalent among females. This reflects higher survival from lung cancer in females and the decreasing incidence rate among males over the past decade.

Similar differences between the sexes were seen in 30-year prevalence, with the exception that pancreatic cancer and melanoma were also higher in females than males.

Cervical cancer, Hodgkin lymphoma and testicular cancer had the greatest relative increases in prevalence between 10-year and 30-year durations (Figure 7.1). Myeloma, liver and esophageal cancers showed the smallest relative increases. Further:

- Among males, Hodgkin lymphoma, testicular and brain cancers showed the greatest increases.
- Among females, Hodgkin lymphoma, cervical and brain cancers showed the greatest increases.

The leading 10-year prevalent cancers among males were:

The leading 10-year prevalent cancers among females were:

Table 7.1 Limited duration prevalence by cancer type and sex, Ontario, 2013

Cancer type	Both Sexes		Males		Females	
	10-year	30-year	10-year	30-year	10-year	30-year
All cancers	**370,713**	**585,016**	**181,515**	**273,257**	**189,198**	**311,759**
Bladder	11,731	19,843	8,996	14,869	2,735	4,974
Brain	3,532	6,540	1,881	3,402	1,651	3,138
Breast (female)	69,412	121,658	—	—	69,412	121,658
Cervix	4,114	9,990	—	—	4,114	9,900
Colorectal	45,346	69,966	24,594	36,780	20,752	33,186
Esophagus	1,484	1,901	1,115	1,380	369	521
Hodgkin lymphoma	3,013	7,198	1,588	3,768	1,425	3,430
Kidney	11,530	17,635	7,116	10,506	4,414	7,129
Larynx	2,329	3,930	1,963	3,283	366	647
Leukemia	11,194	17,299	6,444	9,836	4,750	7,463
Liver	2,273	2,865	1,659	2,083	614	782
Lung	18,941	24,839	8,649	11,611	10,292	13,228
Melanoma	19,541	34,165	9,945	16,540	9,596	17,625
Myeloma	4,257	5,264	2,370	2,877	1,887	2,387
Non-Hodgkin lymphoma	18,592	27,709	9,841	14,450	8,751	13,259
Oral cavity & pharynx	9,353	14,822	6,229	9,682	3,124	5,140
Ovary	5,462	9,166	—	—	5,462	9,166
Pancreas	2,172	2,802	1,094	1,370	1,078	1,432
Prostate	75,610	111,759	75,610	111,759	—	—
Stomach	3,955	5,839	2,420	3,502	1,535	2,337
Testis	3,450	8,095	3,450	8,095	—	—
Thyroid	23,142	34,994	4,840	7,138	18,302	27,856
Uterus	15,630	26,437	—	—	15,630	26,437

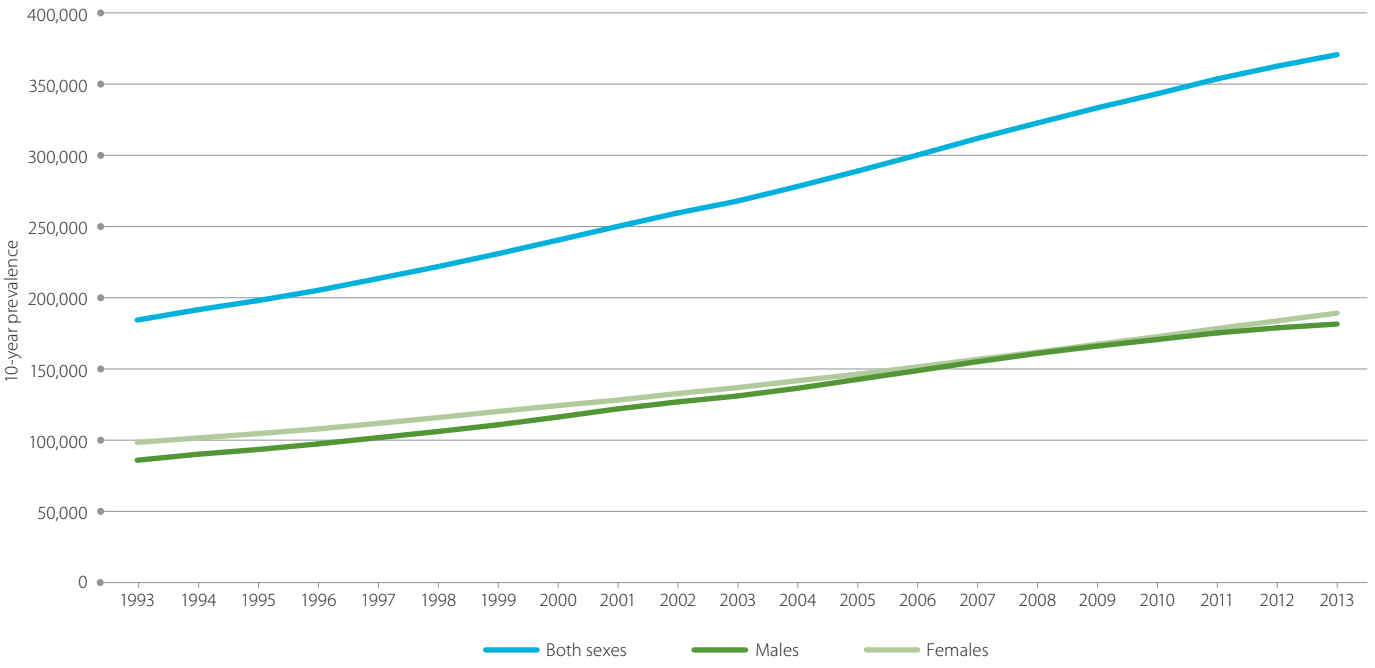
Note: Prevalence counts are based on IARC/IACR rules for counting multiple primaries.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

Prevalence over time

The 10-year prevalence of cancer has been increasing over time. At the end of 1993, there were 184,309 people alive who had been diagnosed with cancer in the previous 10 years. By the end of 2013 this number had more than doubled to 370,713 (Table 7.2). The increase was greater for males (111.4%) than females (92.2%). While prevalence was higher in females than males during every year from 1993 to 2013, the difference between the sexes narrowed from 2007 to 2009 and then expanded again (Figure 7.2).

At the end of 1993, there were 184,309 people alive who had been diagnosed with cancer in the previous 10 years. By the end of 2013 this number had more than doubled to 370,713.

Figure 7.2 **10-year prevalence by sex for all cancers combined, Ontario, 1993–2013**



Note: Prevalence counts are based on IARC/IACR rules for counting multiple primaries.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

With the exception of laryngeal cancer, the prevalence of all cancer types increased each decade between 1993, 2003 and 2013 (Table 7.2). Laryngeal cancer prevalence decreased from 1993 to 2003 from 2,427 cases to 2,272 cases but increased to 2,329 cases in 2013. Among females, however, the number of prevalent cases of laryngeal cancer decreased from 2003 to 2013 as well. This decrease in laryngeal cancer prevalence may be a reflection of decreasing incidence rates (as a result of declines in tobacco use[2]) and decreasing survival.[3]

The greatest relative increases in prevalence from 1993 to 2003 were in:

- liver cancer, which increased from 363 to 1,026 people;
- thyroid cancer, which increased from 4,054 to 9,405 people; and
- prostate cancer, which increased from 25,213 to 53,371 people.

The greatest relative increases in prevalence from 2003 to 2013 were in:

- thyroid cancer, which increased from 9,405 to 23,142 people;
- liver cancer, which increased from 1,026 to 2,273 people; and
- kidney cancer, which increased from 6,890 to 11,530 people.

The smallest relative increases in prevalence over time were in cervical and bladder cancers.

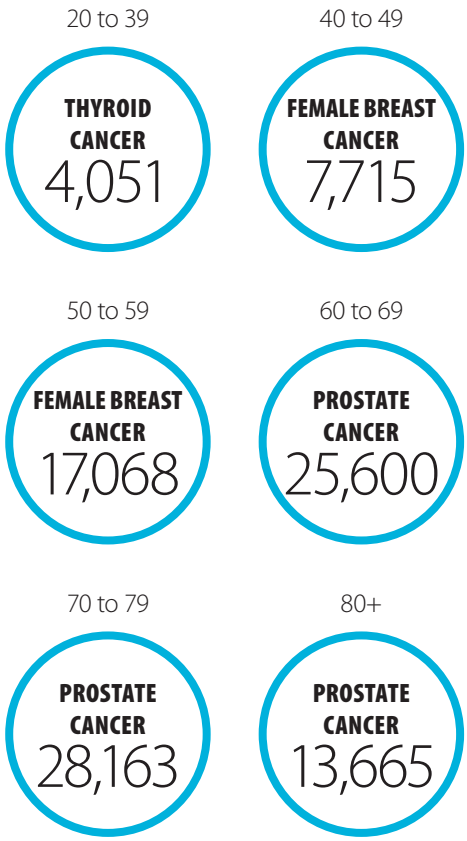
Table 7.2 10-year prevalence by cancer type, time period and sex, Ontario, 1993, 2003 and 2013

Cancer type	Both Sexes			Males			Females		
	1993	2003	2013	1993	2003	2013	1993	2003	2013
All cancers	**184,309**	**267,842**	**370,713**	**85,880**	**130,984**	**181,515**	**98,429**	**136,858**	**189,198**
Bladder	10,146	10,663	11,731	7,545	7,947	8,996	2,601	2,716	2,735
Brain	2,348	3,125	3,532	1,238	1,650	1,881	1,110	1,475	1,651
Breast (female)	37,384	54,354	69,412	—	—	—	37,384	54,354	69,412
Cervix	3,908	4,066	4,114	—	—	—	3,908	4,066	4,114
Colorectal	24,999	33,430	45,346	12,664	17,532	24,594	12,335	15,898	20,752
Esophagus	689	1,019	1,484	446	713	1,115	243	306	369
Hodgkin lymphoma	2,385	2,785	3,013	1,280	1,514	1,588	1,105	1,271	1,425
Kidney	4,581	6,890	11,530	2,702	4,050	7,116	1,879	2,840	4,414
Larynx	2,427	2,272	2,329	2,002	1,888	1,963	425	384	366
Leukemia	5,272	7,419	11,194	2,991	4,286	6,444	2,281	3,133	4,750
Liver	363	1,026	2,273	251	744	1,659	112	282	614
Lung	11,058	13,454	18,941	6,626	6,918	8,649	4,432	6,536	10,292
Melanoma	8,989	12,525	19,541	4,286	6,284	9,945	4,703	6,241	9,596
Myeloma	1,840	2,653	4,257	935	1,400	2,370	905	1,253	1,887
Non-Hodgkin lymphoma	7,218	11,287	18,592	3,755	5,755	9,841	3,463	5,532	8,751
Oral cavity & pharynx	5,996	6,696	9,353	3,986	4,368	6,229	2,010	2,328	3,124
Ovary	3,029	4,416	5,462	—	—	—	3,029	4,416	5,462
Pancreas	959	1,301	2,172	456	648	1,094	503	653	1,078
Prostate	25,213	53,371	75,610	25,213	53,371	75,610	—	—	—
Stomach	2,262	2,797	3,955	1,386	1,670	2,420	876	1,127	1,535
Testis	2,212	2,858	3,450	2,212	2,858	3,450	—	—	—
Thyroid	4,054	9,405	23,142	906	1,943	4,840	3,148	7,462	18,302
Uterus	8,049	10,017	15,630	—	—	—	8,049	10,017	15,630

Note: Prevalence counts are based on IARC/IACR rules for counting multiple primaries.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

Over time, disparities in prevalence between the sexes have also changed by cancer type. The disparity between male and female prevalence increased over time for bladder, brain, colorectal, esophageal, kidney, liver, oral cavity & pharynx and stomach cancers as well as for leukemia and myeloma. Similarly, while the prevalence of thyroid cancer was higher in females, the disparity also increased over time.

Most prevalent cancer in each age group



Prevalence by age group

The majority (68.6%) of prevalent cancers in 2013 were in people ages 60 or older. The age group with the highest prevalence count was the 60 to 69 age group (Table 7.3). This pattern was also true for females; among males, the 70 to 79 age group had the highest prevalence.

Prevalence among younger people was more common in females than males. While 6,661 cases were in males ages 20 to 39, 10,681 cases were in females of the same age. This is likely the result of the higher incidence in females of cancers more common at younger ages (e.g., thyroid and breast cancers, melanoma).

The most prevalent cancers varied by age group:

- For the 20 to 39 age group, the most prevalent cancer was thyroid cancer (4,051) followed by testicular (1,781) and breast (1,608) cancers.
- For the 40 to 49 age group, the most prevalent cancer was breast cancer (7,715), followed by thyroid cancer (5,455) and melanoma (2,207).
- For the 50 to 59 age group, the most prevalent cancer was breast cancer (17,068) followed by prostate (7,671) and colorectal (6,282) cancers.
- For the 60 to 69 age group, the most prevalent cancer was prostate cancer (25,600) followed by breast (18,860) and colorectal (11,206) cancers.
- For the 70 to 79 age group, the most prevalent cancer was prostate cancer (28,163) followed by breast (14,396) and colorectal (13,113) cancers.
- For those 80 or older, the most prevalent cancer was prostate cancer (13,665) followed by colorectal (12,083) and breast (9,759) cancers.

