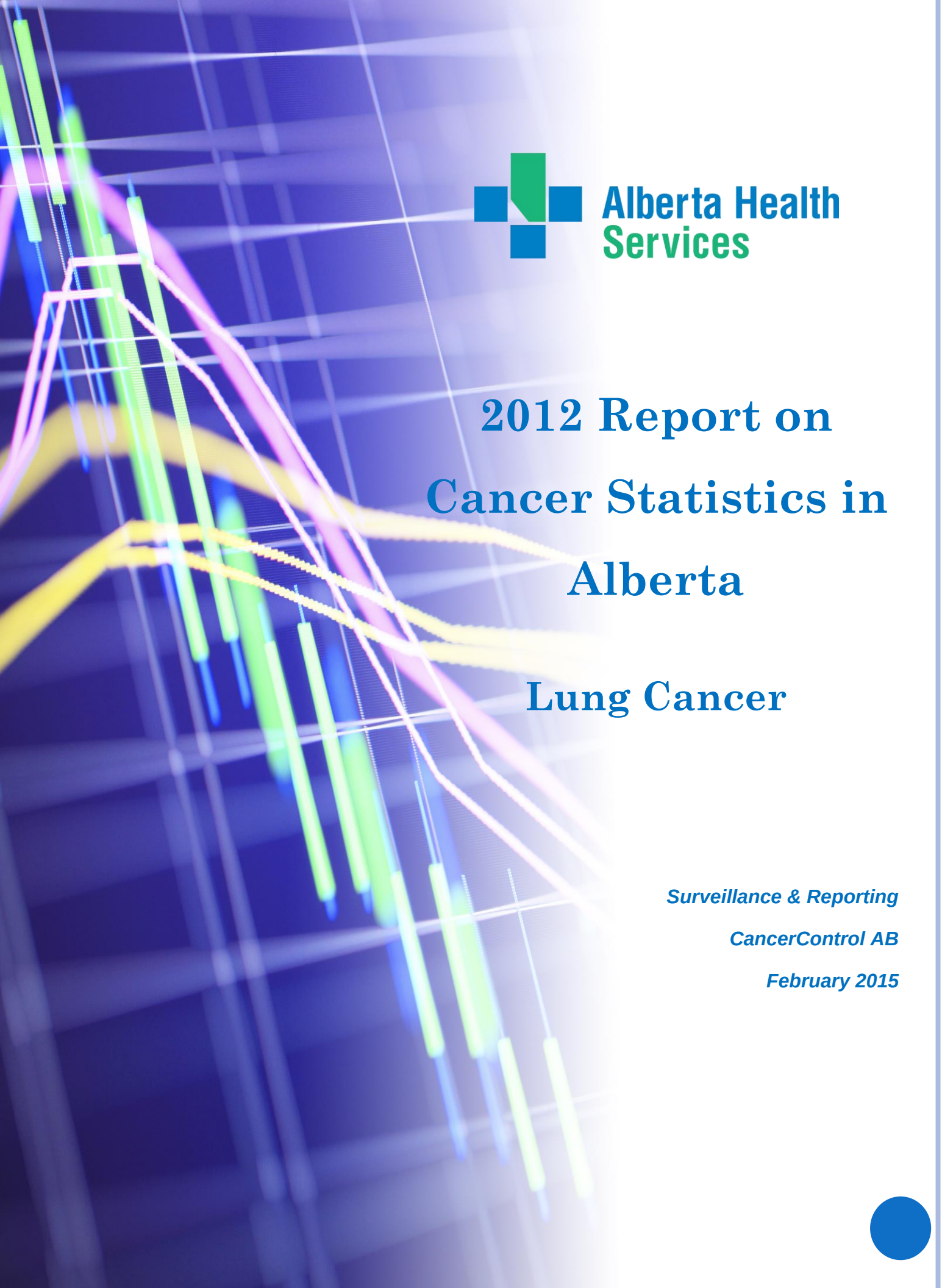

Alberta Health Services

2012 Report on Cancer Statistics in Alberta

Lung Cancer

Surveillance & Reporting

CancerControl AB

February 2015

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Purpose of the Report

Surveillance & Reporting, a specialized team within Cancer Measurement Outcomes Research and Evaluation (C-MORE), Alberta Health Services, actively contributes to Changing our Future: Alberta's Cancer Plan to 2030. As well, Surveillance & Reporting keenly contributes to the goal of making Alberta a place where most cancers are prevented, more cancers are cured, and suffering is reduced. This is accomplished in part by conducting cancer ***surveillance*** through the collection, integration, analysis, and dissemination of cancer-related data and information.

The report is designed to provide comprehensive and detailed information regarding cancer in Alberta. It will help support health professionals, researchers and policy makers in the planning, monitoring and evaluation of cancer-related health programs and initiatives. It will also be a useful education tool for the general public and media.

Navigating the Report

This document provides information on lung cancer (see **Appendix** for cancer definitions) statistics in Alberta. Small cell lung cancer and non-small cell lung cancer are combined in this report. Details about other individual cancer types are available within separate documents. The words highlighted in ***dark blue*** are terms described in detail in the Glossary within the **Appendix** document.

Data Notes

In this document, the term "cancer" refers to ***invasive cancers*** unless otherwise specified. It is important to note that this document contains both actual and estimated data; distinctions are made where applicable. The numbers published in this report should be considered provisional, as a few cases and deaths may be registered in subsequent years. The data in this report reflect the state of the Alberta Cancer Registry as of July 14, 2014.

For detailed descriptions about data sources and how they affect data presented in this report, please see the **Appendix** document.

Summary

- Approximately **1 in 13** men and **1 in 14** women will develop invasive lung cancer within their lifetime. It accounts for **12%** of all cancers diagnosed and **25%** of all cancer deaths.

- Lung cancer is frequently diagnosed at a late stage when outcomes are poor. Lung cancer has the highest potential years of life lost (PYLL) of all cancer types. PYLL is the number of years of life lost when a person dies prematurely from any cause, based on their life expectancy. In 2012, **21,578** potential years of life were lost due to lung cancer. As of December 31, 2012, approximately **4,450** Albertans were alive who had previously been diagnosed with lung cancer.

- Lung cancer is the third most commonly diagnosed cancer in males with **946** diagnosed in 2012 and the second most commonly diagnosed in females at **992**. Approximately **2,350** cases of lung cancer are expected to be diagnosed in 2017. Incidence and mortality rates for men have decreased between 1992 and 2012. In females lung cancer incidence rates increased between 1992 and 2008 and were stable after 2008. F**emale** lung cancer **mortality rates have increased** over the period 1992 to 2004*. Lung cancer incidence and mortality rates are lower in the Calgary Zone than in the rest of the province.

- Age-specific incidence rates for lung cancer in both sexes increase rapidly after the age of 45. After the age of 65, rates for females are lower than for males, and decline after age 75, while male rates decline after 80.

- Generally, cancers diagnosed in earlier stages (I & II) have better survival. Unfortunately, less than **23%** of lung cancer cases are diagnosed in stages I & II. For patients diagnosed in stage I survival is **64%** in males and **77%** in females and decreases to **5%** for males and females diagnosed in stage IV.

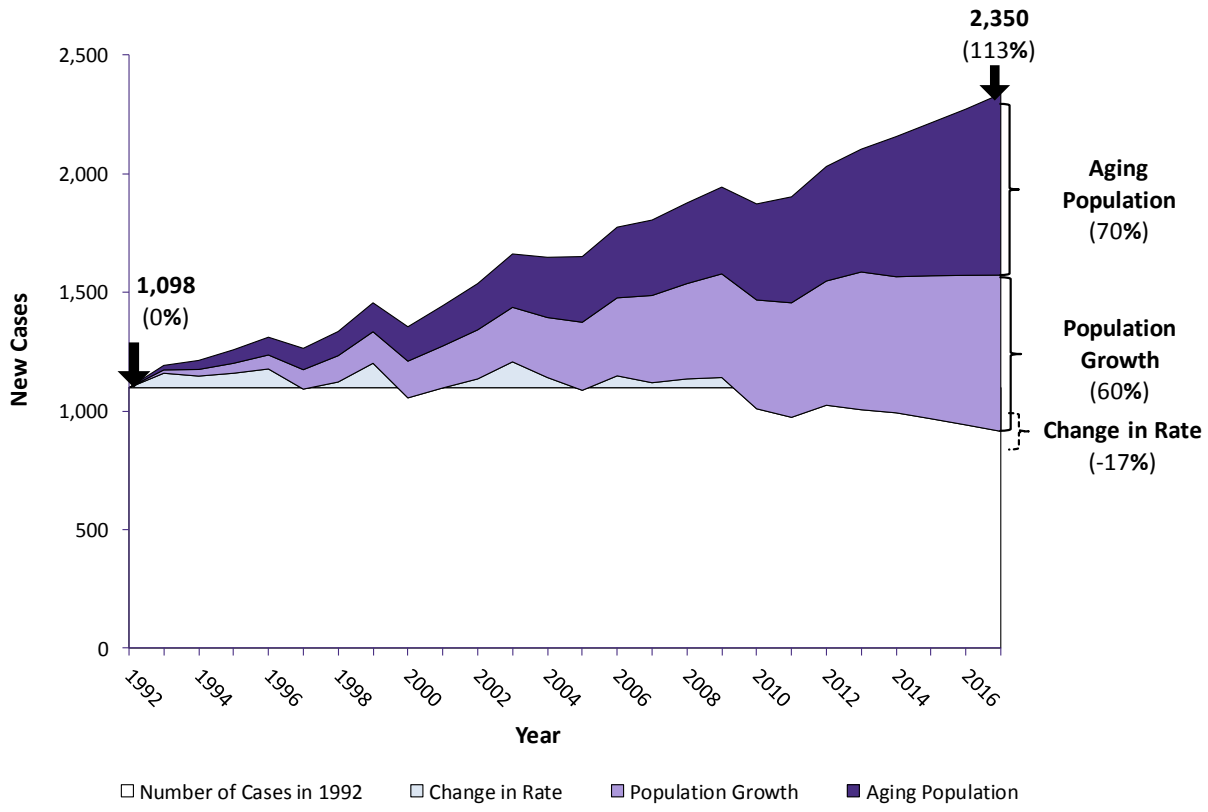
- The five-year relative survival for lung cancer in Alberta is approximately **17%** for those diagnosed between 2010 and 2012, an improvement over those diagnosed in 1992-1994 (**12%).** This means that those diagnosed in 2010 to 2012 are about **17%** as likely to be alive 5 years after their diagnoses as someone who has not been diagnosed with cancer.

*Year range represents the period over which the most recent significant trend was observed.

Demography

Changes in demography in Alberta (aging of the population and population growth) contributed far more new cases of lung cancer in both males and females (**Figure 5-1**) over the last two decades as compared to the substantial reduction in the lung cancer rate.

Figure 5-1: Trends in New Cases Lung Cancer Attributed to Aging Population, Population Growth and Change in Lung Cancer Rate, Both Sexes, Alberta, 1992-2017



Data Source: Alberta Cancer Registry, Alberta Health Services; Alberta Health

The horizontal black line indicating 1,098 new cases in **Figure 5-1** represents the number of lung cancer cases that occurred in 1992. The line at the top of the dark purple-shaded area of the graph represents the number of new cases that actually occurred between 1992 and 2012, projected to 2017. Between these two lines, the three colored areas reflect the increase in lung cancer cases due to the impact of rate change, population growth and aging population.

The light blue shaded area (above the horizontal black line and overlapped by the light purple shaded area in 2009-2017) represents the total number of new lung cancer cases that would have occurred each year if the cancer incidence rates alone had changed but the population had remained the same as in 1992. This will account for approximately a 17% decrease in lung cancer cases in 2017 reflecting the historic decrease in tobacco use.

The light purple shaded area (middle) represents the number of new lung cancer cases that would have occurred each year if the population alone had grown larger but the population age distribution had remained the same as in 1992. This will account for approximately 60% of the total increase in new lung cancer cases in 2017.

The dark purple shaded area (top) represents the number of new lung cancer cases attributed to increases in the older adult population - the aging population. This will account for approximately 70% of the total increase in new lung cancer cases. Lung cancer incidence increases with age, particularly after the age of 40 years, for both males and females (Figure 5-8).

The trends of new lung cancer cases are different between males and females. In 1992, there were 411 new cases in females and 687 new cases in males. In 2017, however, 1,200 new cases are projected in females, accounting for 192% increase from 1992, where approximately 76% will be due to the change in female lung cancer rate, 58% due to the population growth, and 58% is due to aging population. About 1,150 new lung cancer cases are estimated in males, accounting for 65% increase from 1992, where reduction in male lung cancer rate will account for 79% reduction in lung cancer cases, approximately 62% increase in new male lung cancer cases will be due to population growth, and approximately 83% due to aging population.