Table 7.3 10-year prevalence by cancer type and age group, Ontario, 2013

Both sexes							
	Age group (years)						
Cancer type	All ages	20–39	40–49	50–59	60–69	70–79	80+
All cancers	**370,713**	**17,342**	**29,656**	**66,114**	**99,735**	**92,668**	**61,832**
Bladder	11,731	67	246	1,053	2,636	3,849	3,871
Brain	3,532	758	552	658	535	290	131
Breast (female)	69,412	1,608	7,715	17,068	18,860	14,396	9,759
Cervix	4,114	835	1,265	963	600	300	149
Colorectal	45,346	670	1,958	6,282	11,206	13,113	12,083
Esophagus	1,484	10	53	280	456	415	269
Hodgkin lymphoma	3,013	1,375	497	390	264	189	84
Kidney	11,530	307	1,003	2,504	3,357	2,667	1,537
Larynx	2,329	20	68	371	714	714	442
Leukemia	11,194	689	734	1,608	2,521	2,475	2,061
Liver	2,273	49	103	512	729	574	258
Lung	18,941	148	458	2,470	5,377	6,493	3,975
Melanoma	19,541	1,564	2,207	3,872	4,508	3,905	3,448
Myeloma	4,257	28	207	630	1,161	1,298	932
Non-Hodgkin lymphoma	18,592	1,057	1,526	3,280	4,678	4,491	3,329
Oral cavity & pharynx	9,353	363	803	2,279	2,822	1,843	1,215
Ovary	5,462	414	724	1,410	1,358	998	515
Pancreas	2,172	71	144	413	671	561	307
Prostate	75,610	7	498	7,671	25,600	28,163	13,665
Stomach	3,955	78	245	623	960	1,139	908
Testis	3,450	1,781	947	475	128	34	23
Thyroid	23,142	4,051	5,455	6,122	4,405	2,228	777
Uterus	15,630	181	905	3,338	5,760	3,624	1,818

Table 7.3 *(Cont'd)* **10-year prevalence by cancer type and age group, Ontario, 2013**

Males							
	Age group (years)						
Cancer type	All ages	20–39	40–49	50–59	60–69	70–79	80+
All cancers	**181,515**	**6,661**	**9,011**	**25,803**	**52,337**	**53,804**	**32,095**
Bladder	8,996	47	175	834	2,031	3,008	2,896
Brain	1,881	410	322	336	287	145	56
Colorectal	24,594	339	1,007	3,363	6,642	7,587	5,643
Esophagus	1,115	**	**	217	359	306	185
Hodgkin lymphoma	1,588	671	259	254	142	99	29
Kidney	7,116	156	645	1,615	2,139	1,655	841
Larynx	1,963	7	55	315	618	600	368
Leukemia	6,444	383	408	961	1,550	1,476	1,054
Liver	1,659	27	62	396	557	411	172
Lung	8,649	69	188	968	2,403	3,119	1,892
Melanoma	9,945	550	905	1,771	2,442	2,357	1,902
Myeloma	2,370	14	119	356	665	738	478
Non-Hodgkin lymphoma	9,841	584	877	1,821	2,486	2,335	1,577
Oral cavity & pharynx	6,229	201	519	1,615	1,998	1,196	690
Pancreas	1,094	33	72	212	355	280	141
Prostate	75,610	7	498	7,671	25,600	28,163	13,665
Stomach	2,420	31	141	368	609	724	547
Testis	3,450	1,781	947	475	128	34	23
Thyroid	4,840	713	1,003	1,191	1,091	606	206

Table 7.3 *(Cont'd)* **10-year prevalence by cancer type and age group, Ontario, 2013**

Females							
	Age group (years)						
Cancer type	All ages	20–39	40–49	50–59	60–69	70–79	80+
All cancers	**189,198**	**10,681**	**20,645**	**40,311**	**47,398**	**38,864**	**29,737**
Bladder	2,735	20	71	219	605	841	975
Brain	1,651	348	230	322	248	145	75
Breast (female)	69,412	1,608	7,715	17,068	18,860	14,396	9,759
Cervix	4,114	835	1,265	963	600	300	149
Colorectal	20,752	331	951	2,919	4,564	5,526	6,440
Esophagus	369	**	**	63	97	109	84
Hodgkin lymphoma	1,425	704	238	136	122	90	55
Kidney	4,414	151	358	889	1,218	1,012	696
Larynx	366	13	13	56	96	114	74
Leukemia	4,750	306	326	647	971	999	1,007
Liver	614	22	41	116	172	163	86
Lung	10,292	79	270	1,502	2,974	3,374	2,083
Melanoma	9,596	1,014	1,302	2,101	2,066	1,548	1,546
Myeloma	1,887	14	88	274	496	560	454
Non-Hodgkin lymphoma	8,751	473	649	1,459	2,192	2,156	1,752
Oral cavity & pharynx	3,124	162	284	664	824	647	525
Ovary	5,462	414	724	1,410	1,358	998	515
Pancreas	1,078	38	72	201	316	281	166
Stomach	1,535	47	104	255	351	415	361
Thyroid	18,302	3,338	4,452	4,931	3,314	1,622	571
Uterus	15,630	181	905	3,338	5,760	3,624	1,818

**Suppressed due to small cell count (n<6)
Notes: 1. Prevalence counts are based on IARC/IACR rules for counting multiple primaries.
2. "All ages" includes cases with unknown age.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

References

1. Micheli A, Mugno E, Krogh V, Quinn MJ, Coleman M, Hakulinen T, et al. Cancer prevalence in European registry areas. Ann Oncol. 2002;13(6):840-65.
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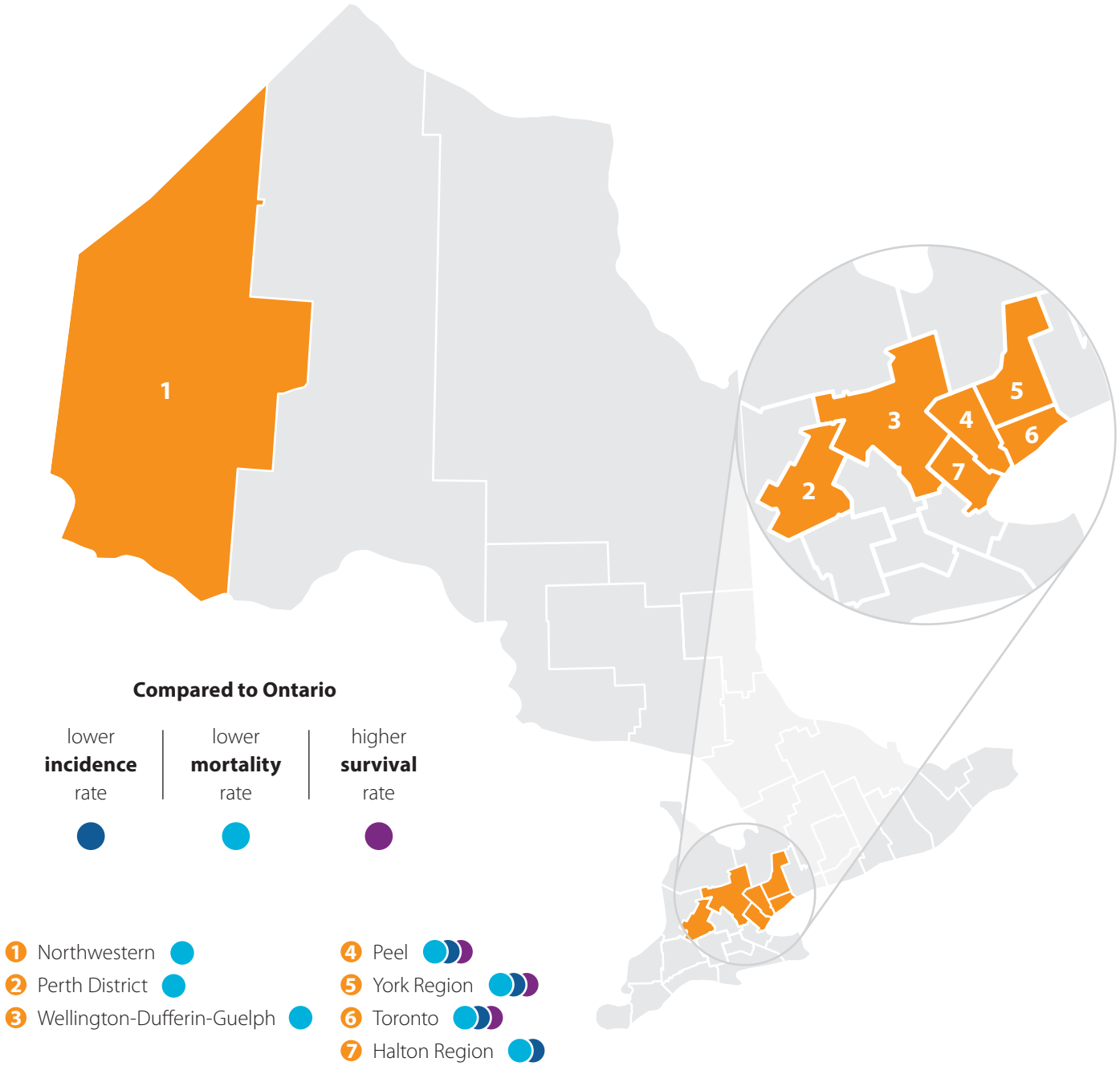
Chapter 8

Cancer statistics by public health unit

Cancer statistics can vary across geography due to variations in risk factors, demographics and medical services. This chapter presents statistics on cancer incidence, mortality and survival by public health unit.

Indicators across the province

"Cancer incidence, mortality and survival vary by public health unit (PHU) in Ontario."



The provision of health services in Ontario is delivered through different geographic regions including public health units (PHUs). A PHU is an official health agency established to administer health promotion and disease prevention programs. Ontario is currently divided into 36 PHUs.

Examining cancer statistics by geographic variation can be helpful for identifying health equity issues and healthcare needs. Geographic factors that can affect incidence, mortality and survival include:

- variation in risk factors;
- variation in demographic makeup; and
- regional differences in diagnostics, treatment practices and access to diagnosis and treatment facilities.

Examining cancer statistics by geographic variation can be helpful for identifying health equity issues and healthcare needs.

Incidence by public health unit and sex

Cancer incidence varied considerably by PHU. This section presents incidence rates by PHU and sex for all cancers combined.

The highest age-standardized incidence rates (ASIR) in 2013 were found in the Algoma Health Unit (842.2 per 100,000 for males, 680.5 per 100,000 for females). The lowest rates tended to be found in Toronto and the surrounding areas.

There was an increasing west-to-east gradient in male ASIR across northern Ontario (Figure 8.1 and Table DA.1 in the Data appendix). For southern Ontario, no significant ASIR pattern was observed. Lower incidence rates in the western part of Ontario may be caused by people in these areas traveling to Manitoba for healthcare due to geographical convenience, and therefore not being captured in the Ontario registry.

The same west-to-east gradient in northern Ontario that was seen in the male rates was also present in the female rates (Figure 8.2 and Table DA.2 in the *Data appendix*).

Males

PHUs with an ASIR significantly higher than Ontario

- Algoma
- Durham Region
- Hamilton
- Hastings and Prince Edward Counties
- Haldimand-Norfolk
- Huron County
- Niagara Region
- Simcoe Muskoka District
- Sudbury and District
- Timiskaming
- Windsor-Essex County

PHUs with an ASIR significantly lower than Ontario

- Halton Region
- Northwestern
- Perth District
- Peel
- Toronto
- Wellington-Dufferin-Guelph
- York Region

Females

PHUs with an ASIR significantly higher than Ontario

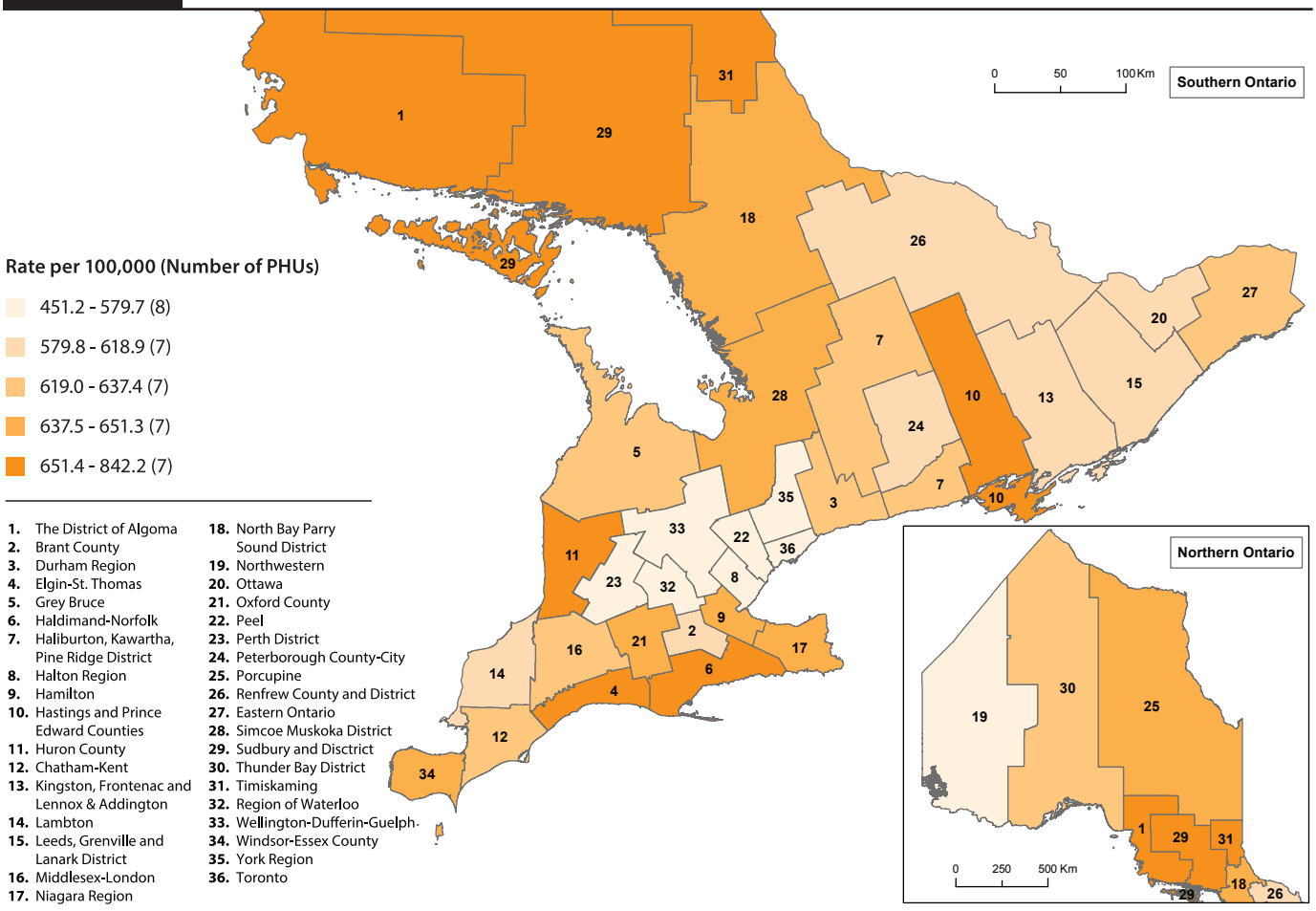
- Algoma
- Eastern Ontario
- Leeds, Grenville and Lanark District
- Simcoe Muskoka District
- Sudbury and District

PHUs with an ASIR significantly lower than Ontario

- Northwestern
- Peel
- York Region

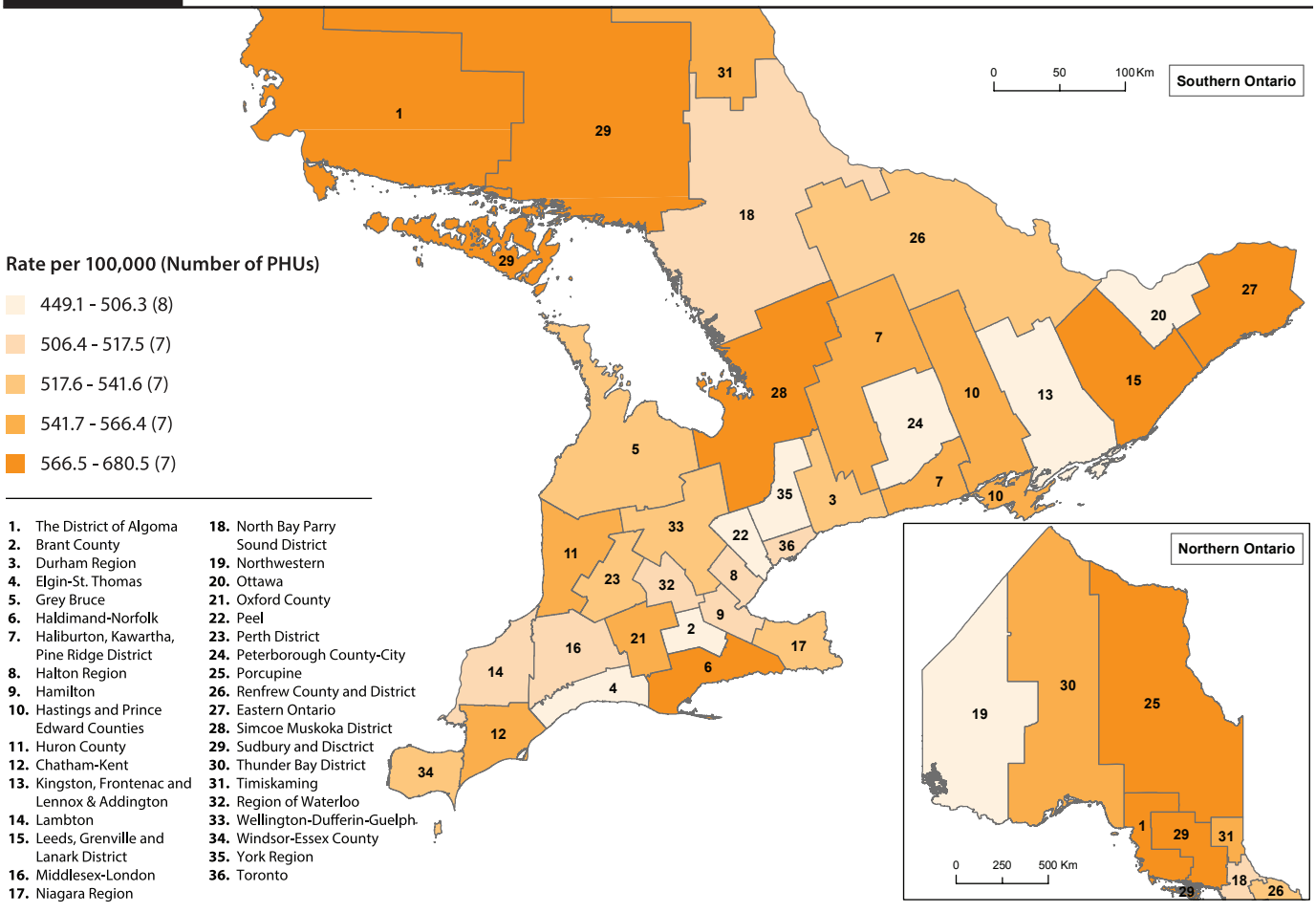
The same west-to-east gradient in northern Ontario that was seen in the male rates was also present in the female rates.

Figure 8.1 **Age-standardized incidence rates by public health unit for males and all cancers combined, Ontario, 2013**



PHU=Public health unit
Note: Rates are per 100,000 and age-standardized to the 2011 Canadian population.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

Figure 8.2 Age-standardized incidence rates by public health unit for females and all cancers combined, Ontario, 2013



PHU=Public health unit
Note: Rates are per 100,000 and age-standardized to the 2011 Canadian population.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

Incidence by public health unit and cancer type

This section presents incidence rates for the years 2011–2013, by sex and PHU, for the four most commonly diagnosed cancers.

Among males (Table 8.1) the following was observed for colorectal, lung and prostate incidence rates:

Males - Colorectal Cancer

PHUs with a colorectal cancer ASIR significantly higher than Ontario

- Eastern Ontario
- Elgin-St.Thomas
- Grey Bruce
- Halimand-Norfolk
- Hamilton
- Huron County
- Lambton
- Niagara Region
- North Bay Parry Sound District
- Porcupine
- Timiskaming

PHUs with a colorectal cancer ASIR significantly lower than Ontario

- Peel
- Toronto
- York Region

Males - Lung Cancer

PHUs with a lung cancer ASIR significantly higher than Ontario

- Algoma
- Eastern Ontario
- Grey Bruce
- Haldimand-Norfolk
- Haliburton, Kawartha, Pine Ridge District
- Hamilton
- Hasting and Prince Edward Counties
- Kingston, Frontenac and Lennox & Addington
- Leeds, Grenville and Lanark District
- Niagara Region
- North Bay Parry Sound District
- Peterborough County-City
- Porcupine
- Renfrew County and District
- Simcoe Muskoka District
- Sudbury and District
- Thunder Bay District
- Timiskaming

PHUs with a lung cancer ASIR significantly lower than Ontario

- Halton Region
- Peel
- Toronto
- York Region

Males - Prostate Cancer

PHUs with a prostate cancer ASIR significantly higher than Ontario

- Algoma
- Durham Region
- Hastings and Prince Edward Counties
- Lambton
- Niagara Region
- Simcoe Muskoka District
- Timiskaming

PHUs with a prostate cancer ASIR significantly lower than Ontario

- Hamilton
- Kingston, Frontenac and Lennox & Addington
- Northwestern
- Peterbourgh County-City
- Region of Waterloo
- Renfrew County and District
- Wellington-Dufferin-Guelph
- York Region

Table 8.1 Incidence counts and age-standardized rates by cancer type and public health unit for males, Ontario, 2011–2013

PHU	Colorectal			Lung			Prostate		
	Count	ASIR	ASIR 95% CI	Count	ASIR	ASIR 95% CI	Count	ASIR	ASIR 95% CI
Ontario	**13,905**	**76.1**	**74.9–77.4**	**14,984**	**82.2**	**80.9–83.6**	**26,066**	**139.3**	**137.6–141.0**
Algoma	189	86.7	74.6–100.4	263	116.3*	102.5–131.6	460	201.1*	183.0–220.7
Brant County	133	65.6	54.9–77.8	167	84.6	72.2–98.5	295	145.0	128.8–162.5
Chatham-Kent	146	84.7	71.4–99.8	166	96.0	81.9–112	229	129.5	113.2–147.5
Durham Region	552	72.0	66.0–78.4	614	82.8	76.2–89.7	1,202	152.6*	144.0–161.6
Eastern Ontario	287	88.6*	78.5–99.7	328	99.6*	89.0–111.1	478	140.1	127.7–153.4
Elgin-St. Thomas	129	99.4*	82.7–118.4	121	91.1	75.4–109.2	198	146.2	126.3–168.3
Grey Bruce	280	92.5*	81.8–104.3	293	92.9*	82.4–104.4	470	146.4	133.4–160.6
Haldimand-Norfolk	174	93.8*	80.2–109.1	202	106.0*	91.8–122.0	284	145.4	128.9–163.6
Haliburton, Kawartha, Pine Ridge District	288	79.1	70.0–89.1	358	96.3*	86.4–107.1	561	150.5	138.1–163.8
Halton Region	486	74.0	67.5–81.0	418	65.0*	58.9–71.6	941	142.1	133.1–151.5
Hamilton	655	84.9*	78.5–91.6	736	95.7*	88.9–102.8	1,004	129.6*	121.7–137.8
Hastings and Prince Edward Counties	233	82.0	71.7–93.5	298	101.2*	90.0–113.6	486	162.8*	148.5–178.2
Huron County	106	97.6*	79.7–118.5	110	98.0	80.4–118.6	167	150.3	128.2–175.4
Kingston, Frontenac and Lennox & Addington	247	81.7	71.7–92.6	303	98.9*	87.9–110.8	317	101.2*	90.3–113.1
Lambton	192	88.8*	76.5–102.5	202	89.9	77.8–103.4	357	155.7*	139.9–173.0
Leeds, Grenville and Lanark District	245	80.4	70.5–91.4	323	107.4*	95.8–120.0	435	137.1	124.4–150.8
Middlesex-London	488	79.1	72.3–86.5	514	83.5	76.4–91.1	871	138.3	129.2–147.8

Table 8.1 *(Cont'd)* **Incidence counts and age-standardized rates by cancer type and public health unit for males, Ontario, 2011–2013**

PHU	Colorectal			Lung			Prostate		
	Count	ASIR	ASIR 95% CI	Count	ASIR	ASIR 95% CI	Count	ASIR	ASIR 95% CI
Niagara Region	611	82.9*	76.4–89.8	685	91.4*	84.6–98.5	1,181	157.9*	148.9–167.2
North Bay Parry Sound District	206	92.2*	79.8–106.1	251	110.4*	96.9–125.4	338	144.3	129.2–160.9
Northwestern	99	85.4	69.3–104.2	93	84.3	67.9–103.5	52	44.7*	33.3–58.7
Ottawa	886	77.8	72.7–83.1	906	79.8	74.7–85.2	1,683	141.8	135.1–148.8
Oxford County	137	83.4	70.0–98.7	122	73.5	61.0–87.8	226	135.3	118.2–154.2
Peel	1,002	67.2*	62.9–71.6	885	62.4*	58.2–66.7	2,117	136.3	130.4–142.4
Perth District	88	76.8	61.6–94.7	78	67.7	53.5–84.6	152	131.2	111.2–153.9
Peterborough County-City	177	72.4	62.0–84.1	252	101.8*	89.5–115.4	301	122.7*	109.1–137.5
Porcupine	129	99.9*	83.1–119.1	131	103.8*	86.3–123.7	173	133.9	114.3–156.0
Region of Waterloo	496	77.5	70.7–84.7	512	80.8	73.9–88.1	803	125.7*	117.1–134.8
Renfrew County and District	135	76.6	64.1–90.9	181	101.9*	87.5–118.0	189	106.3*	91.6–122.7
Simcoe Muskoka District	647	81.0	74.8–87.6	735	90.4*	83.9–97.2	1,258	152.0*	143.7–160.7
Sudbury and District	226	73.4	64.0–83.8	307	99.0*	88.1–111.0	458	143.3	130.4–157.3
Thunder Bay District	186	77.5	66.7–89.6	240	99.3*	87.1–112.8	323	129.2	115.4–144.2
Timiskaming	66	107.5*	82.6–138	78	124.7*	98.0–156.8	117	174.3*	143.9–209.7
Toronto	2,418	68.1*	65.5–70.9	2,529	72.4*	69.6–75.3	4,834	138.1	134.2–142.1
Wellington-Dufferin-Guelph	256	71.4	62.8–80.8	289	81.0	71.8–91.0	442	121.3*	110.1–133.2
Windsor-Essex County	427	75.7	68.6–83.3	492	85.5	78.0–93.4	865	148.6	138.8–158.8
York Region	854	64.6*	60.2–69.2	780	61.5*	57.2–66.1	1,770	129.2*	123.2–135.4

ASIR=Age-standardized incidence rate
CI=Confidence interval
PHU=Public health unit
*Significantly different compared to the rate for Ontario
Note: Rates are per 100,000 and age-standardized to the 2011 Canadian population.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

Among females (Table 8.2) there was less variation in breast cancer ASIR across the PHUs compared to the other cancer types. Of note, the only PHU with a breast cancer ASIR significantly higher than the Ontario rate was the Ottawa PHU.

Additionally, the following was observed for colorectal and lung cancer incidence rates among females:

Females - Breast Cancer

PHUs with a breast cancer ASIR significantly higher than Ontario

Ottawa

PHUs with a breast cancer ASIR significantly lower than Ontario

Brant County

North Bay Parry Sound District

Peel

Renfrew County and District

Sudbury and District

Females - Colorectal Cancer

PHUs with a colorectal cancer ASIR significantly higher than Ontario

Algoma

Chatham-Kent

Eastern Ontario

Haldimand-Norfolk

Leeds, Grenville and Lanark District

North Bay Parry Sound District

Ottawa

Region of Waterloo

Simcoe Muskoka District

Timiskaming

PHUs with a colorectal cancer ASIR significantly lower than Ontario

Peel

Toronto

York Region

Females - Lung Cancer

PHUs with a lung cancer ASIR significantly higher than Ontario

- Algoma
- Chatham-Kent
- Durham Region
- Eastern Ontario
- Haldimand-Norfolk
- Haliburton, Kawartha, Pine Ridge District
- Hamilton
- Hastings and Prince Edward Counties
- Kingston, Frontenac and Lennox & Addington
- Lambton
- Leeds, Grenville and Lanark District
- Niagara Region
- North Bay Parry Sound District
- Peterbourgh County-City
- Porcupine
- Renfrew County and District
- Simcoe Muskoka District
- Sudbury and District
- Thunder Bay District
- Timiskaming

PHUs with a lung cancer ASIR significantly lower than Ontario

- Halton Region
- Peel
- Toronto

There was less variation in female breast cancer incidence rates across the PHUs compared to the other cancer types.

Table 8.2 Incidence counts and age-standardized rates by cancer type and public health unit for females, Ontario, 2011–2013

PHU	Breast			Colorectal			Lung		
	Count	ASIR	ASIR 95% CI	Count	ASIR	ASIR 95% CI	Count	ASIR	ASIR 95% CI
Ontario	**30,503**	**143.4**	**141.8–145.0**	**11,712**	**52.6**	**51.6–53.5**	**14,184**	**64.6**	**63.5–65.6**
Algoma	336	145.9	130.3–162.9	156	62.4*	52.8–73.3	222	86.8*	75.6–99.3
Brant County	287	124.4*	110.3–139.7	112	46.9	38.6–56.6	173	72.0	61.6–83.7
Chatham-Kent	280	147.3	130.2–166.0	137	63.7*	53.2–75.7	167	82.0*	69.9–95.8
Durham Region	1,332	141.2	133.7–149.0	473	50.2	45.7–54.9	690	74.7*	69.2–80.5
Eastern Ontario	529	149.4	136.9–162.9	258	69.4*	61.1–78.5	367	99.0*	89.1–109.8
Elgin-St. Thomas	203	137.3	118.9–157.7	83	53.9	42.8–66.9	108	70.3	57.6–85.0
Grey Bruce	463	147.3	133.7–161.9	204	58.3	50.4–67.2	239	67.9	59.5–77.4
Haldimand-Norfolk	287	145.9	129.2–164.2	134	63.5*	53.1–75.5	183	86.2*	74.1–99.9
Haliburton, Kawartha, Pine Ridge District	501	138.0	125.7–151.2	233	58.2	50.7–66.6	376	91.7*	82.5–101.7
Halton Region	1,188	149.3	140.9–158.0	432	53.0	48.1–58.3	443	55.0*	49.9–60.3
Hamilton	1,217	137.5	129.8–145.6	504	52.8	48.2–57.7	659	70.9*	65.5–76.6
Hastings and Prince Edward Counties	447	143.1	129.8–157.3	167	48.9	41.6–57.2	317	94.8*	84.5–106.1
Huron County	158	138.3	117.0–162.5	68	53.0	41.0–67.9	85	68.1	54.3–84.8
Kingston, Frontenac and Lennox & Addington	489	143.3	130.7–156.7	186	50.5	43.5–58.5	281	77.4*	68.6–87.2
Lambton	344	141.4	126.6–157.6	145	55.4	46.6–65.5	204	78.2*	67.7–90.0
Leeds, Grenville and Lanark District	511	154.4	141.1–168.7	228	64.3*	56.1–73.5	282	80.6*	71.4–90.8
Middlesex-London	1,122	152.2	143.3–161.4	424	53.9	48.9–59.4	482	62.6	57.1–68.5

Table 8.2 *(Cont'd)* **Incidence counts and age-standardized rates by cancer type and public health unit for females, Ontario, 2011–2013**