Probability of Developing or Dying from Lung Cancer

The ***probability of developing or dying of cancer*** measures the risk of an individual in a given age range developing or dying of cancer, and is conditional on the person being lung cancer-free prior to the beginning of that age range.

It is important to note that the probabilities of developing or dying of cancer represent all of Alberta's population on average and should be interpreted with caution at the individual level as the probabilities will be affected by the risk behaviours and exposures of the individual. In addition, someone diagnosed with cancer has a higher probability of developing another cancer in the future.[1]

Table 5-1: Probability of Developing Lung Cancer by Age and Sex, Alberta, 2008-2012

Age Group	Males	Females
Lifetime Risk (all ages)	**1 in 13**	**1 in 14**
0 - 20	**Less than 1 in 10,000**	**Less than 1 in 10,000**
20 - 30	**Less than 1 in 10,000**	**Less than 1 in 10,000**
30 - 40	**1 in 9,651**	**1 in 7,459**
40 - 50	**1 in 973**	**1 in 665**
50 - 60	**1 in 169**	**1 in 154**
60 - 70	**1 in 51**	**1 in 51**
70 - 80	**1 in 26**	**1 in 32**
80+	**1 in 23**	**1 in 34**

Data Source: Alberta Cancer Registry, Alberta Health Services

The probability of developing lung cancer increases with age (**Table 5-1**). Approximately 1 in 13 males and 1 in 14 females will develop invasive lung cancer in their lifetime.

On a population basis the probability of developing lung cancer by the end of the age range for a lung cancer-free individual at the beginning of the age range are shown in **Table 5-1**. For instance, a lung cancer-free female at age 40 has a 1 in 665 chance of developing lung cancer by the time she is 50.

Table 5-2: Probability of Dying from Lung Cancer by Age and Sex, Alberta, 2008-2012

Age Group	Males	Females
Lifetime Risk (all ages)	1 in 16	1 in 18
0 - 20	Less than 1 in 10,000	Less than 1 in 10,000
20 - 30	Less than 1 in 10,000	Less than 1 in 10,000
30 - 40	Less than 1 in 10,000	Less than 1 in 10,000
40 - 50	1 in 1,694	1 in 1,168
50 - 60	1 in 246	1 in 248
60 - 70	1 in 73	1 in 78
70 - 80	1 in 34	1 in 45
80+	1 in 25	1 in 36

Data Source: Alberta Cancer Registry, Alberta Health Services

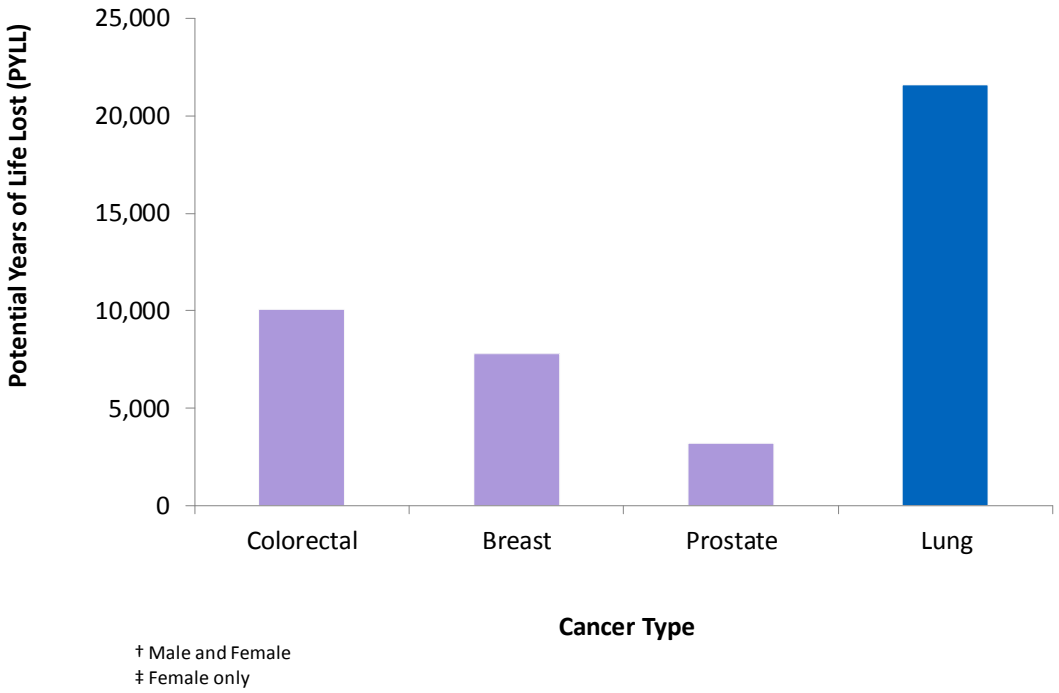
The probability of dying from lung cancer varies by age and sex (**Table 5-2**). Approximately 1 in 16 males and 1 in 18 females will die of invasive lung cancer.

On a population basis the probability of a cancer-free individual at the beginning of the age range dying from lung cancer by the end of the age range are shown in **Table 5-2**. For example, a cancer-free female at age 40 has a 1 in 1,168 chance of dying from lung cancer by the time she is 50.

Potential Years of Life Lost

One frequently used measure of premature death is ***potential years of life lost (PYLL)***. PYLL due to cancer is an estimate of the number of years that people would have lived had they not died from cancer. PYLL due to cancer has been calculated by multiplying the number of deaths in each age group and the absolute difference between the mid-point age of an age group and the age-specific life expectancy. The age-specific life expectancy is calculated by determining the age to which an individual would have been expected to live had they not died from cancer. PYLL is one way to measure the impact, or burden, of a disease on a population.

Figure 5-2: Potential Years of Life Lost (PYLL) from Lung Cancer† Compared with Colorectal†, Breast‡ and Prostate, Alberta, 2012



† Male and Female
‡ Female only

Data Source: Alberta Cancer Registry, Alberta Health Services; Statistics Canada

In 2012, **21,578** potential years of life were lost due to lung cancer, which constitutes 23.3% of PYLL for all cancers (**Figure 5-2**). Lung cancer is the largest single site contributor to PYLL.

Prevalence

The ***prevalence*** of a disease is defined as the number of people alive who had been previously diagnosed with that disease.

Limited-duration lung cancer prevalence represents the number of people alive on a certain day who had previously been diagnosed with lung cancer within a specified number of years (e.g. 2, 5, 10 or 20 years) while complete lung cancer prevalence represents the proportion of people alive on a certain day who had previously been diagnosed with lung cancer, regardless of how long ago the diagnosis was.[2]

In this section of the report, both limited-duration and complete lung cancer prevalence are presented; the latter describing the number of people alive as of December 31, 2012 who had ever been diagnosed with lung cancer.

Prevalence is a useful indicator of the impact of cancer on individuals, the healthcare system and the community as a whole. Although many cancer survivors lead healthy and productive lives, the experience can have a strong impact on the physical and emotional well-being of individuals and their families. The cancer experience can also result in the continued use of the healthcare system through rehabilitation or support services, as well as loss of work productivity that can affect the whole community.

As of December 31, 2012, approximately **4,450** Albertans were alive who had previously been diagnosed with lung cancer (**Table 5-3**). In addition, there were **1,750** Albertans alive who had been diagnosed with lung cancer within the previous two years. The two year time period is significant because most definitive cancer treatments will occur within two years of diagnosis.

Table 5-3: Limited-Duration and Complete Prevalence for Lung Cancer, Both Sexes, Alberta, 2012

Duration	Prevalence (#)
2-Year	1,750
5-Year	2,750
10-Year	3,550
20-Year	4,150
Complete (Ever Diagnosed)	4,450

Data Source: Alberta Cancer Registry, Alberta Health Services

Lung Cancer Incidence and Mortality

Introduction

Incidence counts are the number of new cancer cases diagnosed during a specific time period in a specific population. In this section of the report, incidence counts refer to the number of new lung cancer diagnoses in Alberta residents in a calendar year. Incidence ***rates*** are the number of new cancer cases diagnosed per 100,000 in the population in a specific time period.

Mortality counts describe the number of deaths attributed to cancer during a specific period of time in a specific population. In this section of the report, mortality refers to the number of deaths due to lung cancer in Alberta residents in a calendar year, regardless of date of diagnosis. Mortality rates are the number of deaths per 100,000 in the population in a specific time period.

In order to compare cancer incidence or cancer mortality over time or between populations, ***age-standardized incidence rates (ASIRs)*** or ***age-standardized mortality rates (ASMRs)*** are presented. These are weighted averages of ***age-specific rates*** using a standard population. These rates are useful because they are adjusted for differences in age distributions in a population over time, which permit comparisons of cancer incidence or mortality among populations that differ in size, structure and/or time period. ASIRs and ASMRs give the overall incidence and mortality rates that would have occurred if the population of Alberta had been the same as the standard population. In this report the Canadian 1991 standard population is used.

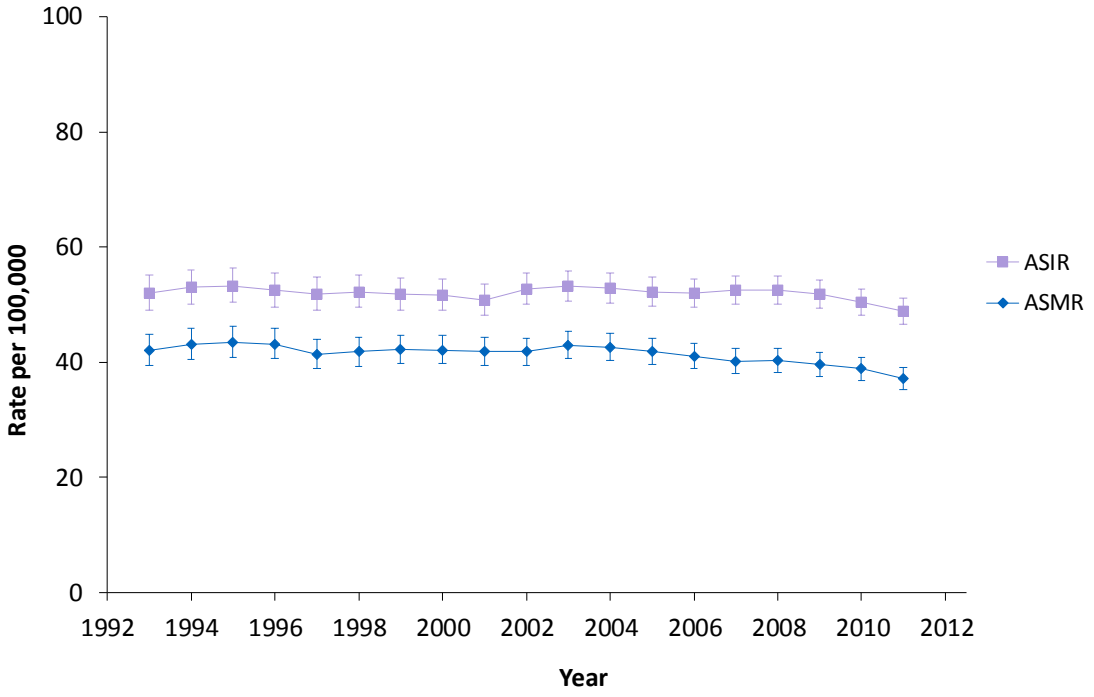
Three-year moving averages are used to smooth out year-to-year fluctuations so that the underlying trend may be more easily observed. They are calculated based on aggregating three years of data. Age-standardized incidence rates (ASIRs) and age-standardized mortality rates (ASMRs) are presented as three-year moving averages; therefore, information can only be presented for 1993-2011. This smoothing of trends is especially important when the number of cancer cases per year is relatively small, where year-to-year variability can be quite large.

Incidence and mortality can be affected by the implementation of public health prevention or screening strategies that either prevent disease or find cancer in its early ***stages*** when treatment is generally more successful, the development of cancer treatment programs that may impact chances of survival and research innovations.

The following figures show incidence and mortality trends in Alberta. Separate analyses for both incidence and mortality are shown in subsequent sections. The statistical significance* of the trends was determined by using Joinpoint[3] and is described in the text accompanying each graph. Joinpoint models are based on yearly rates; hence there may be slight differences in the rates presented in the text (from the Joinpoint model) and the graphs (where ASIRs and ASMRs are shown as three-year moving averages).

* Throughout this report, the use of the word significant refers to statistical significance at an alpha level of 0.05 (i.e. 95%CI).