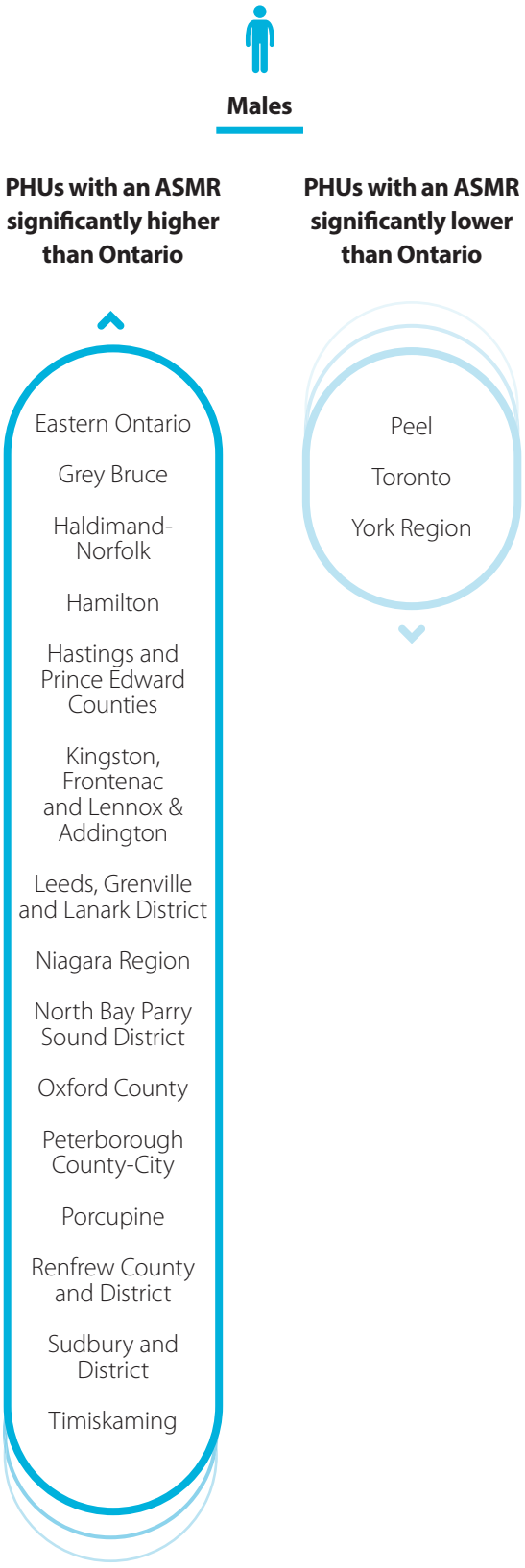
PHU	Breast			Colorectal			Lung		
	Count	ASIR	ASIR 95% CI	Count	ASIR	ASIR 95% CI	Count	ASIR	ASIR 95% CI
Niagara Region	1,196	147.6	139.2–156.4	509	56.7	51.8–62.0	648	73.7*	68.1–79.7
North Bay Parry Sound District	296	123.1*	109.2–138.3	183	71.6*	61.5–83.1	214	81.4*	70.8–93.3
Northwestern	154	125.8	106.6–147.4	78	62.3	49.2–77.8	75	60.4	47.5–75.7
Ottawa	2,124	151.2*	144.8–157.7	831	57.5*	53.6–61.6	953	67.6	63.3–72.0
Oxford County	254	139.1	122.3–157.6	111	56.1	46.0–67.9	125	63.6	52.8–76.0
Peel	2,486	133.9*	128.7–139.3	748	42.8*	39.7–46.0	782	45.6*	42.4–48.9
Perth District	182	140.2	120.3–162.5	89	61.3	49.0–75.9	89	63.8	51.1–78.8
Peterborough County-City	367	141.7	127.2–157.5	144	46.5	39.1–55.1	253	86.7*	76.1–98.4
Porcupine	201	143.6	124.4–165.0	67	47.1	36.5–60.0	127	88.8*	74.0–105.8
Region of Waterloo	1,100	144.3	135.9–153.1	496	63.5*	58.0–69.4	465	61.1	55.7–66.9
Renfrew County and District	227	124.0*	108.1–141.7	119	55.4	45.7–66.7	191	94.2*	81.2–108.9
Simcoe Muskoka District	1,307	146.4	138.5–154.6	553	58.9*	54.0–64.1	784	84.1*	78.3–90.3
Sudbury and District	432	125.4*	113.8–137.9	214	59.9	52.1–68.5	345	95.2*	85.4–105.9
Thunder Bay District	365	138.3	124.4–153.5	166	59.3	50.5–69.2	244	87.9*	77.1–99.8
Timiskaming	90	136.1	109.0–168.3	52	71.2*	53.0–94.3	76	104.5*	82.1–131.7
Toronto	6,161	144.8	141.1–148.4	2,090	45.8*	43.8–47.8	2,119	47.1*	45.1–49.2
Wellington-Dufferin-Guelph	562	133.5	122.7–145.1	234	53.9	47.2–61.3	275	64.3	56.9–72.3
Windsor-Essex County	971	150.1	140.7–159.9	339	49.5	44.3–55.1	464	68.6	62.5–75.2
York Region	2,263	141.1	135.3–147.1	719	46.6*	43.2–50.1	658	43.3*	40.0–46.7

ASIR=Age-standardized incidence rate
CI=Confidence interval
PHU=Public health unit
*Significantly different compared to the rate for Ontario
Note: Rates are per 100,000 and age-standardized to the 2011 Canadian population.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

Mortality by public health unit and sex

As with cancer incidence, cancer mortality also varied considerably by PHU. This section presents mortality rates by PHU and sex for all cancers combined. Cancer mortality rates were lowest in PHUs in Toronto and the surrounding area, while the highest rates were found throughout the province.

For males and females (Figures 8.3 and 8.4 and Tables DA.3 and DA.4 in the Data appendix) the same west-to-east gradient in northern Ontario that was seen in the incidence rates was also observed in the mortality rates. The following patterns in age-standardized mortality rates (ASMR) among males and females were also observed:



Females

PHUs with an ASMR significantly higher than Ontario

- Algoma
- Brant County
- Chatham-Kent
- Eastern Ontario
- Elgin-St. Thomas
- Hastings and Prince Edward Counties
- Leeds, Grenville and Lanark District
- Niagara Region
- Porcupine
- Simcoe Muskoka District
- Wellington-Dufferin-Guelph

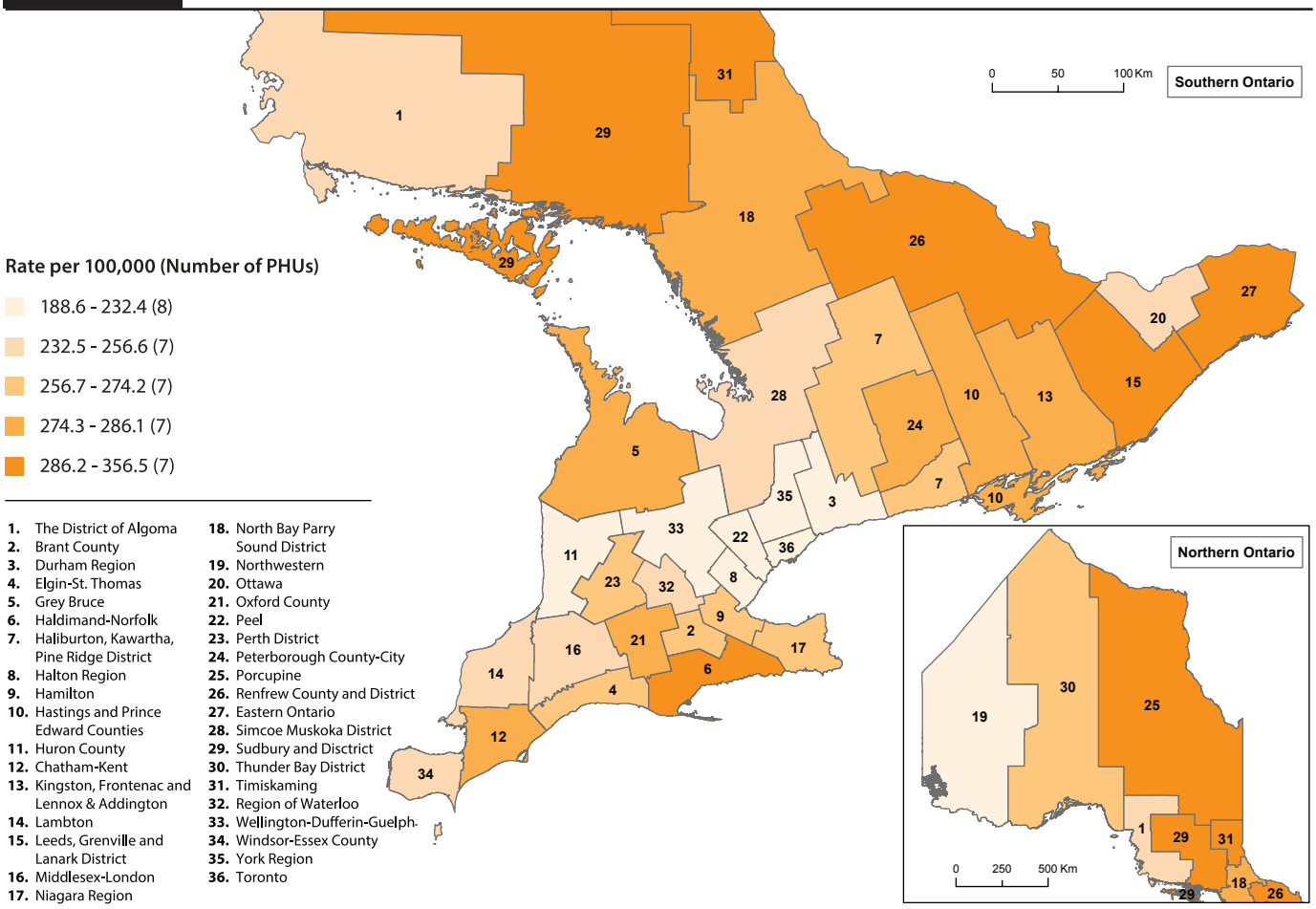
PHUs with an ASMR significantly lower than Ontario

- Peel
- Toronto
- York Region

Cancer mortality rates were lowest in PHUs in Toronto and the surrounding area, while the highest rates were found throughout the province.

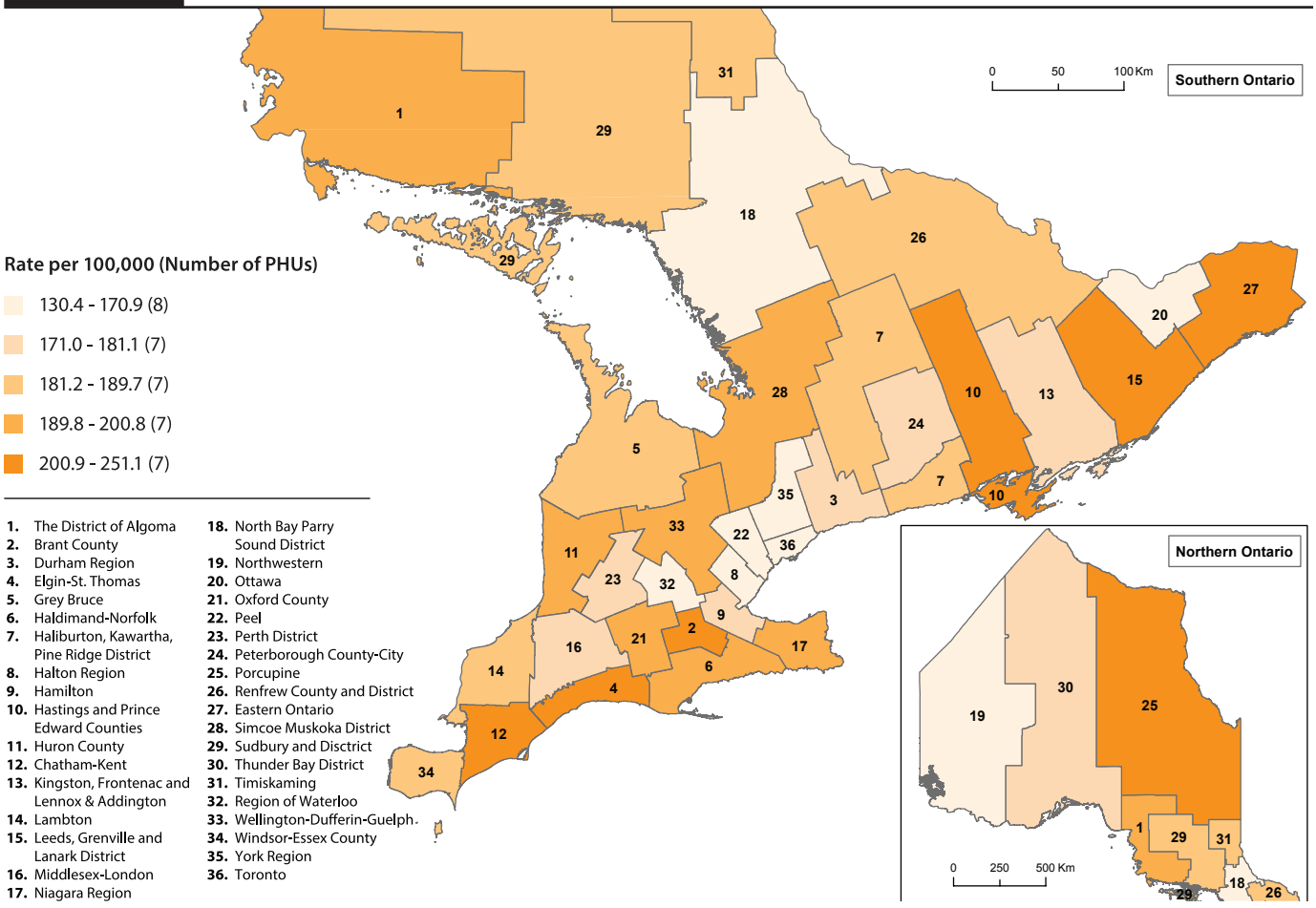
The same west-to-east gradient in northern Ontario that was seen in the incidence rates was also present in the mortality rates for both males and females.

Figure 8.3 Age-standardized mortality rates by public health unit for males and all cancers combined, Ontario, 2013



PHU=Public health unit
Note: Rates are per 100,000 and age-standardized to the 2011 Canadian population
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016) CCO

Figure 8.4 Age-standardized mortality rates by public health unit for females and all cancers combined, Ontario, 2013



PHU=Public health unit
Note: Rates are per 100,000 and age-standardized to the 2011 Canadian population.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016) CCO

Mortality by public health unit and cancer type

This section presents mortality rates for the years 2011–2013, by sex and PHU, for the four most commonly diagnosed cancers.

Among males (Table 8.3) the following was observed for colorectal, lung and prostate mortality rates:

Males - Colorectal Cancer

PHUs with a colorectal cancer ASMR signficantly higher than Ontario

- Lambton
- Leeds, Grenville and Lanark District
- North Bay Parry Sound District
- Oxford County
- Porcupine
- Renfrew County and District
- Timiskaming

PHUs with a colorectal cancer ASMR signficantly lower than Ontario

- Peel
- Toronto
- York Region

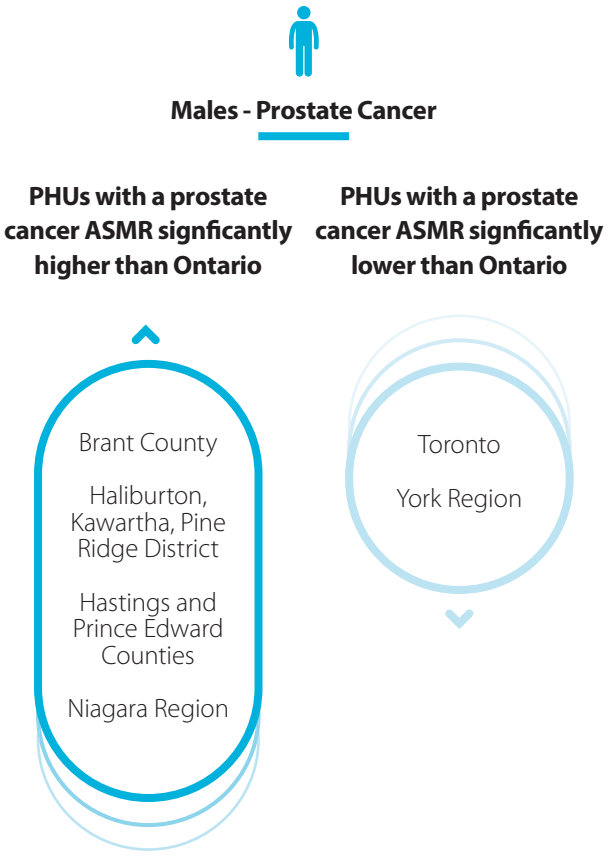
Males - Lung Cancer

PHUs with a lung cancer ASMR significantly higher than Ontario

- Algoma
- Brant County
- Chatham-Kent
- Eastern Ontario
- Grey Bruce
- Haldimand-Norfolk
- Hamilton
- Hastings and Prince Edward Counties
- Kingston, Frontenac and Lennox & Addington
- Lambton
- Leeds, Grenville and Lanark District
- Niagara Region
- North Bay Parry Sound
- Porcupine
- Sudbury and District
- Thunder Bay District
- Timiskaming

PHUs with a lung cancer ASMR significantly lower than Ontario

- Halton Region
- Peel
- Toronto
- York Region



The same PHUs that had male colorectal incidence rates lower than Ontario had male colorectal mortality rates lower than Ontario. However, the PHUs with the lowest male colorectal incidence and mortality rates did not line up in the same way.