Figure 5-3: Age-Standardized Incidence Rates (ASIRs)[*†] and Age-Standardized Mortality Rates (ASMRs)[*†] with 95% Confidence Intervals (CI) for Lung Cancer, Both Sexes, Alberta, 1992-2012



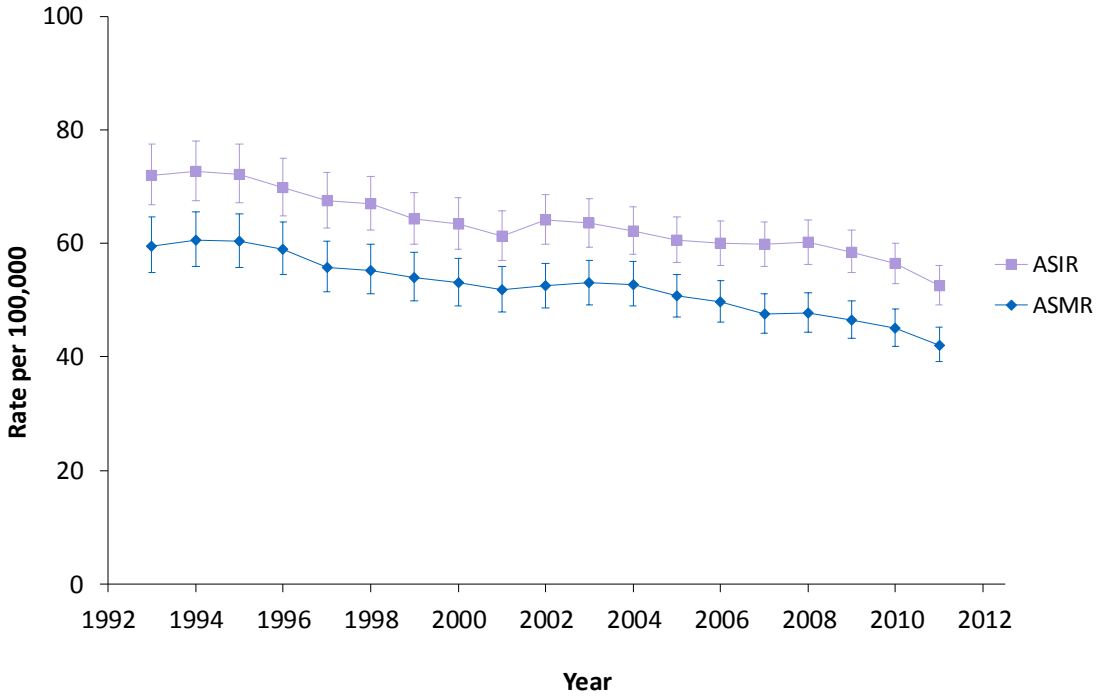
[*] Three-year moving average.
[†] Standardized to 1991 Canadian population.

Data Source: Alberta Cancer Registry, Alberta Health Services; Alberta Health

ASIRs for lung cancer did not change significantly since 1992 (**Figure 5-3)**. In 2012, the ASIR for lung cancer in both sexes was 48.1 per 100,000 population.

Mortality rates are lower than incidence rates (**Figure 5-3**). ASMRs for lung cancer did not change significantly from 1992 to 2005; however, between 2005 and 2012, the ASMR for lung cancer for both sexes combined has decreased significantly by 2.1% annually. In 2012, the ASMR for lung cancer in both sexes was 35.2 per 100,000 population.

Figure 5-4: Age-Standardized Incidence Rates (ASIRs)[*†] and Age-Standardized Mortality Rates (ASMRs)[*†] with 95% Confidence Intervals (CI) for Lung Cancer, Males, Alberta, 1992-2012



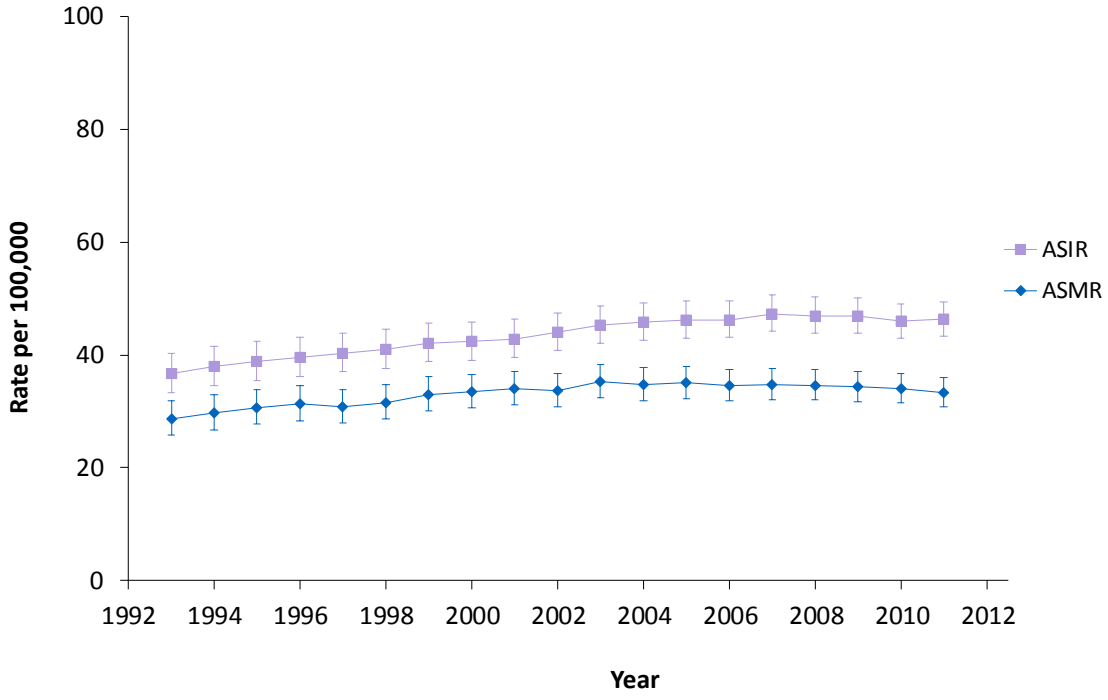
[*] Three-year moving average.
[†] Standardized to 1991 Canadian population.

Data Source: Alberta Cancer Registry, Alberta Health Services; Alberta Health

Male lung cancer ASIRs decreased significantly between 1992 and 2012 by an annual average of 1.5% (**Figure 5-4**). In 2012, the ASIR for lung cancer in males was 50.5 per 100,000 male population.

Male lung cancer ASMRs decreased significantly between 1992 and 2009 by 1.5% annually and between 2009 and 2012 by 5.9% annually (**Figure 5-4**). In 2012, the ASMR for lung cancer in males was 39.5 per 100,000 male population.

Figure 5-5: Age-Standardized Incidence Rates (ASIRs)[*†] and Age-Standardized Mortality Rates (ASMRs)[*†] with 95% Confidence Intervals (CI) for Lung Cancer, Females, Alberta, 1992-2012



[*] Three-year moving average.
[†] Standardized to 1991 Canadian population.

Data Source: Alberta Cancer Registry, Alberta Health Services; Alberta Health

Female lung cancer ASIRs increased significantly between 1992 and 2008 (**Figure 5-5**) by 1.9% annually and did not change significantly between 2008 and 2012. In 2012, the ASIR for lung cancer in females was 46.7 per 100,000 female population.

Over the period 1992 to 2004, female lung cancer ASMRs increased by 1.9% annually (**Figure 5-5**). Between 2004 and 2012 female lung cancer ASMRs did not change significantly. In 2012, the ASMR for lung cancer in females was 32.3 per 100,000 female population.

Lung Cancer Incidence

The following six figures (**Figures 5-6** to **5-11**) provide information on lung cancer incidence in Alberta. The number of new cancer cases in Alberta is affected not only by changes in the underlying risk of developing lung cancer, but also by the changes in the age structure and growth of the population. In order to compare trends over time, age-standardized incidence rates (ASIRs) are also provided.

In **Figures 5-6** and **5-7** observed age standardized incidence rates are shown for 1992 to 2011 (three-year moving averages), and ***projected*** rates for 2012 to 2017, and observed numbers of new lung cancer cases are shown for the years 1992 to 2012 and projected numbers for 2013 to 2017.

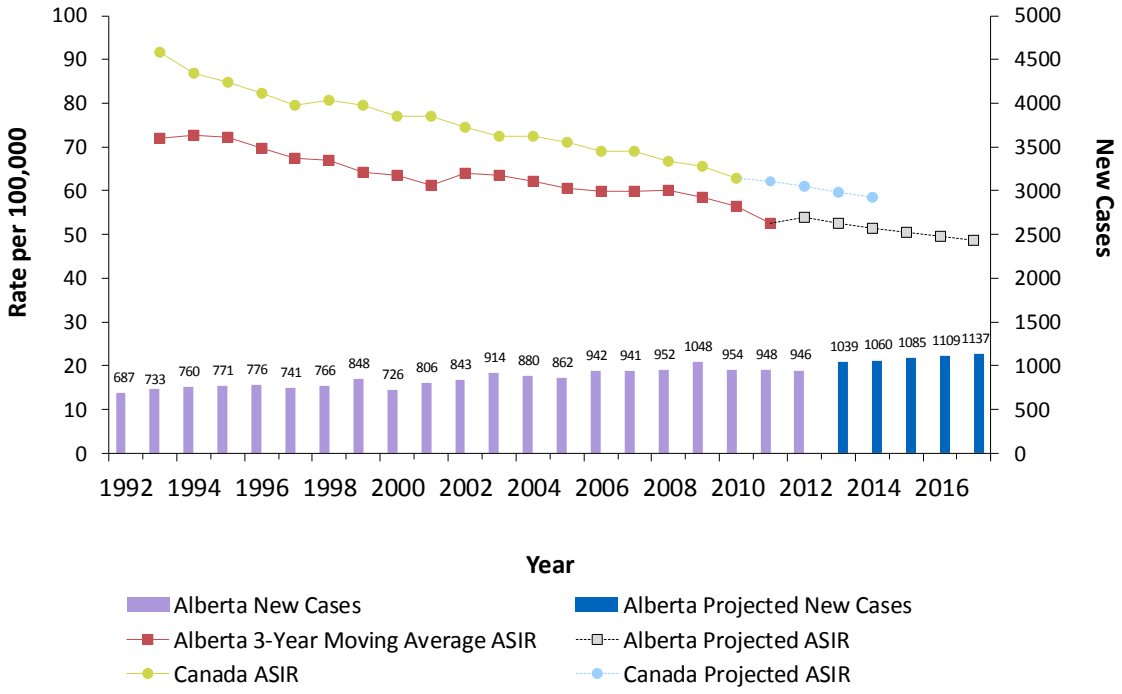
The projected cancer numbers were calculated by applying the estimated age-specific cancer incidence rates to the projected age-specific population figures provided by Alberta Health.[4] These were observed up to 2011 (due to the use of three-year moving averages) and estimated for 2012 to 2017. Caution should be exercised when comparing Canada[5] and Alberta rates as Canadian rates are yearly rates while Alberta rates are three-year moving averages.

The estimated lung cancer incidence rates were calculated by extrapolating the historical trends in age-specific rate based on data from 1987 to 2011.

Cancer stage is an important factor in determining treatment and ***prognosis***; generally, the earlier the diagnosis, the better the outcome. The American Joint Committee on Cancer (AJCC) classification defines cancer stage based on the knowledge that cancers of the same anatomic site and histology share similar patterns of growth and similar outcomes. The Alberta Cancer Registry started to record the stage at diagnosis in 2004 using the collaborative staging system which is based on AJCC, 6th Edition.[6]

Figure 5-11 provides information on the proportion of new cases diagnosed at each stage in three cohorts: 2004-2006, 2007-2009 and 2010-2012. Proportional and multiplicative odds models[7] are employed to analyze the annual change of cancer stage distribution.

Figure 5-6: Actual and Projected Number of New Cases and Age-Standardized Incidence Rates (ASIRs)*† with 95% Confidence Intervals (CI) for Lung Cancer, Males, Alberta, 1992-2017



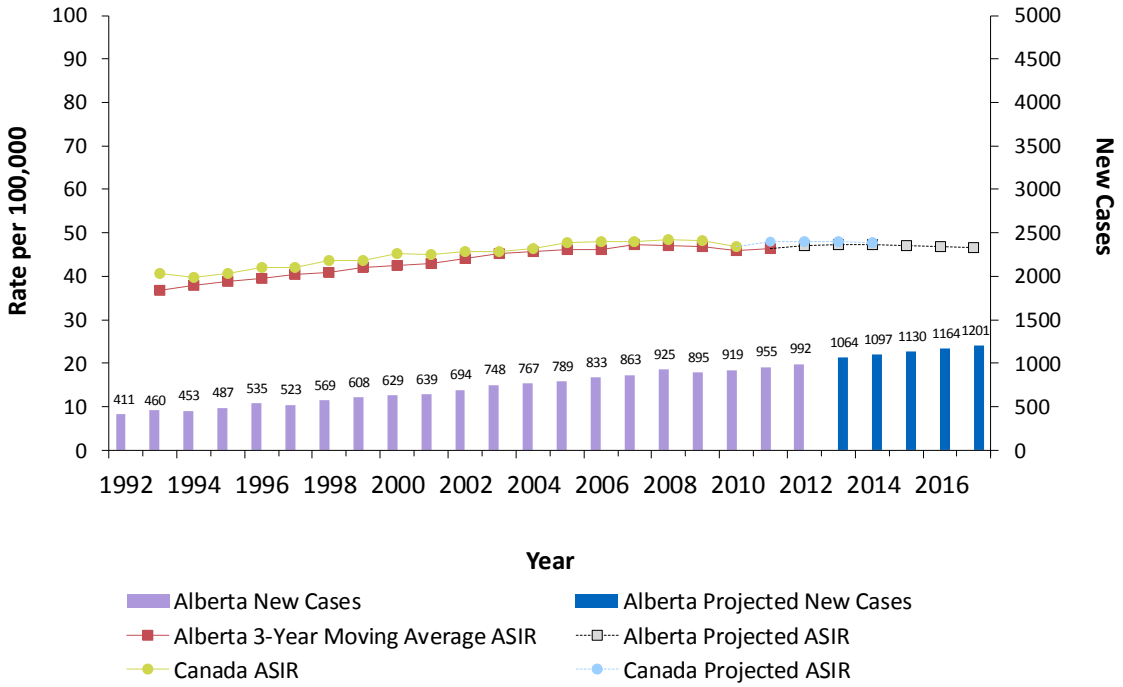
* Three-year moving average.
† Standardized to 1991 Canadian population.

Data Source: Alberta Cancer Registry, Alberta Health Services; Alberta Health; Canadian Cancer Society

In 2012, 946 cases of male lung cancer were diagnosed in Alberta (**Figure 5-6**). ASIRs for male lung cancer in Alberta were lower than ASIRs in Canada.

It is estimated that 1,150 cases of lung cancer will be diagnosed in males in Alberta in 2017.

Figure 5-7: Actual and Projected Number of New Cases and Age-Standardized Incidence Rates (ASIRs)[*†] with 95% Confidence Intervals (CI) for Lung Cancer, Females, Alberta, 1992-2017



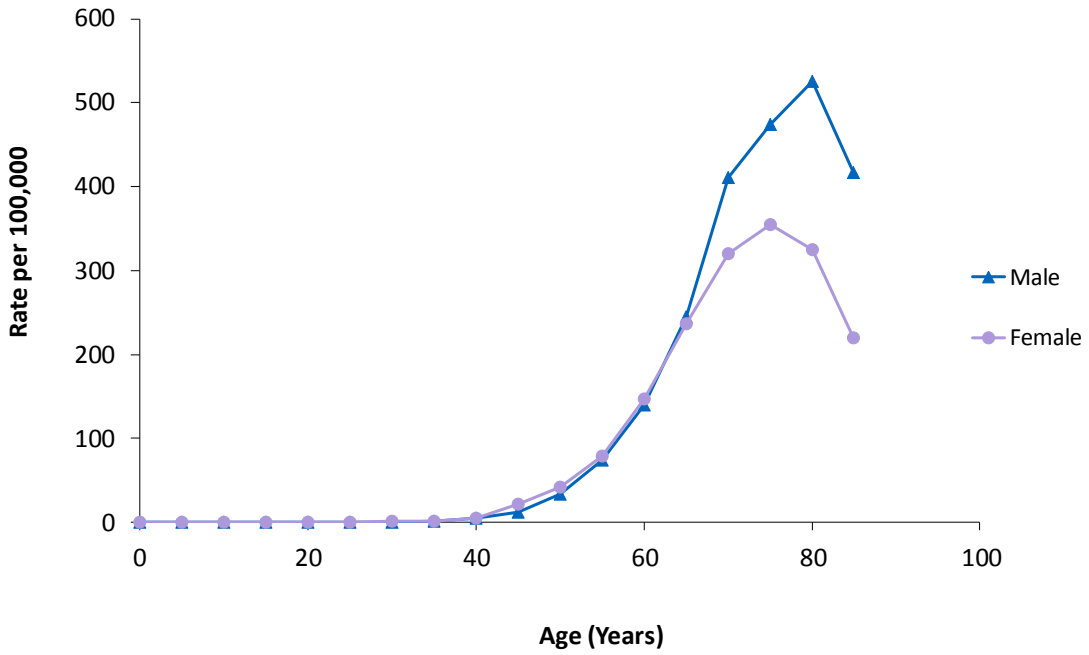
[*] Three-year moving average.
[†] Standardized to 1991 Canadian population.

Data Source: Alberta Cancer Registry, Alberta Health Services; Alberta Health; Canadian Cancer Society

In 2012, 992 cases of female lung cancer were diagnosed in Alberta (**Figure 5-7**); more than double the number of cases diagnosed in 1992. Overall, ASIRs for female lung cancer in Alberta were generally lower than ASIRs in Canada.

It is estimated that 1,200 cases of lung cancer will be diagnosed in females in Alberta in 2017.

Figure 5-8: Age-Specific Incidence Rates for Lung Cancer by Sex, Alberta, 2008-2012

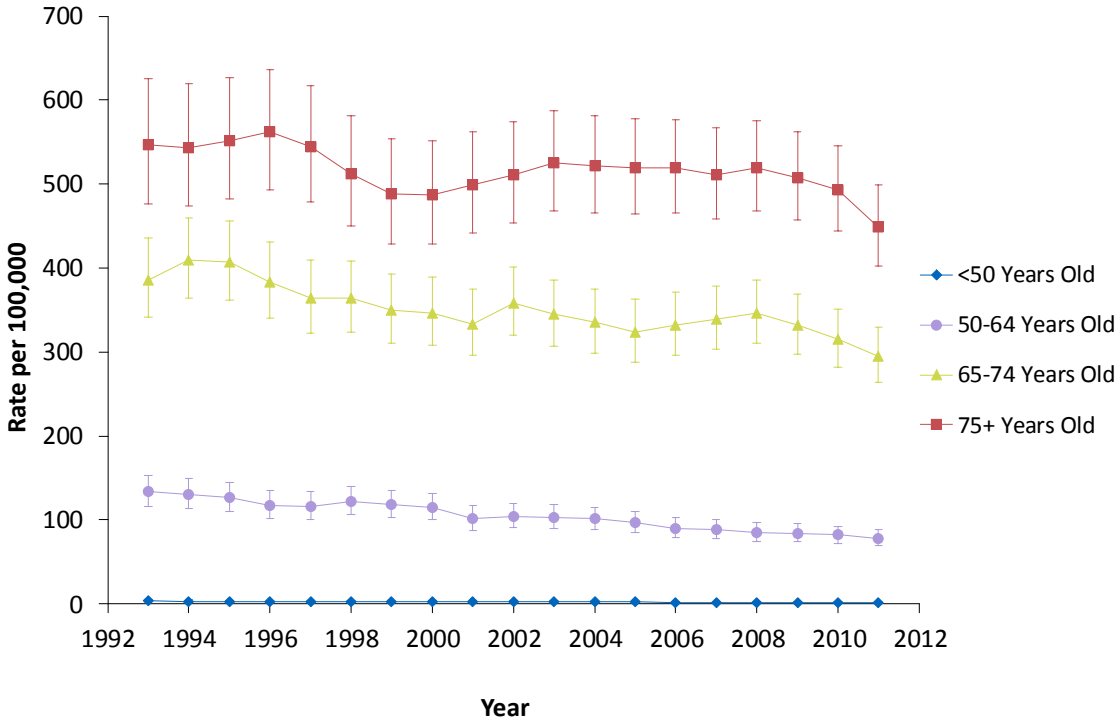


Data Source: Alberta Cancer Registry, Alberta Health Services; Alberta Health

Male and female lung cancer incidence rates differ by age (**Figure 5-8**). Age-specific incidence rates for lung cancer in both sexes increase rapidly after the age of 45. Female rates are similar to male rates until the age of 64 after which female incidence rates are lower compared to incidence rates in males.

Male incidence rate peaks at around age 80 and then declines, whereas female incidence rate peaks at around age 75 and declines thereafter (**Figure 5-8**).

Figure 5-9: Age-Standardized Incidence Rates (ASIRs)[*†] with 95% Confidence Intervals (CI) for Lung Cancer, Ages <50, 50-64, 65-74, and 75+, Males, Alberta, 1992-2012



[*] Three-year moving average.
[†] Standardized to 1991 Canadian population.

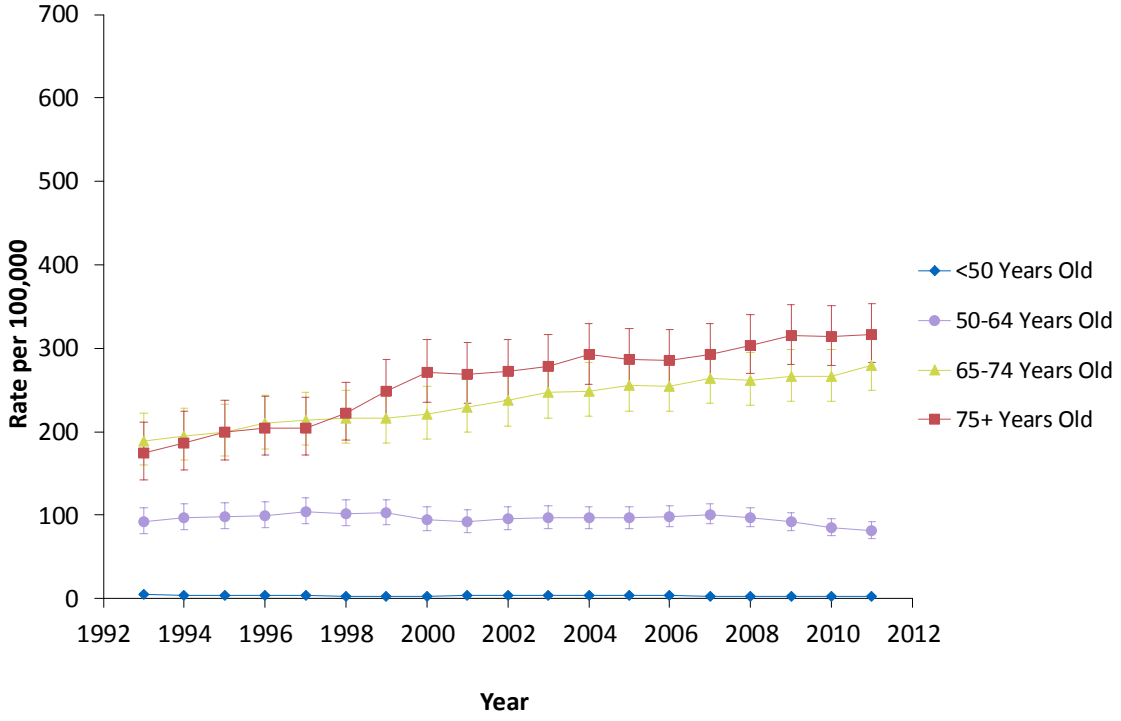
Data Source: Alberta Cancer Registry, Alberta Health Services; Alberta Health

Age-standardized lung cancer incidence rates for males differ across all four age groups (**Figure 5-9**).

Lung cancer incidence rates for males significantly decreased over the period 1992 to 2012 for the age groups <50 years, 50-64 years and 65-74 years by 4.0%, 3.0%, and 1.3% annually respectively.

Male lung cancer incidence rates for the 75+ age group were the highest among the age groups but did not change significantly between 1992 and 2012.