Male lung cancer mortality rates did not always correspond with male lung cancer incidence rates. For example, while the PHUs with significantly lower mortality rates were located in Toronto and the surrounding areas, significantly lower incidence rates were also found in PHUs in southwestern Ontario.

Prostate cancer mortality rates differed from prostate cancer incidence rates. While seven PHUs had prostate incidence rates significantly higher than the Ontario rate, only two had mortality rates significantly higher. Only two PHUs—Hastings and Prince Edward Counties, and Niagara Region—had both prostate incidence and mortality rates significantly higher than Ontario.

Table 8.3 Mortality counts and age-standardized rates by cancer type and public health unit for males, Ontario, 2011–2013

PHU	Colorectal			Lung			Prostate		
	Count	ASMR	ASMR 95% CI	Count	ASMR	ASMR 95% CI	Count	ASMR	ASMR 95% CI
Ontario	**4,976**	**28.4**	**27.6–29.2**	**10,833**	**60.2**	**59.1–61.3**	**4,356**	**26.7**	**25.9–27.5**
Algoma	70	32.4	25.1–41.3	182	81.0*	69.5–94.0	54	26.9	20.1–35.4
Brant County	55	27.8	20.9–36.2	142	72.6*	61.1–85.6	66	36.7*	28.3–46.7
Chatham-Kent	61	36.4	27.7–46.9	147	85.1*	71.8–100.2	51	31.3	23.3–41.3
Durham Region	183	25.2	21.6–29.1	457	63.1	57.3–69.2	145	22.9	19.2–26.9
Eastern Ontario	101	33.4	27.1–40.7	263	79.9*	70.4–90.3	83	29.2	23.2–36.3
Elgin-St. Thomas	43	33.9	24.3–45.8	94	72.4	58.3–88.8	31	27.9	18.7–39.7
Grey Bruce	99	34.3	27.7–42.0	217	70.0*	60.9–80.2	81	29.7	23.4–37.1
Haldimand-Norfolk	65	35.9	27.6–45.9	136	72.4*	60.6–85.8	53	30.5	22.7–40.1
Haliburton, Kawartha, Pine Ridge District	122	34.4	28.5–41.3	249	67.7	59.4–77.0	117	34.4*	28.4–41.5
Halton Region	159	25.7	21.8–30.0	299	47.4*	42.2–53.2	176	31.2	26.7–36.2
Hamilton	227	30.2	26.4–34.4	525	68.6*	62.8–74.7	209	28.7	24.9–32.8
Hastings and Prince Edward Counties	93	33.0	26.5–40.6	224	77.0*	67.1–88.0	97	37.0*	29.9–45.4
Huron County	27	26.0	17.1–38.3	70	63.0	49.0–80.0	25	24.3	15.6–36.2
Kingston, Frontenac and Lennox & Addington	94	32.8	26.4–40.2	221	73.0*	63.6–83.3	90	32.5	26.0–40.0
Lambton	79	37.6*	29.7–47.1	161	73.5*	62.4–86.0	57	27.9	21.0–36.3
Leeds, Grenville and Lanark District	104	36.7*	29.9–44.7	232	78.9*	68.9–90.0	89	32.5	26.0–40.2
Middlesex-London	193	32.3	27.8–37.1	379	62.2	56.1–68.8	176	30.7	26.3–35.5

Table 8.3 *(Cont'd)* **Mortality counts and age-standardized rates by cancer type and public health unit for males, Ontario, 2011–2013**

PHU	Colorectal			Lung			Prostate		
	Count	ASMR	ASMR 95% CI	Count	ASMR	ASMR 95% CI	Count	ASMR	ASMR 95% CI
Niagara Region	236	32.1	28.1–36.5	502	67.0*	61.3–73.2	225	31.7*	27.7–36.2
North Bay Parry Sound District	84	38.9*	30.8–48.5	180	78.6*	67.4–91.4	50	25.2	18.5–33.5
Northwestern	33	29.3	20.1–41.3	83	75.6	60.1–93.9	33	34.1	23.3–47.8
Ottawa	332	30.5	27.3–34.0	633	56.6	52.3–61.2	252	25.2	22.2–28.5
Oxford County	66	41.4*	32.0–52.7	106	64.8	53.0–78.4	47	30.1	22.1–40.1
Peel	285	21.2*	18.7–23.9	656	49.1*	45.3–53.2	271	24.2	21.3–27.4
Perth District	42	37.0	26.7–50.1	57	49.8	37.7–64.5	40	36.1	25.8–49.1
Peterborough County-City	61	24.6	18.8–31.8	171	68.8	58.8–80.1	70	28.6	22.2–36.2
Porcupine	53	43.9*	32.5–57.9	110	87.6*	71.6–106.1	32	30.3	20.3–43.1
Region of Waterloo	173	29.0	24.8–33.7	361	57.8	52.0–64.1	133	24.6	20.5–29.1
Renfrew County and District	67	40.0*	31.0–51.0	119	68.0	56.2–81.5	49	31.8	23.4–42.1
Simcoe Muskoka District	234	30.5	26.7–34.8	529	65.6	60.1–71.6	216	30.6	26.6–35.1
Sudbury and District	94	31.2	25.1–38.3	252	80.9*	71.1–91.8	79	29.4	23.1–36.8
Thunder Bay District	68	29.3	22.7–37.2	188	78.3*	67.4–90.4	60	27.1	20.6–34.9
Timiskaming	36	57.9*	40.2–81.2	72	116.1*	90.3–147.4	21	37.2	22.6–57.7
Toronto	820	23.6*	22.0–25.3	1,713	49.1*	46.8–51.5	747	22.0*	20.4–23.6
Wellington-Dufferin-Guelph	92	27.4	22.0–33.6	222	63.7	55.5–72.8	87	28.8	23.0–35.6
Windsor-Essex County	173	31.5	26.9–36.6	370	65.2	58.7–72.2	137	25.8	21.6–30.5
York Region	244	20.5*	17.9–23.3	486	39.6*	36.1–43.4	204	19.7*	17.0–22.7

ASMR=Age-standardized mortality rate
CI=Confidence interval
PHU=Public health unit
*Significantly different compared to the rate for Ontario
Note: Rates are per 100,000 and age-standardized to the 2011 Canadian population.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

While there was little variation in female breast cancer incidence rates, there was greater variation in mortality rates—especially in regard to PHUs with rates significantly higher than Ontario (Table 8.4). However, while the Ottawa PHU was the only PHU to have a breast cancer ASIR higher than Ontario, its mortality rate was not significantly different from the Ontario rate. Meanwhile, seven other PHUs did have ASMR significantly higher than Ontario. Only the Peel and Sudbury and District PHUs had both incidence and mortality rates for breast cancer that were significantly lower than Ontario.

Additionally, the following was observed for colorectal and lung cancer mortality rates among females:

Females - Breast Cancer

PHUs with a breast cancer ASMR significantly higher than Ontario	PHUs with a breast cancer ASMR significantly lower than Ontario
Brant County	Peel
Halton Region	Peterborough County-City
Leeds, Grenville and Lanark District	Sudbury and District
Niagara Region	Toronto
Porcupine	York Region
Thunder Bay District	
Timiskaming	

Females - Colorectal Cancer

PHUs with a colorectal cancer ASMR significantly higher than Ontario	PHUs with a colorectal cancer ASMR significantly lower than Ontario
Eastern Ontario	Peel
Elgin-St. Thomas	Toronto
Kingston, Frontenac and Lennox & Addington	York Region
Leeds Grenville and Lanark District	
Region of Waterloo	
Simcoe Muskoka District	

Females - Lung Cancer

PHUs with a lung cancer ASMR significantly higher than Ontario	PHUs with a lung cancer ASMR significantly lower than Ontario
Algoma	Halton Region
Brant County	Peel
Chatham-Kent	Region of Waterloo
Durham Region	Toronto
Eastern Ontario	York Region
Elgin-St. Thomas	
Haldimand-Norfolk	
Haliburton, Kawartha, Pine Ridge District	
Hamilton	
Hastings and Prince Edward Counties	
Kingston, Frontenac and Lennox & Addington	
Lambton	
Leeds, Grenville and Lanark District	
Niagara Region	
North Bay Parry Sound District	
Peterborough County-City	
Porcupine	
Renfrew County and District	
Simcoe Muskoka District	
Sudbury and District	
Thunder Bay District	
Timiskaming	
Windsor-Essex County	

As with male colorectal cancer rates, among females the same PHUs had both incidence and mortality rates significantly lower than Ontario.

With the exception of the Region of Waterloo, the same PHUs with a significantly lower female lung cancer mortality rate than Ontario also had a female lung cancer incidence rate lower than Ontario.

While there was little variation in female breast cancer incidence rates, there was greater variation in mortality rates— especially in regard to PHUs with rates significantly higher than Ontario.

Table 8.4 Mortality counts and age-standardized rates by cancer type and public health unit for females, Ontario, 2011–2013

PHU	Breast			Colorectal			Lung		
	Count	ASMR	ASMR 95% CI	Count	ASMR	ASMR 95% CI	Count	ASMR	ASMR 95% CI
Ontario	**5,718**	**25.6**	**25.0–26.3**	**4,361**	**18.7**	**18.1–19.3**	**9,248**	**41.4**	**40.6–42.3**
Algoma	67	26.4	20.4–33.8	47	17.8	13.0–24.0	136	52.8*	44.2–62.8
Brant County	89	36.4*	29.2–44.9	54	20.5	15.4–26.9	129	53.6*	44.7–63.8
Chatham-Kent	55	25.9	19.3–34.2	55	23.3	17.5–30.7	133	63.2*	52.8–75.3
Durham Region	249	26.3	23.1–29.8	179	18.9	16.2–21.9	495	53.7*	49.0–58.6
Eastern Ontario	105	27.9	22.8–33.9	94	24.2*	19.6–29.8	259	69.1*	60.9–78.2
Elgin-St. Thomas	51	34.1	25.3–45.0	47	28.3*	20.7–37.9	81	52.7*	41.8–65.6
Grey Bruce	94	27.2	21.8–33.6	87	23.3	18.6–29.1	155	43.6	36.9–51.3
Haldimand-Norfolk	59	28.9	21.9–37.5	40	18.0	12.8–24.8	115	54.1*	44.6–65.2
Haliburton, Kawartha, Pine Ridge District	114	28.7	23.5–34.8	98	22.5	18.2–27.7	218	51.1*	44.5–58.6
Halton Region	247	30.1*	26.4–34.1	148	17.6	14.9–20.7	291	35.7*	31.7–40.1
Hamilton	251	25.6	22.5–29.0	185	18.4	15.8–21.3	456	48.0*	43.6–52.7
Hastings and Prince Edward Counties	101	30.7	24.8–37.5	75	21.0	16.4–26.5	223	65.3*	56.9–74.7
Huron County	40	32.1	22.8–44.4	19	14.5	8.6–23.5	56	45.1	33.9–59.2
Kingston, Frontenac and Lennox & Addington	91	24.9	20.0–30.7	99	26.1*	21.2–31.9	183	49.6*	42.6–57.4
Lambton	66	25.0	19.2–32.1	55	19.6	14.7–25.8	136	50.3*	42.1–59.7
Leeds, Grenville and Lanark District	120	33.5*	27.6–40.3	100	26.5*	21.5–32.5	193	54.3*	46.9–62.8
Middlesex-London	206	26.6	23.1–30.6	140	16.7	14.0–19.8	327	41.6	37.1–46.4

Table 8.4 *(Cont'd)* **Mortality counts and age-standardized rates by cancer type and public health unit for females, Ontario, 2011–2013**

PHU	Breast			Colorectal			Lung		
	Count	ASMR	ASMR 95% CI	Count	ASMR	ASMR 95% CI	Count	ASMR	ASMR 95% CI
Niagara Region	289	32.4*	28.7–36.5	193	19.4	16.7–22.4	424	46.1*	41.7–50.8
North Bay Parry Sound District	64	24.6	18.9–31.7	67	24.0	18.6–30.7	143	53.5*	45.1–63.2
Northwestern	43	34.4	24.8–46.4	28	21.7	14.4–31.4	60	47.4	36.1–61.1
Ottawa	405	27.7	25.0–30.5	312	20.7	18.5–23.2	589	41.2	37.9–44.7
Oxford County	42	20.5	14.7–28.0	43	20.5	14.8–27.9	85	42.9	34.1–53.3
Peel	390	21.8*	19.7–24.1	260	15.6*	13.7–17.6	469	27.8*	25.3–30.4
Perth District	34	23.5	16.2–33.2	34	20.7	14.2–29.4	66	44.9	34.6–57.6
Peterborough County-City	51	17.1*	12.6–22.7	57	18.1	13.6–23.8	157	50.9*	43.1–60.0
Porcupine	50	35.2*	26.1–46.6	29	19.6	13.1–28.3	83	57.2*	45.5–71.0
Region of Waterloo	223	28.6	25.0–32.7	184	22.6*	19.4–26.1	277	36.0*	31.9–40.5
Renfrew County and District	41	19.6	13.9–27.0	37	17.1	11.9–23.9	116	54.7*	45.1–65.9
Simcoe Muskoka District	246	26.1	22.9–29.6	238	24.2*	21.2–27.5	507	53.7*	49.1–58.6
Sudbury and District	68	19.0*	14.7–24.1	69	18.5	14.4–23.6	226	61.8*	54.0–70.5
Thunder Bay District	94	33.2*	26.8–40.9	47	15.9	11.6–21.4	155	55.5*	47.0–65.1
Timiskaming	35	47.4*	32.9–66.9	17	22.9	13.2–37.7	48	65.6*	48.3–87.9
Toronto	1,038	23.1*	21.7–24.6	760	15.5*	14.4–16.7	1,312	28.3*	26.8–29.9
Wellington-Dufferin-Guelph	126	28.6	23.8–34.1	88	19.7	15.8–24.3	191	44.1	38.0–50.8
Windsor-Essex County	180	26.8	23.0–31.0	134	18.4	15.4–21.9	335	48.7*	43.6–54.3
York Region	287	18.4*	16.3–20.6	234	15.6*	13.6–17.7	397	26.3*	23.7–29.0

ASMR=Age-standardized mortality rate
CI=Confidence interval
PHU=Public health unit
*Significantly different compared to the rate for Ontario
Note: Rates are per 100,000 and age-standardized to the 2011 Canadian population.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

Survival by public health unit

Five-year relative survival also varied by PHU. The majority of PHUs had five-year relative survival ratios (RSRs) significantly lower than the age-standardized Ontario RSR of 63.9% (Table 8.5). The RSRs varied from a low of 52.8% in the Northwestern PHU to a high of 70.5% in the York Region PHU. The PHUs with the highest survival tended to be located in the greater Toronto area.