Figure 5-10: Age-Standardized Incidence Rates (ASIRs)*† with 95% Confidence Intervals (CI) for Lung Cancer, Ages <50, 50-64, 65-74, and 75+, Females, Alberta, 1992-2012



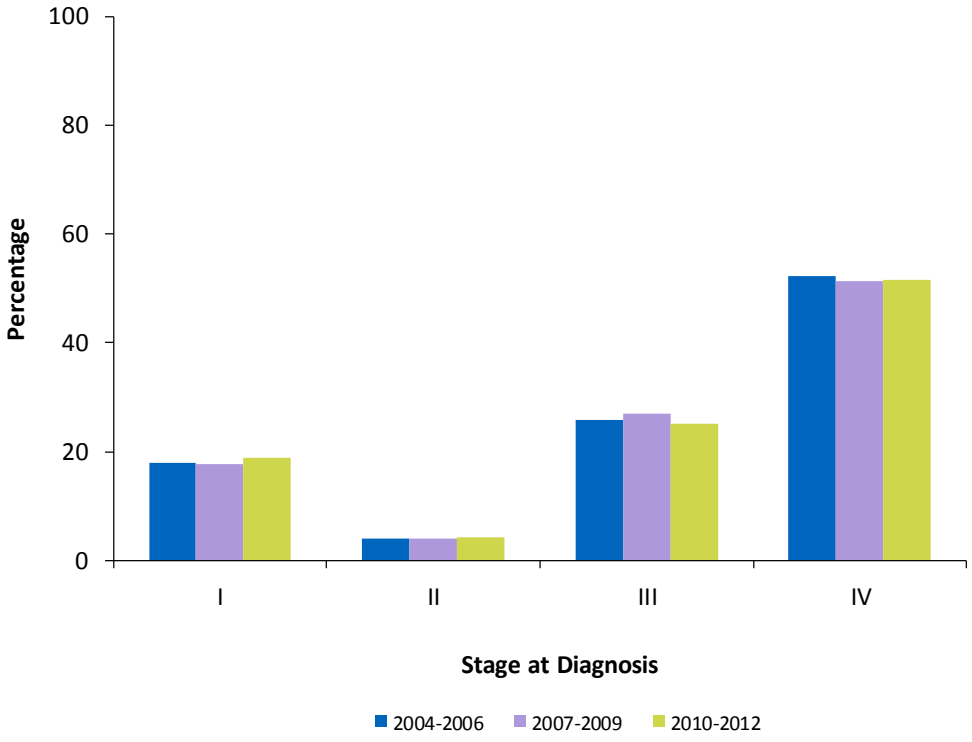
* Three-year moving average.
† Standardized to 1991 Canadian population.

Data Source: Alberta Cancer Registry, Alberta Health Services; Alberta Health

Age-standardized lung cancer incidence rates for females differ across age groups (**Figure 5-10**).

Between 1992 and 2012, the lung cancer incidence rates of females significantly decreased for the age group <50 years by 2.3% annually, remained stable for the age group 50-64 years and significantly increased for the age group 65-74 years by 2.1% annually. For the age group 75+ years, female lung cancer incidence rates significantly increased by 6.6% annually between 1992 and 2000, and increased by an annual average of 1.6% between 2000 and 2012.

Figure 5-11: Relative Distribution of New Cases by Stage at Diagnosis and Cohort for Lung Cancer, Both Sexes, Alberta, 2004-2006, 2007-2009, 2010-2012



* Stage at diagnosis based on AJCC 6th Ed.; Stage 0 was combined with Stage I.

More than 50% of lung cancer cases were diagnosed at stage IV, while less than 23% cases were diagnosed in stages I or II (**Figure 5-11**). Over the 9 years from 2004 to 2012, a small but significant improvement in early detection of cancer was observed.

Lung Cancer Mortality

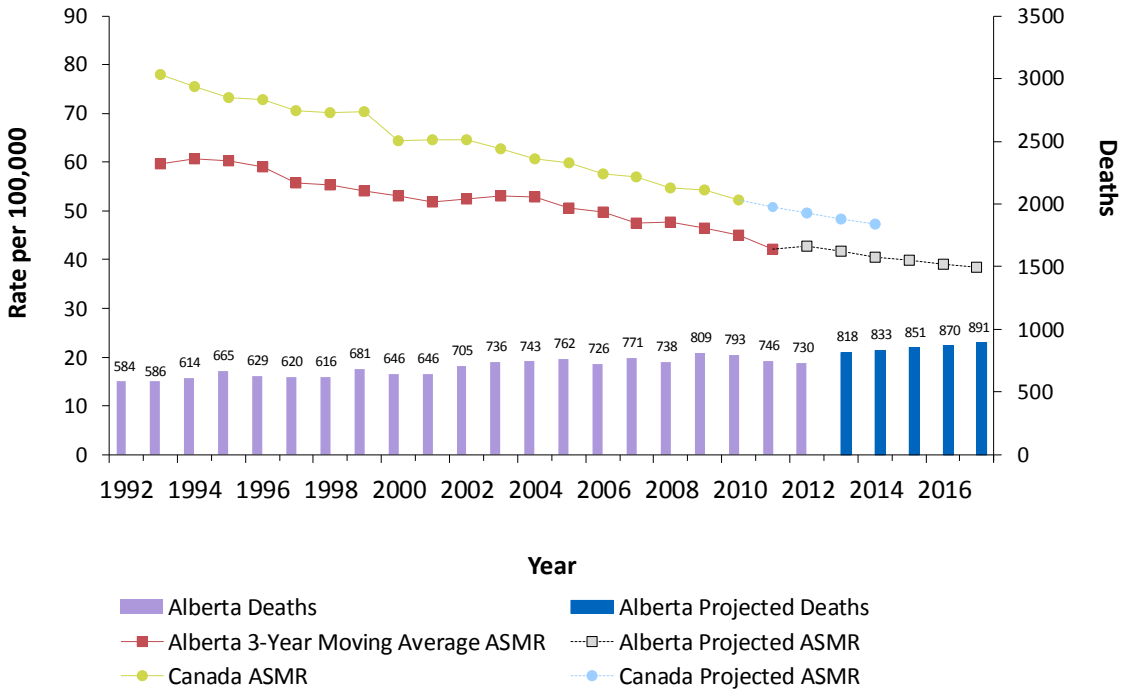
The following five figures (**Figures 5-12** to **5-16**) provide information on lung cancer mortality in Alberta. The number of deaths in Alberta is affected not only by changes in the underlying risk of dying from lung cancer, but also by the changes in the age structure and growth of the population. In order to compare trends over time, age-standardized mortality rates (ASMRs) are also provided.

In **Figures 5-12** and **5-13** observed age standardized mortality rates are shown for 1992 to 2011 (three-year moving average), and ***projected*** rates for 2012 to 2017, and observed numbers of cancer deaths are shown for the years 1992 to 2012 and projected numbers for 2013 to 2017.

The projected numbers of cancer deaths were calculated by applying the estimated age-specific cancer mortality rates to the age-specific population figures provided by Alberta Health[4]. These were observed up to 2011 (due to the use of three-year moving averages) and estimated for 2012 to 2017. Caution should be exercised when comparing Canada[5] and Alberta rates as Canadian rates are yearly rates while Alberta rates are three-year moving averages.

The estimated lung cancer mortality rates were calculated by extrapolating the historical trends in age-specific rate based on data from 1987 to 2011.

Figure 5-12: Actual and Projected Number of Deaths and Age-Standardized Mortality Rates (ASMRs)*† with 95% Confidence Intervals (CI) for Lung Cancer, Males, Alberta, 1992-2017



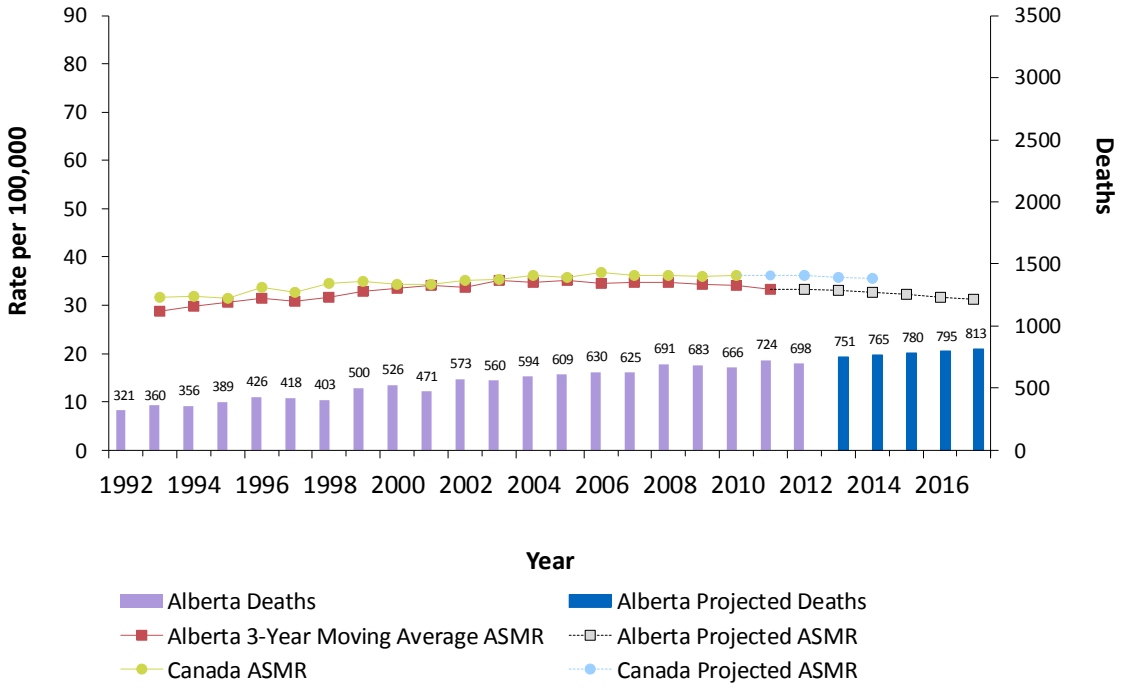
* Three-year moving average.
† Standardized to 1991 Canadian population.

Data Source: Alberta Cancer Registry, Alberta Health Services; Alberta Health; Canadian Cancer Society

In 2012, 730 males died of lung cancer in Alberta (**Figure 5-12**). ASMRs for male lung cancer in Alberta were lower than ASMRs in Canada.

It is estimated that 890 males will die from lung cancer in Alberta in 2017.

Figure 5-13: Actual and Projected Number of Deaths and Age-Standardized Mortality Rates (ASMRs)*† with 95% Confidence Intervals (CI) for Lung Cancer, Females, Alberta, 1992-2017



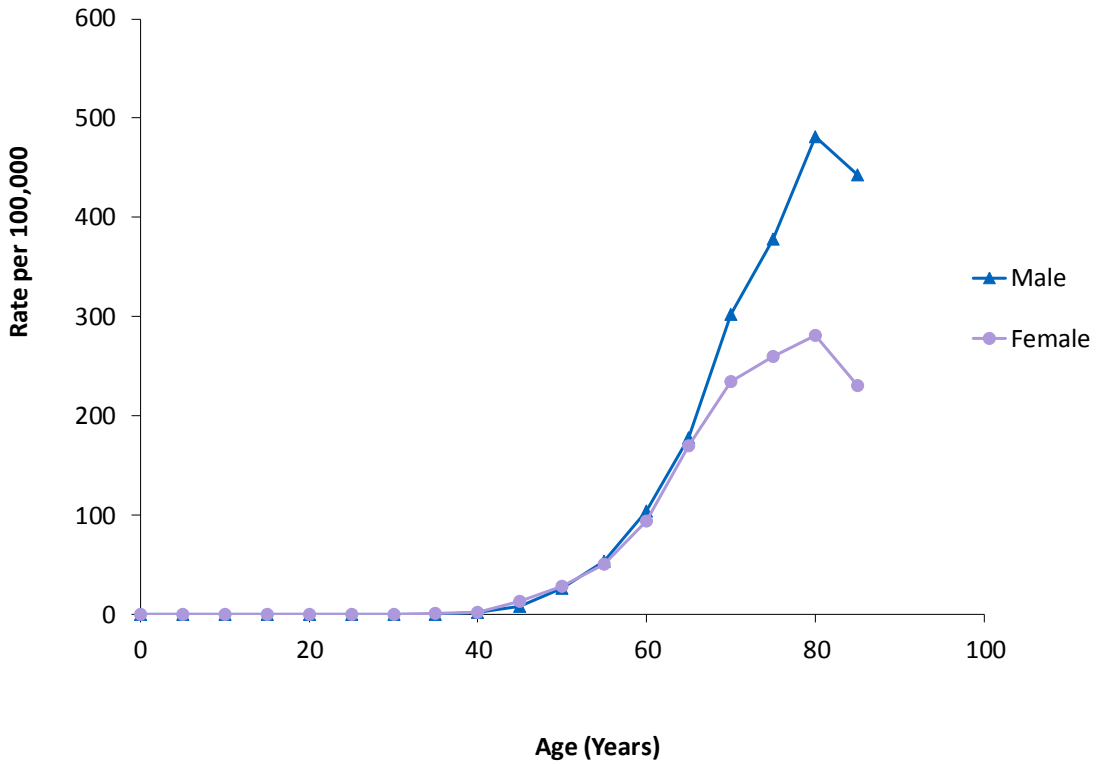
* Three-year moving average.
† Standardized to 1991 Canadian population.

Data Source: Alberta Cancer Registry, Alberta Health Services; Alberta Health; Canadian Cancer Society

In 2012, 698 females died of lung cancer in Alberta (**Figure 5-13**). Overall, ASMRs for female lung cancer in Alberta were generally similar to but lower than ASMRs in Canada.

It is estimated that 810 females will die from lung cancer in Alberta in 2017.

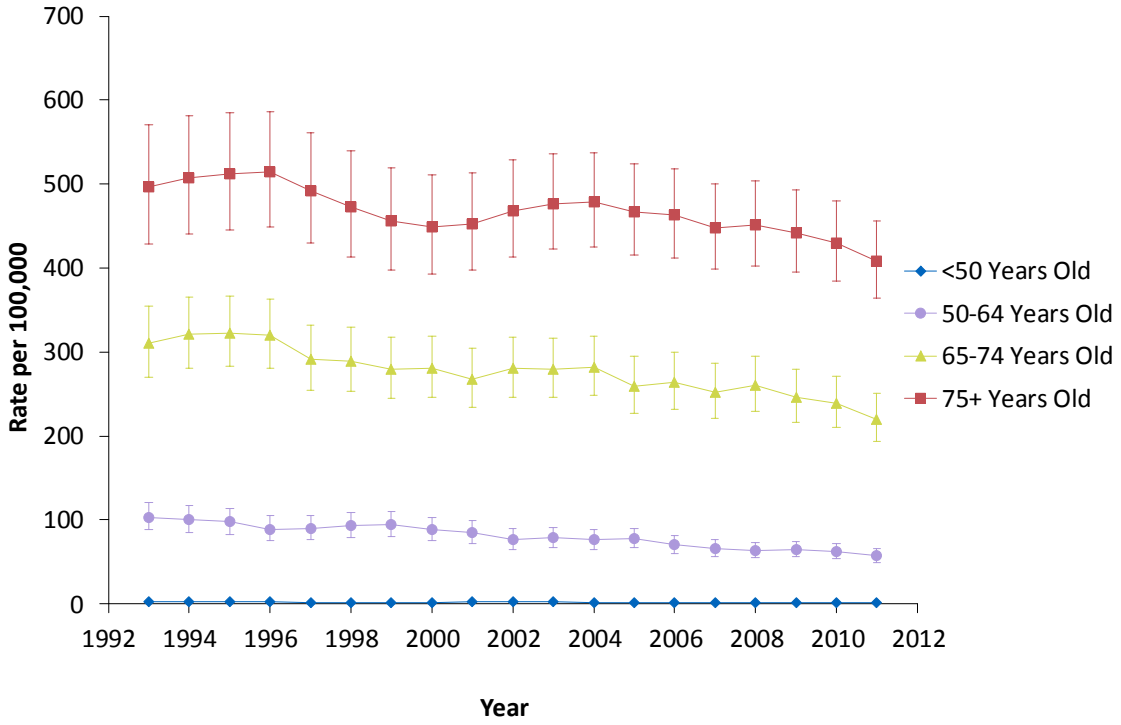
Figure 5-14: Age-Specific Mortality Rates for Lung Cancer by Sex, Alberta, 2008-2012



Data Source: Alberta Cancer Registry, Alberta Health Services; Alberta Health

Male and female lung cancer mortality rates differ by age and sex (**Figure 5-14**). Age-specific mortality rates for lung cancer in both sexes increase rapidly after about the age of 40. Female rates are similar to male rates until about the age of 55 after which female mortality rates are lower compared to mortality rates in males. Male and female mortality rates peaks at around age 80 and then decline.

Figure 5-15: Age-Standardized Mortality Rates (ASMRs)[*†] with 95% Confidence Intervals (CI) for Lung Cancer, Ages <50, 50-64, 65-74, and 75+, Males, Alberta, 1992-2012



[*] Three-year moving average.
[†] Standardized to 1991 Canadian population.

Data Source: Alberta Cancer Registry, Alberta Health Services; Alberta Health

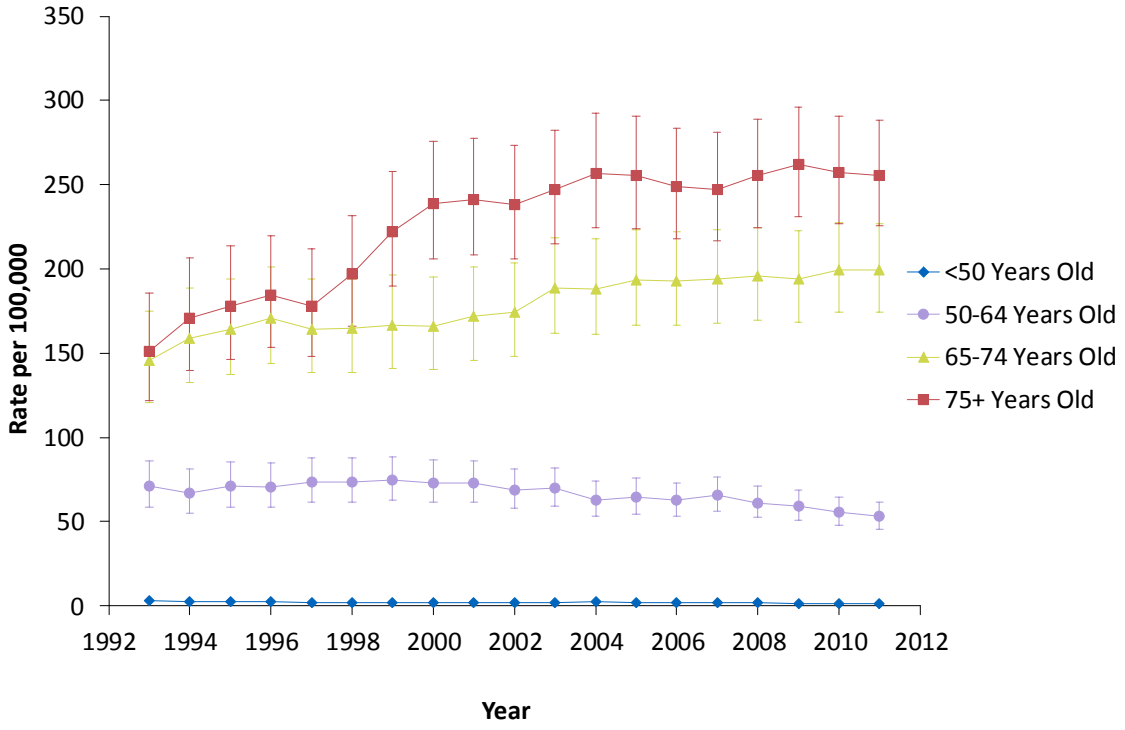
Age-standardized lung cancer mortality rates in males vary over time and by age group (**Figure 5-15**).

Between 1990 and 2012, male lung cancer mortality rates in the <50 age group decreased significantly by 5.3% annually.

Male lung cancer mortality rates for those in the 50-64 and 65-74 age groups decreased significantly between 1992 and 2012 by 3.2% and 1.8% annually respectively.

Lung cancer mortality rates for those over 75 significantly decreased between 1992 and 2012 by 1.0% annually.

Figure 5-16: Age-Standardized Mortality Rates (ASMRs)*† with 95% Confidence Intervals (CI) for Lung Cancer, Ages <50, 50-64, 65-74, and 75+, Females, Alberta, 1992-2012



* Three-year moving average.
† Standardized to 1991 Canadian population.

Data Source: Alberta Cancer Registry, Alberta Health Services; Alberta Health

Age-standardized lung cancer mortality rates for females vary over time and by age group (**Figure 5-16**).

Between 1992 and 2012, female mortality rates for lung cancer significantly decreased in the <50 and 50-64 age group by 3.4% and 1.6% annually respectively.

Female lung cancer mortality rates for those in the age group 65-74 significantly increased by 1.5% annually.

Female lung cancer mortality rates in the 75+ age group significantly increased by 7.0% annually between 1992 and 2000, but did not change significantly between 2000 and 2012.

Lung Cancer Survival

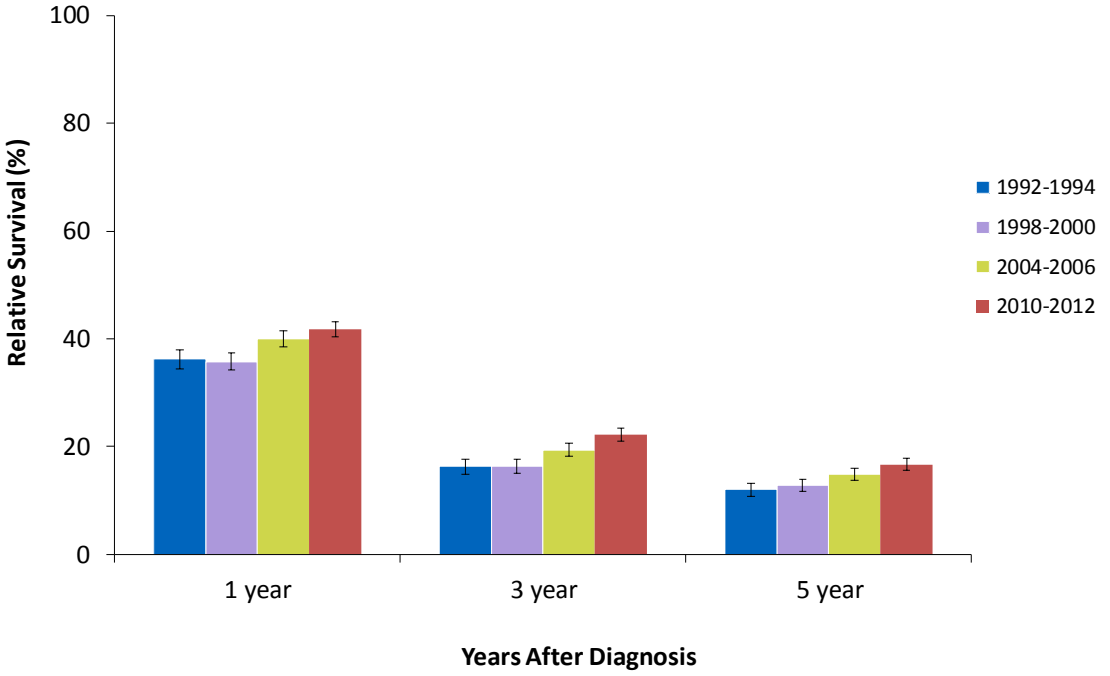
Cancer survival ratios indicate the proportion of people who will be alive at a given time after they have been diagnosed with cancer. Survival is an important outcome measure and is used for evaluating the effectiveness of cancer control programs.

Survival depends on several factors including the cancer type (most importantly site, stage and morphology at diagnosis), sex, age at diagnosis, health status and available treatments for that cancer. While ***relative survival ratios*** (RSRs) give a general expectation of survival over the whole province, these ratios may not apply to individual cases. Individual survival outcomes depend on the stage at diagnosis, treatment and other individual circumstances.

Relative survival ratios are estimated by comparing the survival of cancer patients with that expected in the general population of Albertans of the same age, sex and in the same calendar year.[8] In this section of the report, RSRs are standardized by the age structure in the standard population (i.e. all persons who were diagnosed with that cancer in Canada between 1992 and 2001) to permit RSRs to be compared over time, independent of differences in age distribution of cancer cases.

RSRs are estimated by the ***cohort method*** [8] when complete follow-up data (e.g., at least five years of follow-up to estimate five-year rate) after diagnosis are available. For recently diagnosed cases, whose complete follow-up data are not available, the up-to-date estimates are computed using the ***period method***.[9] However, comparison between cohort and period RSRs should be interpreted with caution because of the two different methods used to derive the respective ratios.
The relative survival ratio is usually expressed as a percentage (%) and the closer the value is to 100%, the more similar the survival pattern is to the general population.