Table 8.5 Age-standardized five-year relative survival ratios by public health unit for all cancers combined, Ontario, 2009–2013

PHU	RSR (%)	95% CI
Ontario	**63.9**	**63.7–64.2**
Algoma	62.0	59.7–64.3
Brant County	59.7*	57.1–62.3
Chatham-Kent	59.3*	56.6–61.9
Durham Region	64.6	63.3–65.8
Eastern Ontario	57.3*	55.3–59.3
Elgin-St. Thomas	60.6*	57.4–63.7
Grey Bruce	65.7	63.6–67.7
Haldimand-Norfolk	62.3	59.7–64.7
Haliburton, Kawartha, Pine Ridge District	59.7*	57.9–61.5
Halton Region	67.5*	66.1–68.9
Hamilton	60.3*	59.0–61.5
Hastings and Prince Edward Counties	57.7*	55.6–59.8
Huron County	64.8	61.5–67.9
Kingston, Frontenac and Lennox & Addington	58.4*	56.3–60.5
Lambton	62.5	60.1–64.8
Leeds, Grenville and Lanark District	56.7*	54.7–58.7
Middlesex-London	62.3*	60.8–63.7
Niagara Region	61.3*	60.0–62.6
North Bay Parry Sound District	61.1*	58.7–63.4
Northwestern	52.8*	49.3–56.2
Ottawa	64.3	63.2–65.3
Oxford County	59.6*	56.8–62.3
Peel	66.6*	65.5–67.6
Perth District	63.1	59.8–66.2
Peterborough County-City	60.9*	58.6–63.1
Porcupine	55.8*	52.5–58.9
Region of Waterloo	63.3	61.8–64.7
Renfrew County and District	59.6*	56.8–62.3
Simcoe Muskoka District	63.7	62.4–65.0
Sudbury and District	58.8*	56.7–60.9
Thunder Bay District	59.8*	57.5–61.9
Timiskaming	56.8*	52.3–61.1
Toronto	67.2*	66.6–67.8
Wellington-Dufferin-Guelph	63.2	61.2–65.1
Windsor-Essex County	60.7*	59.2–62.1
York Region	70.5*	69.4–71.5

CI=Confidence interval
PHU=Public health unit
RSR=Relative survival ratio
*Significantly different compared to the Ontario RSR
Note: Analysis was restricted to people ages 15 to 99.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

Both sexes

PHUs with a 5-year RSR significantly higher than Ontario	PHUs with a 5-year RSR significantly lower than Ontario
Halton Region	Brant County
Peel	Chatham-Kent
Toronto	Eastern Ontario
York Region	Elgin-St.Thomas
	Haliburton, Kawartha, Pine Ridge District
	Hamilton
	Hastings and Prince Edward Counties
	Kingston, Frontenac and Lennox & Addington
	Leeds, Grenville and Lanark District
	Middlesex-London
	Niagara Region
	North Bay and Parry Sound District
	Northwestern
	Oxford County
	Peterborough County-City
	Porcupine
	Renfrew County and District
	Sudbury and District
	Thunder Bay District
	Timiskaming
	Windsor-Essex County

This chapter presented cancer statistics by public health unit. Incidence and mortality statistics by Local Health Integration Network (LHIN) are available through the Ontario Cancer Profiles tool available at: **https://www.cancercare.on.ca/ontariocancerprofiles.**

Glossary

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 four, five to nine, …, 85 and older) diagnosed during a year divided by the total number of people in that age group that year. Age-standardized rates give 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 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 four, five to nine, …, 85 and older) that occurred during a year divided by the number of people in that age group that year. Age-standardized rates give 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 population.

ANNUAL PERCENT CHANGE (APC):
A measure to assess the rate of change over time of an incidence or mortality rate. It is calculated by fitting a linear model to the annual rates after applying a logarithmic transformation. The estimated slope is then transformed back to represent a percentage increase or decrease per year. The method allows for a series of straight line segments with different slopes to be fitted to long-term trend data.

AVERAGE ANNUAL PERCENT CHANGE (AAPC):
The weighted average of the APCs during a specified time period.

CANCER INCIDENCE:
The number of new cancer cases diagnosed during a specific time period in a population.

CANCER MORTALITY:
The number of deaths due to cancer during a specific time period in a population.

COMORBIDITY:
A disease or condition that exists alongside the cancer of interest but is not an adverse effect of the cancer or its treatment.

CONDITIONAL SURVIVAL:
The probability of surviving a certain number of years given that a patient has already survived "n" years.

DEATH CERTIFICATE ONLY (DCO):
Cases for which the only data source is a death certificate. Such cases are excluded from survival analyses.

POPULATION AGING:
Refers to an increasing proportion of people 65 years of age or older in the population, as defined in demographic terms.

PREVALENCE:
The number of people still alive who have ever been diagnosed with cancer.

PUBLIC HEALTH UNIT (PHU):
An official health agency established by a group of urban and rural municipalities in Ontario to provide health promotion and disease prevention programs. There are 36 PHUs in Ontario.

RELATIVE SURVIVAL RATIO (RSR):
The proportion of people alive after a specific period of time after cancer diagnosis (e.g., five years) compared to the expected survival of similar people (based on age, sex and time period) in the general population.

WAIT TIME:
The time before a patient receives treatment. In this report, this is defined as the time between the decision to treat and the first surgical treatment. Other publications may define this term differently (e.g., by commencing the wait time at the date of diagnosis).

Technical appendix

Data sources

CANCER DATA

The Ontario Cancer Registry (OCR), maintained by Cancer Care Ontario, is the main data source for this report. Its goals are to collect, analyze and disseminate timely and high-quality information describing cases of cancer diagnosed among Ontario residents.

The OCR is a dynamic database: new case information and updates to past cases may be added throughout the year. Consequently, the results of analyses will vary based on the date that data are extracted from the OCR. The data used in this report were extracted from the OCR between November 2016 and March 2017.

OCR 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 OCR:

- pathology reports;
- activity-level reporting (ALR) from regional cancer centres (RCCs);
- surgery and discharge data (e.g., Discharge Abstract Database [DAD] and National Ambulatory Care Reporting System [NACRS]) from the Canadian Institute for Health Information (CIHI); and
- death certificates from the Office of the Registrar General for Ontario.

Safeguarding confidential information is a guiding principle for Cancer Care Ontario. All activities—from the initial registration of a new cancer case in the OCR, through to research and reporting—are governed by the Personal Health Information Protection Act (PHIPA), 2004.[1] This Ontario law governs the collection and use of data and the disclosure of personal health information. PHIPA designates Cancer Care Ontario as a prescribed entity and authorizes Cancer Care Ontario to collect, use and disclose personal health information for the purposes of managing and planning Ontario's health system.

DATA QUALITY

Death certificate only and microscopically confirmed cases

Table TA.1 presents the percentage of cases in the OCR that were diagnosed based on a death certificate only (DCO) and the percentage that were microscopically confirmed.

Overall, 1.8% of cases diagnosed in 2013 were DCOs. The percentage ranged from a low of zero for testicular cancer to a high of 4.9% for liver cancer.

For all cancer types, 89.8% of cases were microscopically confirmed. This falls below the Surveillance, Epidemiology and End Results (SEER) Program's recommendation of having at least 93% of cases be microscopically confirmed.[2] The percentage microscopically confirmed varied from a low of 56.8% for liver cancer to a high of 99.3% for thyroid cancer.

Table TA.1 Percentage death certificate only and microscopically confirmed cases by cancer type, Ontario Cancer Registry, 2013

Cancer type	DCO		Microscopically confirmed	
	Number of cases	% of cases	Number of cases	% of cases
All cancers	**1,367**	**1.8%**	**69,234**	**89.8%**
Bladder	36	0.8%	4,624	97.6%
Brain	21	1.9%	897	83.1%
Breast	74	0.7%	10,044	97.8%
Cervix	6	1.1%	507	96.9%
Colorectal	171	2.0%	8,071	92.1%
Esophagus	16	2.0%	749	93.6%
Hodgkin lymphoma	**	**	363	94.0%
Kidney	46	2.1%	1,998	89.2%
Larynx	**	**	404	95.7%
Leukemia	22	0.9%	1,897	78.6%
Liver	61	4.9%	706	56.8%
Lung	319	3.3%	7,817	80.1%
Melanoma	24	0.7%	3,324	97.5%
Myeloma	20	1.6%	896	72.6%
Non-Hodgkin lymphoma	47	1.1%	3,453	84.5%
Oral cavity & pharynx	32	1.7%	1,832	94.5%
Ovary	29	2.4%	1,051	88.2%
Pancreas	75	4.0%	1,238	65.9%
Prostate	68	0.9%	7,354	96.2%
Stomach	23	1.5%	1,407	94.0%
Testis	0	0.0%	399	98.0%
Thyroid	**	**	3,198	99.3%
Uterus	18	0.7%	2,343	97.3%

**Suppressed due to small cell count (n<6)
DCO=Death certificate only
Analysis by: Ontario Cancer Registry, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

Incidence to mortality ratio

The age-standardized incidence to mortality (I:M) ratio is used to identify areas of undercoverage within a registry. The I:M ratio for malignant cases in the OCR for 2013 was 2.9:1 (Table TA.2). This ratio meets the Canadian Partnership Against Cancer's recommended ratio of at least 2.3:1.[2] Almost all the public health units (PHUs) in Ontario met that recommended ratio. The exception was the Eastern Ontario Health Unit with an I:M ratio of 2.2:1, which is just below the recommended ratio. An I:M ratio below the recommended level may indicate incomplete registration of cases.[2] The mostly similar I:M ratios among the province's PHUs indicate that case registration is fairly complete across Ontario, with no obvious areas of undercoverage.

Table TA.2 **Age-standardized incidence to mortality ratio by public health unit for all cancers combined, Ontario Cancer Registry, 2013**

PHU†	I:M ratio
Algoma	3.4
Brant County	2.4
Chatham-Kent	2.3
Durham Region	2.9
Eastern Ontario	2.2
Elgin-St. Thomas	2.4
Grey Bruce	2.6
Haldimand-Norfolk	2.7
Haliburton, Kawartha, Pine Ridge District	2.7
Halton Region	2.9
Hamilton	2.6
Hastings and Prince Edward Counties	2.6
Huron County	3.1
Kingston, Frontenac and Lennox & Addington	2.3
Lambton	2.6
Leeds, Grenville and Lanark District	2.4
Middlesex-London	2.7
Niagara Region	2.6
North Bay Parry Sound District	2.6
Northwestern	2.3
Ottawa	2.8
Oxford County	2.5
Peel	3.1
Perth District	2.5
Peterborough County-City	2.5
Porcupine	2.3
Region of Waterloo	2.8
Renfrew County and District	2.5
Simcoe Muskoka District	2.7
Sudbury and District	2.6
Thunder Bay District	2.7
Timiskaming	2.4
Toronto	3.2
Wellington-Dufferin-Guelph	2.7
Windsor-Essex County	2.8
York Region	3.3

I:M ratio=Incidence to mortality ratio
PHU=Public health unit
†For all cancers combined
Note: I:M ratio is the ratio of the age-standardized incidence rate to the age-standardized mortality rate.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (March 2017), CCO

Further data quality measures are presented in Table TA.3.

Table TA.3 **Data element completeness estimates, Ontario Cancer Registry, 2013**

Measure	Value
Average number of sources/notification per case	12
Percent of cases with unknown primary site of cancer	0%
Percent of cases with unknown morphology	0%
Percent of cases staged*	90%
Completeness of CS data collection*	91%
Synoptic pathology completeness	87%
Percent of cases missing "age at diagnosis/death"	0.003%

Measure	Value
Percent of cases missing "sex"	0%
Percent of cases missing "postal code" at diagnosis	3.7%
Percent of patients listed as "alive" with current age >100	0%
Percent of patients listed as "dead" missing death date	0%

*For lung, female breast, colorectal, cervix and prostate cancers only
Notes: 1. For all malignant cases and *in situ* bladder.
2. Total number of cases: 79,549; total number of patients: 75,662.
Analysis by: Ontario Cancer Registry, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (March 2017), CCO

POPULATION DATA

Except where otherwise noted, population data are from the Ontario Ministry of Finance (Fall 2016 release). These population figures are based on the 2011 census, conducted by Statistics Canada. Population figures by PHU are provided in Table TA.4.

Table TA.4 **Population estimates by sex and public health unit, Ontario, 2013**

PHU	Both sexes	Males	Females
Algoma	116,829	57,319	59,510
Brant County	143,323	70,335	72,988
Chatham-Kent	105,998	51,835	54,163
Durham Region	645,055	316,765	328,290
Eastern Ontario	204,166	101,184	102,982
Elgin St. Thomas	90,367	44,791	45,576
Grey Bruce	163,186	80,894	82,292
Haldimand-Norfolk	110,349	55,305	55,044
Haliburton, Kawartha, Pine Ridge District	178,678	88,531	90,147
Halton Region	539,958	264,380	275,578
Hamilton	546,600	269,018	277,582
Hastings and Prince Edward Counties	163,921	80,545	83,376
Huron County	59,258	29,391	29,867
Kingston, Frontenac and Lennox & Addington	199,618	98,632	100,986
Lambton	130,490	64,014	66,476
Leeds, Grenville and Lanark District	169,130	82,944	86,186
Middlesex-London	461,783	225,616	236,167
Niagara Region	445,495	217,217	228,278
North Bay Parry Sound District	128,032	63,318	64,714
Northwestern	81,645	41,115	40,530
Ottawa	935,810	457,514	478,296
Oxford County	110,155	54,733	55,422
Peel	1,391,479	688,432	703,047
Perth District	77,815	38,459	39,356
Peterborough County-City	139,337	67,471	71,866
Porcupine	87,084	43,723	43,361
Region of Waterloo	534,132	265,110	269,022
Renfrew County and District	105,514	53,101	52,413
Simcoe Muskoka District	534,540	265,001	269,539
Sudbury and District	199,854	98,936	100,918
Thunder Bay District	155,047	76,860	78,187
Timiskaming	34,613	17,307	17,306
Toronto	2,777,211	1,345,590	1,431,621
Wellington-Dufferin-Guelph	278,361	137,678	140,683
Windsor-Essex County	401,742	199,170	202,572
York Region	1,104,429	543,592	560,837

PHU=Public health unit
Data source: Ontario Ministry of Finance population estimates (Fall 2016)

DISEASE SITE GROUPING

The OCR uses disease site groupings based on the third edition of the International Classification of Diseases for Oncology (ICD-O-3).[3] These disease site groupings are recoded based on the SEER groups.[4]

Cancer deaths are classified according to the 10th edition of the International Classification of Diseases and Related Health Problems (ICD-10).[5]

The primary cancer groupings used in this report are found in Table TA.5.