Figure 5-17: Age-Standardized One, Three and Five-Year Relative Survival Ratios with 95% Confidence Intervals (CI) for Lung Cancer, Both Sexes, Alberta, 1992-1994^, 1998-2000^ and 2004-2006^, 2010-2012*



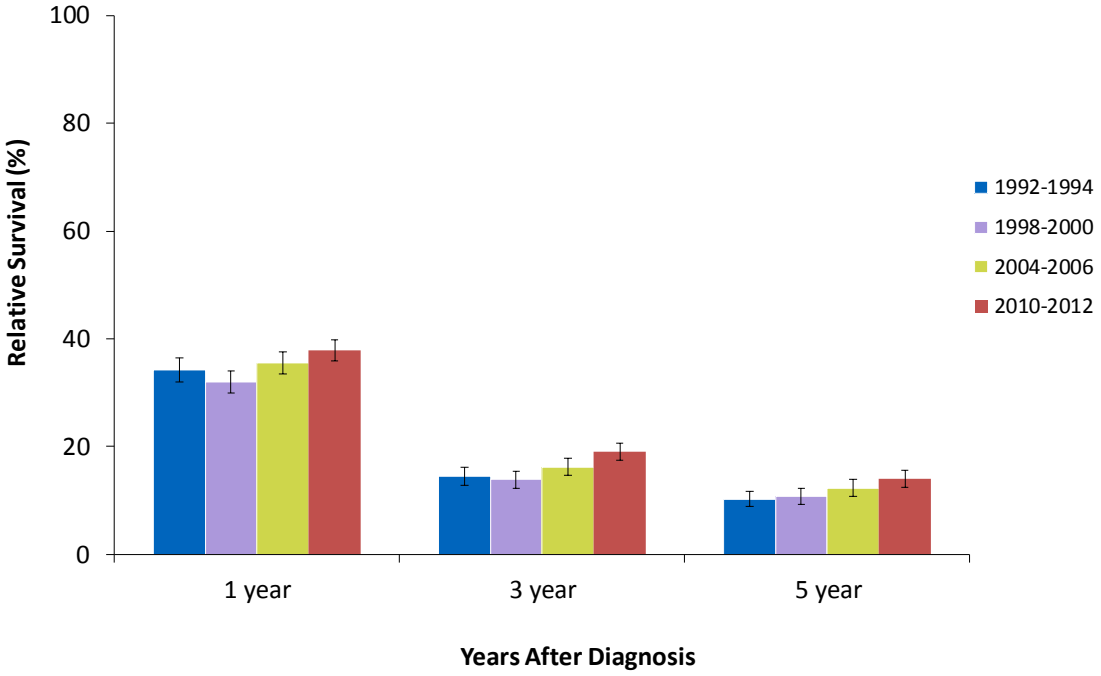
^ Ratios calculated by cohort method, where complete follow-up data are available.
* Ratios calculated by period method, where complete follow-up data are not available.

Data Source: Alberta Cancer Registry, Alberta Health Services; Statistics Canada

The five-year relative survival ratio for individuals diagnosed with lung cancer in the period 2010-2012 is estimated to be 17%.

The five-year relative survival ratios for individuals diagnosed with lung cancer in 2010-2012 has improved compared to those diagnosed in the 1992-1994 cohort years (**Figure 5-17**).

Figure 5-18: Age-Standardized One, Three and Five-Year Relative Survival Ratios with 95% Confidence Intervals (CI) for Lung Cancer, Male, Alberta, 1992-1994^, 1998-2000^ and 2004-2006^, 2010-2012*



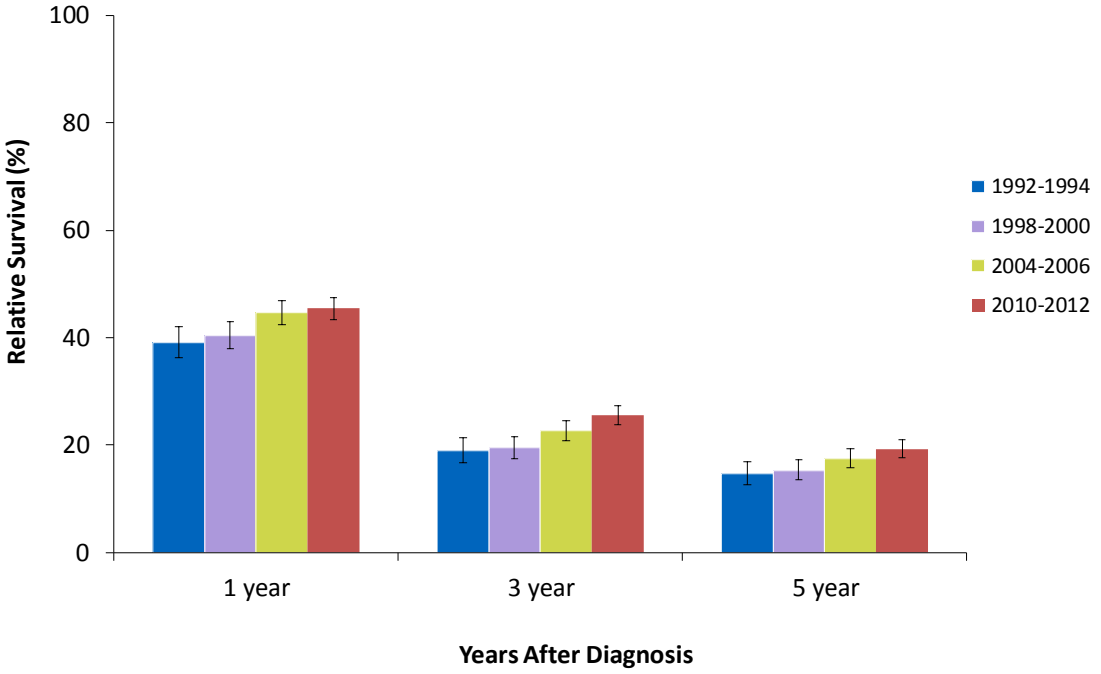
^ Ratios calculated by cohort method, where complete follow-up data are available.
* Ratios calculated by period method, where complete follow-up data are not available.

Data Source: Alberta Cancer Registry, Alberta Health Services; Statistics Canada

The five-year relative survival ratio for males diagnosed with lung cancer in the period 2010-2012 is estimated to be 14%.

The five-year relative survival ratios for males diagnosed with lung cancer in 2010-2012 has improved compared to those diagnosed in the 1992-1994 cohort years (**Figure 5-18**).

Figure 5-19: Age-Standardized One, Three and Five-Year Relative Survival Ratios with 95% Confidence Intervals (CI) for Lung Cancer, Females, Alberta, 1992-1994^, 1998-2000^ and 2004-2006^, 2010-2012*



^ Ratios calculated by cohort method, where complete follow-up data are available.
* Ratios calculated by period method, where complete follow-up data are not available.

Data Source: Alberta Cancer Registry, Alberta Health Services; Statistics Canada

The five-year relative survival ratio for females diagnosed with lung cancer in the period 2010-2012 is estimated to be19%.

The five-year relative survival ratios for females diagnosed with lung cancer in 2010-2012 has improved compared to those diagnosed in the 1992-1994 cohort years (**Figure 5-19**).

Table 5-4: One-, Two- and Three-Year Relative Survival Ratios† (%) for Lung Cancer* by Stage and Sex, Alberta, 2009-2012.

Stage‡	Number of Cases		One-year Survival Rate (95% CI)		Two-year Survival Rate (95% CI)		Three-year Survival Rate (95% CI)	
	Male	Female	Male	Female	Male	Female	Male	Female
I	**398**	**538**	87 (83, 90)	92 (90, 95)	75 (70, 79)	84 (80, 87)	64 (58, 69)	77 (73, 81)
II	**207**	**198**	81 (74, 86)	69 (62, 76)	56 (48, 63)	59 (51, 67)	45 (36, 54)	50 (41, 59)
III	**588**	**608**	48 (44, 52)	56 (52, 60)	26 (22, 29)	36 (33, 40)	16 (13, 19)	26 (23, 30)
IV	**1852**	**1607**	17 (16, 19)	21 (19, 23)	7 (6, 8)	10 (8, 11)	5 (4, 6)	5 (4, 7)

† Ratios calculated by period method, where complete follow-up data are not available
* Inclusion criteria: First-primary invasive cancer and age 15 to 99 years at diagnosis.
ǂ The staging method changed in 2010 (from AJCC 6 to AJCC 7), so caution should be used when comparing to data from previous reports.

Data Source: Alberta Cancer Registry, Alberta Health Services; Statistics Canada

Cancer ***stage*** (extent or severity of cancer) at diagnosis affects survival. Those diagnosed at an earlier stage have better survival than those diagnosed at a later stage.

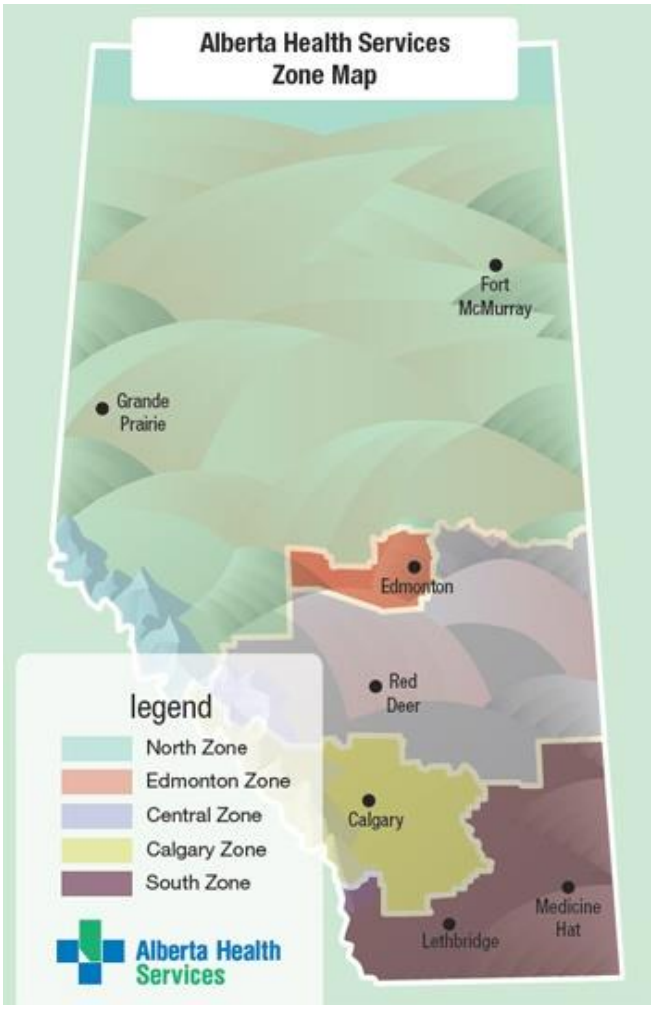
Most lung cancer cases in Alberta for the same time period were diagnosed at the later stages (III & IV). The estimated relative survival ratios, compared to the earlier stages (I & II), are low. Survival ratios are lower among males than females at all stages of diagnosis (**Table 5-4**).

Geographic Variation

The geographic variation section illustrates how the observed rates in each health zone compare with the provincial average. It also compares each zone to the rest of Alberta (excluding the zone of interest). The age standardized incidence and mortality rates for each zone and the respective "rest of Alberta" groupings are presented with their corresponding 95% ***confidence intervals***[10]. The overall age standardized incidence and mortality rates for all of Alberta are presented with their corresponding 95% confidence intervals as horizontal lines on each graph. Any observed differences in rates may be due to several factors such as regional differences in:

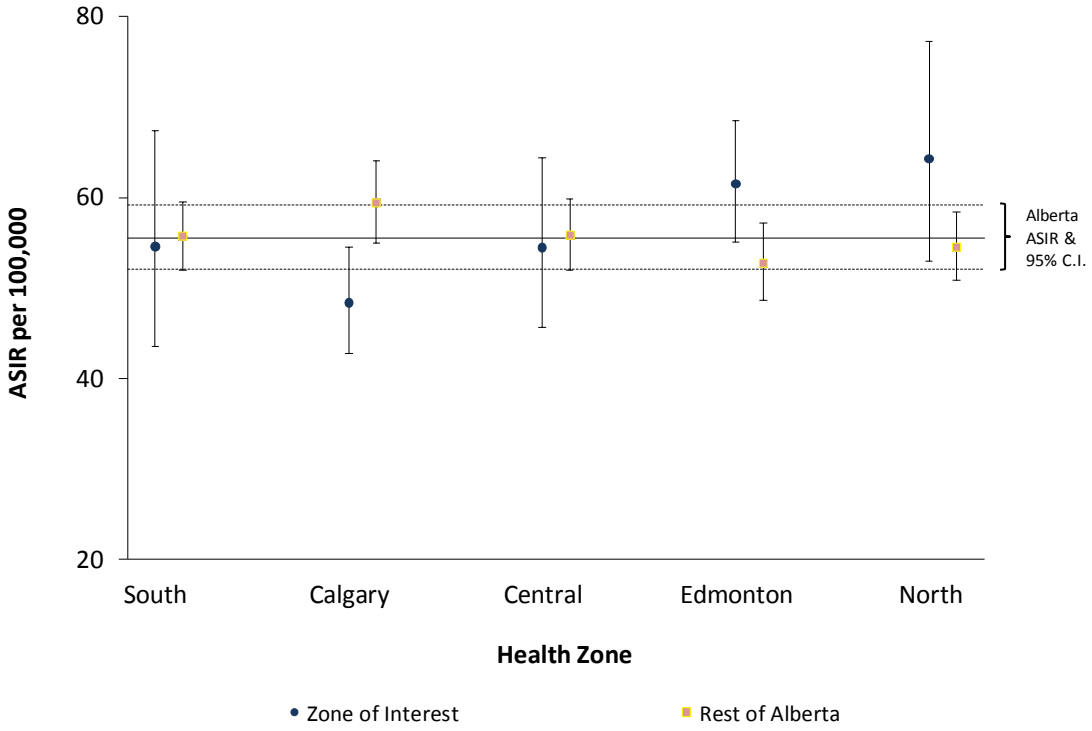
- individual risk factors
- prevention efforts
- diagnostic activity
- access to cancer care.[11]

Figure 5-20: Five Health Zones in Alberta, 2012



Source: Alberta Health Services

Figure 5-21: Age-Standardized Incidence Rates (ASIRs)† with 95% Confidence Intervals (CI) by Zone for Lung Cancer, Males, Alberta, 2008-2012

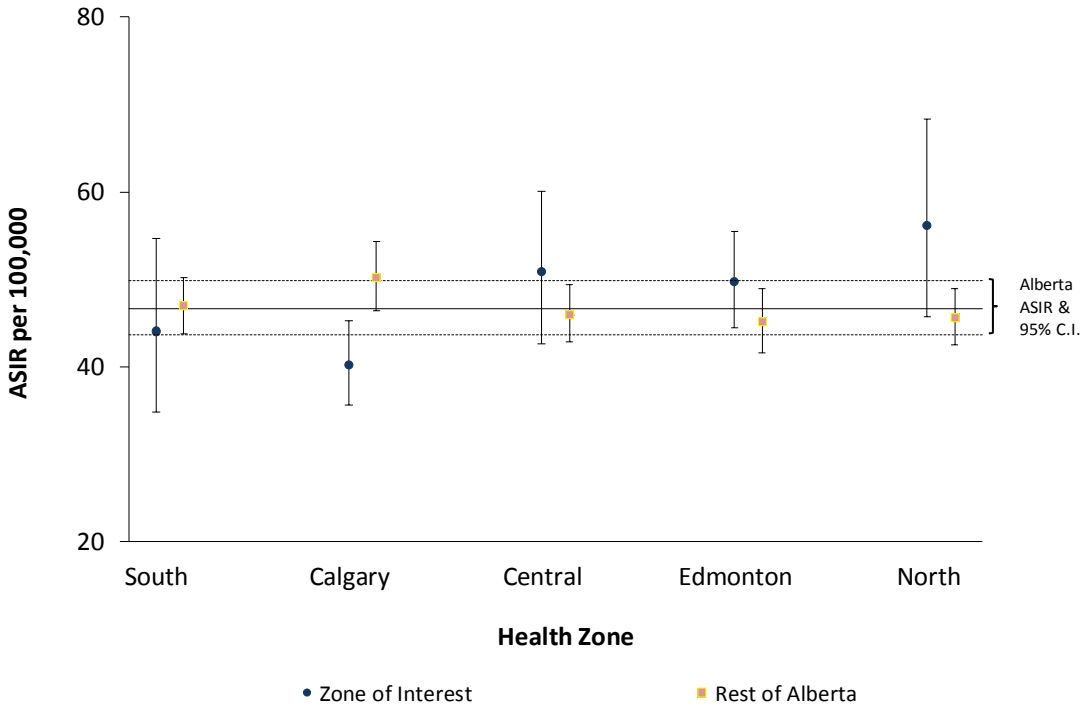


† Standardized to 1991 Canadian population for age-specific rates in 2008-2012.

Data Source: Alberta Cancer Registry, Alberta Health Services; Alberta Health

There is no evidence that male lung cancer ASIRs in the zones are higher or lower than the provincial average; however, the ASIR in Calgary Zone is significantly lower than that in the "rest of Alberta" (excluding the zone of interest) (**Figure 5-21**). Lung cancer incidence is generally reflective of the rates of smoking 20 to 30 years prior suggesting that male residents of Calgary may have had historically lower smoking rates.

Figure 5-22: Age-Standardized Incidence Rates (ASIRs)[†] with 95% Confidence Intervals (CI) by Zone for Lung Cancer, Females, Alberta, 2008-2012

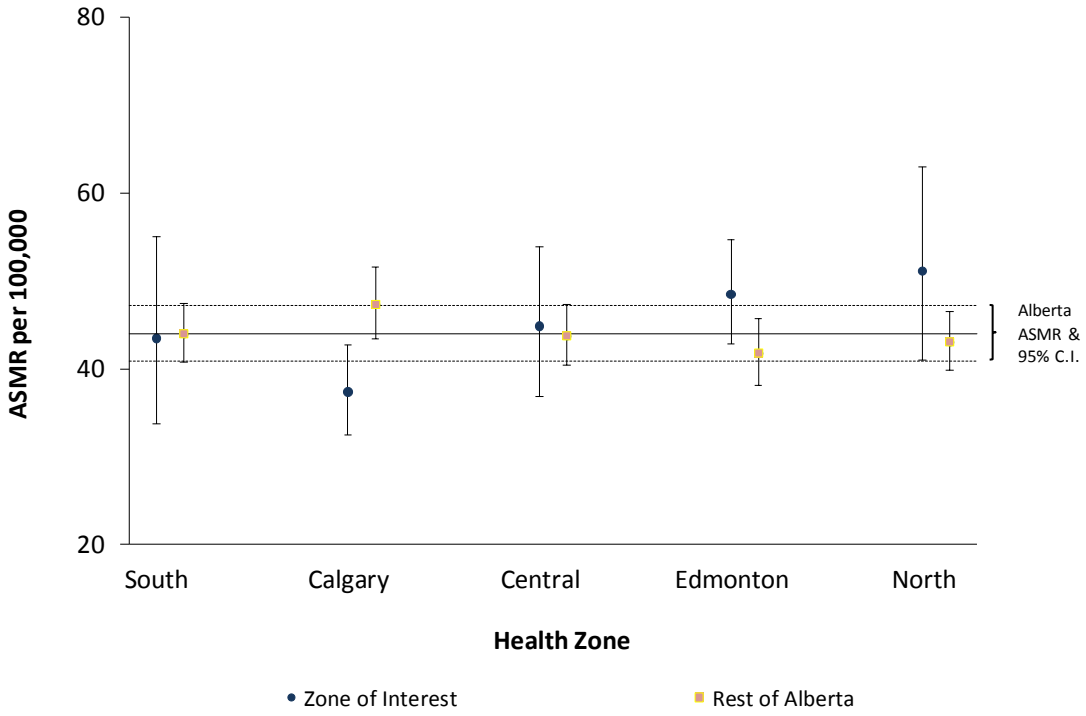


[†] Standardized to 1991 Canadian population for age-specific rates in 2008-2012.

Data Source: Alberta Cancer Registry, Alberta Health Services; Alberta Health

There is no evidence that female lung cancer ASIRs in the zones are higher or lower than the provincial average; however, the ASIR in Calgary Zone is significantly lower than that in the "rest of Alberta" (excluding the zone of interest) (**Figure 5-22**). Lung cancer incidence is generally reflective of the rates of smoking 20 to 30 years prior suggesting that female residents of Calgary may have had historically lower smoking rates.

Figure 5-23: Age-Standardized Mortality Rates (ASMRs)† with 95% Confidence Intervals (CI) by Zone for Lung Cancer, Males, Alberta, 2008-2012

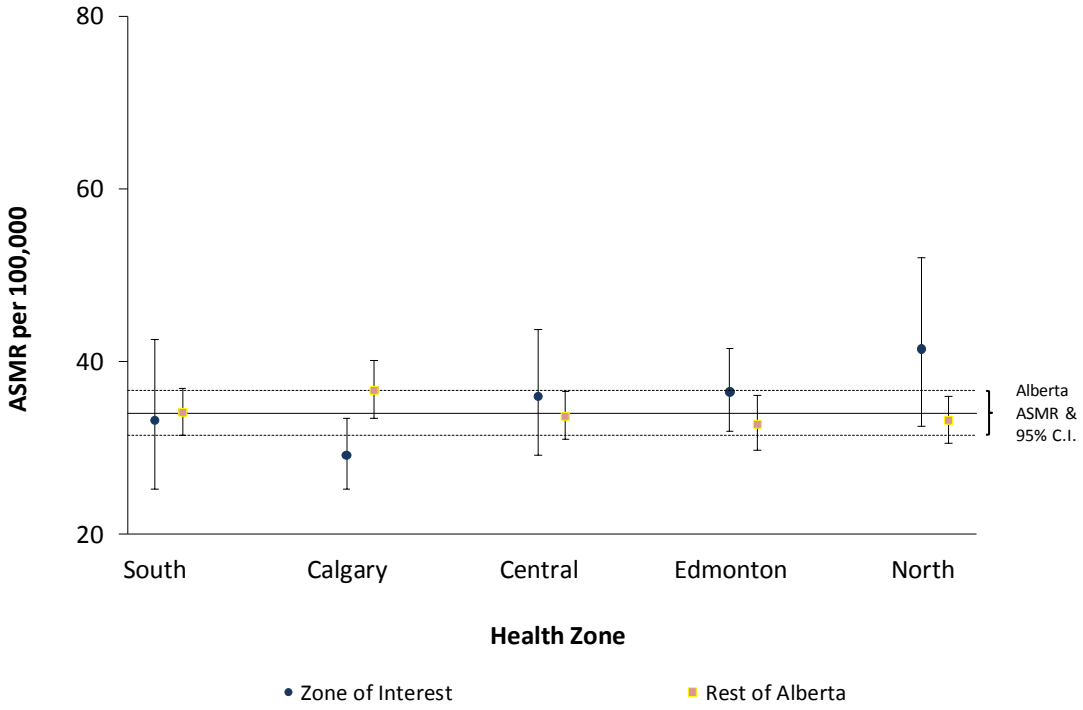


† Standardized to 1991 Canadian population for age-specific rates in 2008-2012.

Data Source: Alberta Cancer Registry, Alberta Health Services; Alberta Health

There is no evidence that male lung cancer ASMRs in the zones are higher or lower than the provincial average; however, the ASMR in Calgary Zone is significantly lower than that in the "rest of Alberta" (excluding the zone of interest) (**Figure 5-23**).

Figure 5-24: Age-Standardized Mortality Rates (ASMRs)† with 95% Confidence Intervals (CI) by Zone for Lung Cancer, Females, Alberta, 2008-2012



† Standardized to 1991 Canadian population for age-specific rates in 2008-2012.

Data Source: Alberta Cancer Registry, Alberta Health Services; Alberta Health

There is no evidence that female lung cancer ASMRs in the zones are higher or lower than the provincial average; however, the ASMR in Calgary Zone is marginally but not significantly lower than that in the "rest of Alberta" (excluding the zone of interest) (**Figure 5-24**).

Further Information

Further information is available on a separate document, the **Appendix**:

Appendix 1: Glossary of Terms
Appendix 2: Cancer Definitions
Appendix 3: Data Notes

References

1. Okamoto N, Morio S, Inoue R and Akiyama K. The risk of a second primary cancer occurring in five-year survivors of an initial cancer. Jpn. J Clin Oncol, 1987; 17(3):205-213.

2. National Cancer Institute - Surveillance Epidemiology and End Results [Internet]. USA. National Institutes of Health; Cancer Prevalence Statistics Overview; 2014 Apr 10 [cited 2014 Nov 6]; Available from: http://surveillance.cancer.gov/prevalence/

3. Kim H-J, Fay M and Feuer E. Permutation tests for JoinPoint regression with applications to cancer rates. Stat Med, 2000; 19:335-351.

4. 2012 Alberta Population Data [Excel Spreadsheet]. Edmonton (Alberta): Alberta Health; 2014.

5. Canadian Cancer Society's Steering Committee: Canadian Cancer Statistics 2014. Toronto: Canadian Cancer Society, 2014.

6. Greene FL, Page DL, Fleming ID, Fritz AG, Balch CM, Haller DG and Morrow M (Eds). AJCC Cancer Staging Manual, 6th ed. Chicago: American Joint Committee on Cancer, 2002. Available from http://springeronline.com
7. Agresti A. Analysis of Ordinal Categorical Data, 2nd ed. New Jersey: John Wiley & Sons; 2012.

8. Ederer F, Axtell LM and Cutler SJ. The relative survival rate: a statistical methodology. Natl Cancer Inst Monogr, 1961; 6: 101-121.

9. Brennera H, Gefellerb O and Hakulinen T. Period analysis for 'up-to-date' cancer survival data: theory, empirical evaluation, computational realisation and applications. European Journal of Cancer, 2004; 40: 326-335.

10. Fay MP and Feuer EJ. Confidence intervals for directly standardized rates: a method based on the gamma distribution. Stat Med, 1997; 16: 791-801.

11. Levi F. Cancer Prevention: Epidemiology and Perspectives. Eur J Cancer. 1999; 35(7):1046-1058.

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