Table TA.5 **Cancer definitions by coding methodology**

Cancer type: short form	Cancer type: full name	Incidence	Mortality
		ICD-O-3 definition	ICD-10 definition
All cancers		C00.0–C80.9	C00–C97
Bladder	Urinary bladder	C67	C67
Brain	Brain and other nervous system	C70–C72	C70–C72
Breast (female)		C50	C50
Cervix	Cervix uteri	C53	C53
Colorectal	Colon and rectum	C18–C20, C26.0	C18–C20, C26
Esophagus		C15	C15
Hodgkin lymphoma		All sites with histologies 9650–9667	C81
Kidney	Kidney and renal pelvis	C64.9, C65.9	C64–C65
Larynx		C32	C32
Leukemia		C42.0, C42.1, C42.4 with histologies 9811–9818, 9837,9823. 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, 9930, 9801, 9805–9809, 9931, 9733, 9742, 9800, 9831, 9870, 9948, 9963–9964, 9827	C90.1, C91.0–C91.5, C91.7, C91.9, C92.0–C92.1, C92.4–C92.5, C92.7, C92.9, C93.0–C93.2, C93.7, C93.9, C94.0–C94.2, C94.4–C94.5, C94.7, C95.0–C95.2, C95.7, C95.9
Liver	Liver and intrahepatic bile duct	C22.0, C22.1	C22.0, C22.2–C22.4, C22.7, C22.9
Lung	Lung and bronchus	C34	C34

Table TA.5 *(Cont'd)* **Cancer definitions by coding methodology**

Cancer type: short form	Cancer type: full name	Incidence	Mortality
		ICD-O-3 definition	ICD-10 definition
Melanoma	Melanoma of skin	C44 with histologies 8720–8790	C43
Myeloma	Multiple myeloma	Histologies 9731–9732, 9734	C90.0, C90.2
Non-Hodgkin lymphoma		Histologies 9590–9596, 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	C82–C85, C96.3
Oral cavity & pharynx		C00–C00.9, C01.9-C02.9, C03-C11, C12.9, C13, C14.0, C14.2, C14.8	C00–C14
Ovary		C56.9	C56
Pancreas		C25	C25
Prostate		C61.9	C61
Stomach		C16	C16
Testis		C62	C62
Thyroid		C73.9	C73
Uterus	Corpus and uterus NOS	C54, C55.9	C54–55

ICD-O-3=International Classification of Disease for Oncology, Third Edition
ICD-10=International Statistical Classification of Diseases and Related Health Problems, Tenth Revision
Notes: 1. All cancer types exclude basal cell and squamous cell skin cancers
2. Histology types 9590-9989 (leukemias, lymphomas and hematopoietic diseases), 9050-9055 (mesothelioma) and 9140 (Kaposi sarcoma) are excluded from other specific organ sites.

NON-MELANOMA SKIN CANCER

Data presented in this document exclude cases of basal cell and squamous cell carcinoma of the skin, which are the most common types of non-melanoma skin cancer. Although approximately 30% of the malignant cancers diagnosed among Ontarians each year are basal cell and squamous cell carcinomas of the skin, these tumours are generally not life-threatening and are treated in out-patient settings. As a result, they are too inconsistently reported to the OCR to allow meaningful analysis

CANCER STAGE AT DIAGNOSIS

Cancer staging is viewed as an essential element for quality care. Stage data are vital for evaluating the effectiveness of screening and treatment programs, analysis of survival, research into new treatments and resource planning for healthcare management.

The tumour-node-metastasis (TNM) system is the most widely used classification system for stage at diagnosis and it is recognized as the international standard for describing the anatomic extent of various cancers. TNM definitions are maintained by the Union for International Cancer Control (UICC) and the American Joint Committee on Cancer (AJCC).[6]

Collaborative Staging (CS) is a staging approach used by central cancer registries. CS brings together the principles of the National Cancer Institute (NCI)/SEER Summary Stage, the TNM categories and stage groupings and the SEER Extent of Disease coding structure. Most of the CS data items have traditionally been collected by some cancer registries, including tumour size, extension, lymph node status and metastatic status. Other data such as site/histology-specific factors (e.g., Gleason score and receptor status) are specific to CS. The data is used to derive the "best stage" grouping consistent with the AJCC Cancer Staging Manual (currently in its seventh edition).[7]

CS values for invasive cancer range from stage I, which means the disease is in the early phase, to stage IV, 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 work-up, limited documentation in the person's health record or both. Cases that are defined as "not staged" are cases where no attempt at staging has yet occurred.

Starting with cases diagnosed on January 1, 2005, the OCR implemented various versions of CS in a phased approach by reporting hospital (see Table TA.6 for a list of contributing hospitals and regional cancer centres) and selected cancer type. More specifically, full implementation of CS was achieved 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. Stage data included in this report are for the diagnosis years 2010 to 2013.

Table TA.6 Contributing facilities to activity-level reporting data used for population-level staging, Ontario Cancer Registry

Regional cancer centres
Grand River Regional Cancer Centre
Juravinski Cancer Centre
Cancer Centre of Southeastern Ontario
R.S. McLaughlin Durham Regional Cancer Centre
London Regional Cancer Program
Simcoe Muskoka Regional Cancer Centre
Stronach Regional Cancer Centre at Southlake
Northeast Cancer Centre
Odette Cancer Centre
The Ottawa Hospital Regional Cancer Centre
Regional Cancer Care North West – Northwest
Carlo Fidani Peel Regional Cancer Centre
Princess Margaret Hospital
Windsor Regional Cancer Centre

Hospitals
Grand River Hospital
Hamilton Health Sciences
Kingston Health Sciences Centre
Lakeridge Health
London Health Sciences Centre
Royal Victoria Hospital
Southlake Regional Health Centre
Health Sciences North Sudbury
Sunnybrook Health Sciences Centre
The Ottawa Hospital
Thunder Bay Regional Health Sciences Centre
Trillium Health Partners
University Health Network
Windsor Regional Hospital
Bluewater Health
Cambridge Memorial Hospital
Grey Bruce Health Services
Halton Healthcare Services
Headwaters Health Centre
Humber River Regional Hospital
Mackenzie Health (formerly York Central Hospital)
Markham-Stouffville Hospital
The Scarborough Hospital
Sinai Health System
North York General Hospital
Quinte Healthcare Corporation
Rouge Valley Health System
Sault Area Hospital
St. Joseph's Health Centre
St. Michael's Hospital
Toronto East Health Network
William Osler Health Centre

CODING RULES FOR MULTIPLE PRIMARY CANCERS

Different rules exist to determine if a cancer is a new primary cancer or an extension of a previous cancer. Following a recent rebuild, the OCR adopted the SEER program's rules for counting multiple primaries and assigning histology,[8] similar to other North American cancer registries. To identify multiple primary cancers the SEER counting rules take into account histology, site, laterality and time since the initial diagnosis. The SEER rules are more liberal than the rules previously used in the OCR for counting multiple primaries in their consideration of what constitutes a new primary case. The SEER rules for multiple primary cancers have been applied to cases in the OCR that were diagnosed on or after January 1, 2010.

Cases from the years prior to SEER adoption (i.e., 1964 to 2009) have been imported into the new OCR from the Ontario Cancer Registry Information System (OCRIS) to allow for continued analytic use. OCRIS applied a modified version of the International Agency for Research on Cancer/International Association of Cancer Registries (IARC/IACR) rules,9 which are more conservative than the SEER rules. Under the IARC/IACR rules, only one tumour is registered for an organ irrespective of time unless there are histological differences. In this report, data were converted using the IARC/IACR rules for all trend analyses that span both the OCR (2010 onward) and OCRIS (1983 to 2009) eras and whenever comparisons are made between data from the two registry systems. When data are presented only from 2010 onward, the SEER rules were applied.

Given that the SEER rules are less conservative than the IARC/IACR rules, applying the SEER rules results in an increase in the number of cases included in incidence counts. This is simply a result of using a different methodology and does not reflect an actual increase in the number of people being diagnosed with cancer. The impact of applying the SEER versus IARC/IACR rules on new cases differed by cancer type. For example, the largest increases in new cases due to the adoption of the SEER rules were observed for melanoma (15.9% higher when based on SEER rules), breast cancer (14.0% higher) and testicular cancer (9.8% higher) for 2011–2012 data; the smallest changes were for Hodgkin lymphoma (0.5% higher), pancreatic cancer (0.5% higher) and prostate cancer (0.8% higher).

Analysis

CANCER INCIDENCE AND MORTALITY

Counts

Incidence counts are the number of new cancer cases diagnosed in a population during a specific time period. In this report, this refers to the number of new cancer diagnoses in a calendar year in Ontario. Complete death-cleared incidence data were available up to 2013 at the time of writing.

Mortality counts describe the number of deaths attributed to cancer during a specific period of time in a specific population. In 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., 1983 to 2013).

Rates

Incidence and mortality rates are the number of new cancer cases or deaths per 100,000 people in a population during a specific time period. This is sometimes called the crude rate since it does not adjust for the age distribution of the population. Rates were calculated using CCO SEER*Stat v.8.3.2.[10]

Age-standardized rates

Age-standardized rates are weighted averages of age-specific rates using a standard population. Age-standardized incidence rates (ASIR) and age-standardized mortality rates (ASMR) are adjusted for differences in the age structure of different populations, which permits comparisons of cancer incidence or mortality between different populations. These may be different segments of a population (e.g., different geography) or the same population at different periods of time. Age-standardized rates give the rate that would have occurred if the population of Ontario 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 in this report is the 2011 Canadian census population (Table TA.7). Surveillance reports published by Cancer Care Ontario prior to 2016 used the 1991 Canadian census population. 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 (e.g., the 2012 ASIR for prostate cancer using the 1991 population was 47.8 per 100,000 compared to 63.1 per 100,000 using the 2011 standard population, while the crude rate was 63.4 per 100,000). Given the change in standard population, the age-standardized rates in this report should not be compared to previously published rates that used the 1991 population for standardization.

Table TA.7 **Canada 2011 reference population used for calculating age-standardized rates**

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

Note: Postcensal estimates are based on the 2011 census counts adjusted for census net undercoverage (CNU) (including adjustment for incompletely enumerated Indian reserves [IEIR]) and the components of demographic growth that occurred since that census. Intercensal estimates are produced using counts from two consecutive censuses adjusted for CNU (including IEIR and postcensal estimates).
Data source: Statistics Canada. Table 051-0001 - Estimates of population, by age group and sex for July 1, Canada, provinces and territories, annual (persons unless otherwise noted), CANSIM (database).

Trends in age-standardized rates

Incidence and mortality trends were determined using annual percent change (APC) and average annual percent change (AAPC), which were calculated using age-standardized rates. APCs were used when examining short term changes in trend. AAPCs are summary measures that describe the change in trend over a longer period of time with a single statistic.

APCs and AAPCs were determined using Joinpoint regression software (version 4.2.0.2).[11] Joinpoint regression uses piecewise regression to model the change in rates on the log scale. A statistical algorithm finds the optimal number and points in a trend (the joinpoints) where the trend changes.

In general, the model that Joinpoint software found to be the best fit was used. However, for some types of cancer, models other than what the Joinpoint software suggested were used to best describe the changes in trend for the data. A maximum of five joinpoints was allowed. If the Joinpoint software found a best-fit model with a joinpoint three or less observations from the end of the data, the model was rerun using five as the minimum number of observations from a joinpoint to the end of the data.

Projections

Incidence and mortality projections for the years 2014 to 2018 were calculated using the Nordpred package in R software.[12]

For incidence projections, cases meeting the IARC/IACR multiple primary rules from 1984 to 2012 were grouped by five-year age groups and time periods. Population data was similarly aggregated (with the exception of bladder cancer for which cases were grouped from 1994 to 2012 due to the classification changes since 1989). To obtain projections for all cancers combined, projections were calculated separately for female breast, prostate, colorectal, lung, thyroid and bladder cancers and for all other cancers by sex, and then summed.

Projections were performed using a Nordpred Power 5 age-period-cohort model (with the exception of prostate cancer incidence):

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

where R_ap is the incidence rate in age group a in calendar period p, which is the mean count μ_ap of case divided by the corresponding population size n_ap, A_a is the age component for age group a, D is the common linear drift parameter of period and cohort, P_p is the non-linear period component of period p and C_c is the non-linear cohort component of cohort c. Cohorts were calculated as c=A+p-a, with A = total number of age groups (=18).

Nordpred is based on an age-period-cohort Poisson regression model. It has enhancements that overcome difficulties in the standard Poisson model and improve projection accuracy.[13] Further details of Nordpred's background methods can be found elsewhere.[14] Projections were produced in five-year periods and linear interpolation was used to create annual counts. An inflation factor was applied based on the age-specific increase in multiple primary cancers due to the application of the SEER counting rules in 2010 to 2013.

Due to the major drop in the prostate cancer incidence rate in the past few years, the age-period-cohort models do not fit for prostate incidence. Instead, an age-only model based on DCO-corrected data from 2013 to 2014 was used. This method is more appropriate when there has been a recent change in the trend.

Mortality projections were also performed using a Nordpred Power 5 age-period-cohort model using cancer deaths from 1984 to 2012 divided into five-year age groups and time periods. To obtain mortality projections for all cancers combined, projections were calculated separately for female breast, prostate, colorectal and lung cancers and for all other cancers by sex, and then summed.

Geospatial analysis

Geospatial analysis for the ASIR and ASMR by PHU shown in the maps in *Chapter 8: Cancer statistics by public health unit* was performed by obtaining digital boundary files for the PHUs from Statistics Canada.[15] Using the Geographic Information System software ArcGIS®, the age-standardized rates were linked to the geographic boundary files and mapped to display the rates for each PHU.

PROBABILITY OF DEVELOPING OR DYING FROM CANCER

The probability of developing or dying from cancer refers to the probability of a newborn child developing or dying from cancer at some point during his or her lifetime. Lifetime risk calculations are based on current incidence and mortality rates and are therefore calculated under the assumption that the current rates, within each age group, will remain constant during the life of the newborn child.

The probability of developing or dying from cancer was calculated using DevCan software.[16] 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.

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. Non-significant changes in trend are described in this report as "stable."

COMORBIDITY

Data on comorbidity were extracted from the DAD[17] and the NACRS.[18] Data was linked to the OCR by health insurance card number (HIN). The analysis cohort was restricted to first primary malignant cases of bladder, female breast, colorectal, kidney, lung and pancreatic cancer as well as melanoma, diagnosed from 2011 to 2015 with valid HIN numbers. DCO and autopsy only cases were excluded.

The comorbidity time span was defined as one year prior to diagnosis to one month post diagnosis. Comorbidity was measured using the Charlson Comorbidity Index (CCI).[19] There is no "gold standard" for measuring comorbidity in the context of cancer, so the most commonly used index was selected.[20] The CCI index was developed to predict three-year mortality in medical inpatients and was subsequently validated in people with cancer.[21, 22] Comorbid conditions are assigned weights based on the ratio of the mortality risk for patients with the comorbidity of interest versus the mortality risk for those without. The sum of the weights for all of the conditions is calculated to create a comorbidity index for each patient. We modified the CCI index to exclude metastatic carcinomas because it was not possible to distinguish between metastases for other cancers and metastases for the cancer of interest, the latter not being considered comorbidity.

Survival analysis were done in SAS v 9.2 using a publicly available algorithm,[23] with some minor adaptations. Expected survival proportions were derived using the Ederer II approach,[24] from provincial life tables produced by Statistics Canada. Relative survival ratios (RSRs) were estimated by the period method.

WAIT TIME

Data on wait time to treatment were extracted from CCO's Wait Time Information System (WTIS). The analysis focused on "Wait 2" — the time from the decision to treat with surgery to the first therapeutic surgery. Once the decision to treat the cancer with surgery is made, the patient is assigned a priority level. Priority level is based on the invasiveness of the cancer.[25] There are four priority levels: one (surgery recommended within 24 hours); two (highly aggressive malignancies, surgery recommended within 14 days); three (invasive malignancies that do not meet the criteria for priority two or four, surgery recommended with 28 days); and four (slow-growing malignancies, surgery recommended within 84 days). Wait caused by the patient being unavailable for the procedure due to patient-related reasons were excluded from the final wait time. These delays are known as Dates Affecting Readiness to Treat (DART) and do not include system-related delays such as surgeon unavailability or lack of hospital resources.

The analysis cohort was restricted to adult first primary malignant cases of female breast, colorectal, esophageal, lung, oral cavity & pharynx, ovarian and pancreatic cancers, diagnosed from 2011 to 2015 with a valid HIN number and for which the primary method of treatment was surgical. WTIS data was linked to OCR data through HIN number. DCO and autopsy only cases were excluded. In addition, cases were the surgeon and patient decide to take a "watchful waiting" approach to care were excluded. The analysis cohort was then further narrowed to cases for which the cancer diagnosis and first therapeutic surgery type matched.

The same survival methodology that was used for the comorbidity analysis was used for the wait time analysis. The one exception is that the wait time analysis reports observed survival, rather than relative survival. This is because this analysis is restricted to patients who received surgical treatment. Existing life tables do not accurately reflect this population. As a result, we decided to only report observed survival estimates.

SURVIVAL

RSRs are estimated by comparing the survival of people with cancer to the expected survival for the general population of Ontarians of the same age and sex during the same time period. Relative survival shows the extent to which a diagnosis of cancer shortens a life span. The RSR is usually expressed as a percent. The closer the value is to 100%, the more similar the survival pattern is to the general population.

Survival analyses were based on first primary cancers. RSRs are provided for cases diagnosed in people between 15 and 99 years of age. Cases were excluded from the survival analyses if the age of the person was unknown, they were diagnosed on the basis of an autopsy only, or when the date of diagnosis and date of death were the same (i.e., DCO cases where the diagnosis happened at or following death). (See Table TA.1 for details on DCO cases.)

Relative and conditional survival analyses were performed using CCO SEER*Stat software (version 8.3.2). Expected survival proportions were derived using the Ederer II approach[24] from provincial life tables produced by Statistics Canada. It should be noted that 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 should be taken into account when interpreting the estimates.

RSRs were estimated by the cohort method when complete follow-up data after diagnosis (e.g., at least five years of follow-up to estimate a five-year ratio) were available. For recently diagnosed cases whose complete follow-up data were not available, the estimates were computed using the period method. Period analysis uses the survival experience of people in a recent time interval to estimate survival.[26] The period method, modeled after period life tables, allows for more up to date estimates because it means analysis does not have wait for data on the full follow-up period (e.g., five years for a five-year ratio). Comparisons between cohort and period RSRs should be interpreted with caution because of the two different methods used to derive the respective ratios.

RSRs were age-standardized by weighting with the International Cancer Survival Standard (ICSS) weights.[27] (See Table TA.8 for details on weightings).

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

Age groups (years)	Weightings	Cancer types
15–44, 45–54, 55–64, 65–74, 75–100	60, 10, 10, 10, 10	Testis, Hodgkin lymphoma, acute lymphatic leukemia
15–44, 45–54, 55–64, 65–74, 75–100	28, 17, 21, 20,14	Nasopharynx, soft tissues, melanoma, cervix uteri, brain, thyroid gland, bone
15–44, 45–54, 55–64, 65–74, 75–100	7, 12, 23, 29, 29	All other cancer types except prostate
15–54, 55–64, 65–74, 75–84, 85–100	19, 23, 29, 23, 6	Prostate

Data Source: Corazziari I, Quinn M, Capocaccia R. Standard cancer patient population for age standardizing survival ratios. Eur J Cancer. 2004;40(15):2307-16.

PREVALENCE

Prevalence analyses were performed using CCO SEER*Stat software (version 8.3.2). This report provides person-based limited duration prevalence; that is, the number of people diagnosed with malignant cancer over a specific time period (e.g., two years, five years or 10 years) who were still alive on the index date. The chosen index date was January 1, 2014.

Multiple primary cancers were treated as follows: only the first primary was included in the prevalence count for all cancers combined, but for individual cancer types, each individual could contribute a case for each cancer. For example, a person 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 but twice in the individual cancer type counts (i.e., once in the prostate prevalence count and once in the colorectal prevalence count).

This appendix presented an overview of the methodologies used in this report. For more information or further details please contact us at: **surveillance@cancercare.on.ca.**

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Data appendix

Table DA.1 Incidence counts and age-standardized rates by public health unit for males and all cancers combined, Ontario, 2013

PHU	Count	ASIR	95% CI
Ontario	**38,453**	**605.1**	**599.0–611.2**
Algoma	624	842.2*	776.2–912.7
Brant County	424	618.4	560.7–680.4
Chatham-Kent	369	635.6	571.8–704.8
Durham Region	1,731	637.5*	607.3–668.8
Eastern Ontario	695	620.6	574.7–669.2
Elgin-St. Thomas	301	669.2	594.7–750.5
Grey Bruce	667	636.4	588.1–687.9
Haldimand-Norfolk	447	713.1*	647.5–783.7
Haliburton, Kawartha, Pine Ridge District	791	636.9	592.1–684.5
Halton Region	1,300	569.7*	538.8–601.8
Hamilton	1,695	640.4*	610.2–671.6
Hastings and Prince Edward Counties	726	738.7*	685.3–795.5
Huron County	254	708.5*	622.4–803.7
Kingston, Frontenac and Lennox & Addington	608	579.9	534.3–628.4
Lambton	462	617.8	562.1–677.8
Leeds, Grenville and Lanark District	620	612.3	564.2–663.7
Middlesex-London	1,347	631.2	597.8–665.9
Niagara Region	1,626	643.5*	612.4–675.9
North Bay Parry Sound District	504	651.4	594.7–712.3
Northwestern	176	451.2*	386.3–523.7
Ottawa	2,431	601.0	577.1–625.6
Oxford County	369	648.5	583.8–718.4
Peel	2,901	542.1*	521.9–562.8
Perth District	207	526.5*	457.0–603.5
Peterborough County-City	508	611.3	558.7–667.8
Porcupine	282	650.5	575.0–733.1
Region of Waterloo	1,297	579.8	548.4–612.5
Renfrew County and District	370	619.0	557.1–686.2
Simcoe Muskoka District	1,791	640.1*	610.5–670.7
Sudbury and District	717	679.8*	630.3–732.2
Thunder Bay District	522	635.4	581.6–692.9
Timiskaming	163	765.9*	650.7–896.9
Toronto	6,942	570.0*	556.7–583.6
Wellington-Dufferin-Guelph	700	559.6*	518.5–603.1
Windsor-Essex County	1,262	642.9*	607.7–679.6
York Region	2,565	550.4*	528.8–572.6

ASIR=Age-standardized incidence rate
CI=Confidence interval
PHU=Public health unit
*Significantly different compared to the rate for Ontario
Note: Rates are per 100,000 and age-standardized to the 2011 Canadian population.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

Table DA.2 Incidence counts and age-standardized rates by public health unit for females and all cancers combined, Ontario, 2013

PHU	Count	ASIR	95% CI
Ontario	**38,635**	**523.3**	**518.1–528.6**
Algoma	535	680.5*	622.2–743.1
Brant County	397	492.2	444.6–543.6
Chatham-Kent	376	564.4	507.4–626.2
Durham Region	1,723	532.2	507.4–558.0
Eastern Ontario	710	571.1*	529.4–615.3
Elgin-St. Thomas	234	460.2	402.6–523.8
Grey Bruce	603	540.4	496.5–587.4
Haldimand-Norfolk	393	570.2	514.0–631.2
Haliburton, Kawartha, Pine Ridge District	701	557.4	514.8–603.0
Halton Region	1,401	506.7	480.4–534.0
Hamilton	1,582	512.1	486.8–538.3
Hastings and Prince Edward Counties	605	566.5	521.1–615.0
Huron County	221	554.7	481.7–636.3
Kingston, Frontenac and Lennox & Addington	589	489.9	450.5–531.9
Lambton	430	514.6	465.9–567.2
Leeds, Grenville and Lanark District	672	581.2*	537.1–628.2
Middlesex-London	1,305	506.7	479.3–535.3
Niagara Region	1,541	539.9	512.6–568.3
North Bay Parry Sound District	428	515.0	466.3–567.8
Northwestern	187	449.1*	386.8–518.7
Ottawa	2,454	506.4	486.5–527.0
Oxford County	355	559.2	501.7–621.6
Peel	2,999	476.2*	459.2–493.7
Perth District	244	541.7	474.7–615.7
Peterborough County-City	467	495.0	449.7–544.0
Porcupine	278	590.2	522.6–664.4
Region of Waterloo	1,359	517.6	490.4–546.0
Renfrew County and District	349	537.4	481.1–598.8
Simcoe Muskoka District	1,793	574.2*	547.7–601.8
Sudbury and District	691	583.9*	540.8–629.7
Thunder Bay District	499	548.7	501.0–599.8
Timiskaming	120	542.3	447.7–652.3
Toronto	7,688	516.0	504.4–527.8
Wellington-Dufferin-Guelph	768	529.0	492.2–567.9
Windsor-Essex County	1,211	539.5	509.3–571.1
York Region	2,678	489.8*	471.4–508.7

ASIR=Age-standardized incidence rate
CI=Confidence interval
PHU=Public health unit
*Significantly different compared to the rate for Ontario
Note: Rates are per 100,000 and age-standardized to the 2011 Canadian population.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

Table DA.3 Mortality counts and age-standardized rates by public health unit for males and all cancers combined, Ontario, 2013

PHU	Count	ASMR	95% CI
Ontario	**14,465**	**236.7**	**232.8–240.6**
Algoma	187	253.1	217.5–293.3
Brant County	181	274.3	235.6–317.4
Chatham-Kent	158	277.5	235.5–324.9
Durham Region	587	232.5	213.7–252.5
Eastern Ontario	328	300.2*	268.1–335.1
Elgin-St. Thomas	117	272.2	224.2–327.3
Grey Bruce	286	278.5*	246.6–313.6
Haldimand-Norfolk	184	297.3*	255.3–344.5
Haliburton, Kawartha, Pine Ridge District	326	263.7	235.2–295.0
Halton Region	482	224.7	204.8–245.8
Hamilton	684	261.7*	242.4–282.1
Hastings and Prince Edward Counties	275	286.2*	252.9–322.8
Huron County	80	217.0	171.5–271.6
Kingston, Frontenac and Lennox & Addington	287	282.9*	250.7–318.1
Lambton	187	255.2	219.6–295.3
Leeds, Grenville and Lanark District	298	307.3*	272.8–345.1
Middlesex-London	529	256.7	235.2–279.6
Niagara Region	672	266.3*	246.4–287.4
North Bay Parry Sound District	208	277.4*	240.2–319.0
Northwestern	83	224.1	177.9–278.4
Ottawa	894	234.1	218.9–250.1
Oxford County	158	280.0*	237.9–327.4
Peel	923	193.9*	181.1–207.3
Perth District	103	265.2	216.4–321.7
Peterborough County-City	232	275.7*	241.1–314.2
Porcupine	142	338.5*	283.5–400.8
Region of Waterloo	499	234.1	213.8–255.6
Renfrew County and District	175	300.9*	257.6–349.6
Simcoe Muskoka District	684	254.2	235.3–274.2
Sudbury and District	317	311.1*	277.2–348
Thunder Bay District	217	265.9	231.4–304.1
Timiskaming	76	356.5*	279.6–449.5
Toronto	2,386	199.5*	191.6–207.7
Wellington-Dufferin-Guelph	255	217.6	191.3–246.4
Windsor-Essex County	474	247.7	225.7–271.1
York Region	791	188.6*	175.3–202.6

ASMR=Age-standardized mortality rate
CI=Confidence interval
PHU=Public health unit
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Note: Rates are per 100,000 and age-standardized to the 2011 Canadian population.
Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

Table DA.4 Mortality counts and age-standardized rates by public health unit for females and all cancers combined, Ontario, 2013

PHU	Count	ASMR	95% CI
Ontario	**13,169**	**169.5**	**166.6–172.5**
Algoma	174	200.9*	171.6–234.3
Brant County	174	205.0*	175.5–238.3
Chatham-Kent	177	240.0*	205.2–279.6
Durham Region	572	176.2	162.0–191.3
Eastern Ontario	323	251.1*	224.2–280.6
Elgin-St. Thomas	111	208.8*	171.5–252.1
Grey Bruce	224	184.8	160.8–211.8
Haldimand-Norfolk	142	192.8	162.0–228.2
Haliburton, Kawartha, Pine Ridge District	267	189.8	167.1–215.3
Halton Region	446	155.2	141.0–170.4
Hamilton	598	177.1	163.0–192.3
Hastings and Prince Edward Counties	243	212.8*	186.3–242.3
Huron County	79	192.2	151.0–242.1
Kingston, Frontenac and Lennox & Addington	229	181.2	158.2–206.8
Lambton	175	186.3	159.3–217.0
Leeds, Grenville and Lanark District	263	211.7*	186.4–239.9
Middlesex-London	486	178.1	162.4–194.9
Niagara Region	602	191.0*	175.7–207.4
North Bay Parry Sound District	154	169.2	143.2–199.0
Northwestern	71	162.8	126.9–205.8
Ottawa	855	171.0	159.6–182.9
Oxford County	134	198.1	165.5–235.6
Peel	845	141.9*	132.4–151.8
Perth District	89	175.2	140.0–217.1
Peterborough County-City	189	176.0	151.0–204.4
Porcupine	102	208.5*	169.9–253.5
Region of Waterloo	446	165.7	150.6–181.9
Renfrew County and District	132	183.0	152.5–218.3
Simcoe Muskoka District	641	195.1*	180.2–211.0
Sudbury and District	236	187.2	163.9–213.0
Thunder Bay District	174	179.4	153.4–208.7
Timiskaming	45	182.4	132.5–247.3
Toronto	2,351	146.7*	140.8–152.9
Wellington-Dufferin-Guelph	293	194.5*	172.8–218.2
Windsor-Essex County	432	182.6	165.6–200.9
York Region	695	130.4*	120.8–140.4

ASMR=Age-standardized mortality rate
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PHU=Public health unit
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Analysis by: Surveillance, Analytics and Informatics, CCO
Data source: Ontario Cancer Registry (November 2016), CCO

Related resources

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

See **cancercareontario.ca/ontariocancerprofiles**

CCO SEER*Stat is a statistical software package containing Ontario cancer incidence and mortality data from the Ontario Cancer Registry and is available for the purpose of health planning, management or research.

See **cancercareontario.ca/seerstat**

Cancer System Quality Index is a web-based tool that reports on a variety of evidence-based indicators covering every aspect of cancer control, from cancer prevention to end-of-life care and tracking progress against six dimensions of quality.

See **csqi.on.ca**

Ontario Cancer Facts are short, monthly fact sheets intended to increase knowledge about cancer and its risk modifiers in Ontario. Data typically originate from several sources including the Ontario Cancer Registry, Cancer Care Ontario publications, and federal, provincial or regional health surveys. Readers may subscribe to receive Ontario Cancer Facts by email.

See **cancercareontario.ca/cancerfacts**

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

See **cancercareontario.ca/riskfactor**

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Cancer Care Ontario

Working together to create the best health systems in the world

Cancer Care Ontario
620 University Avenue
Toronto, ON M5G 2L7
416.971.9800

publicaffairs@cancercare.on.ca
cancercareontario.ca

Ontario
Cancer Care Ontario