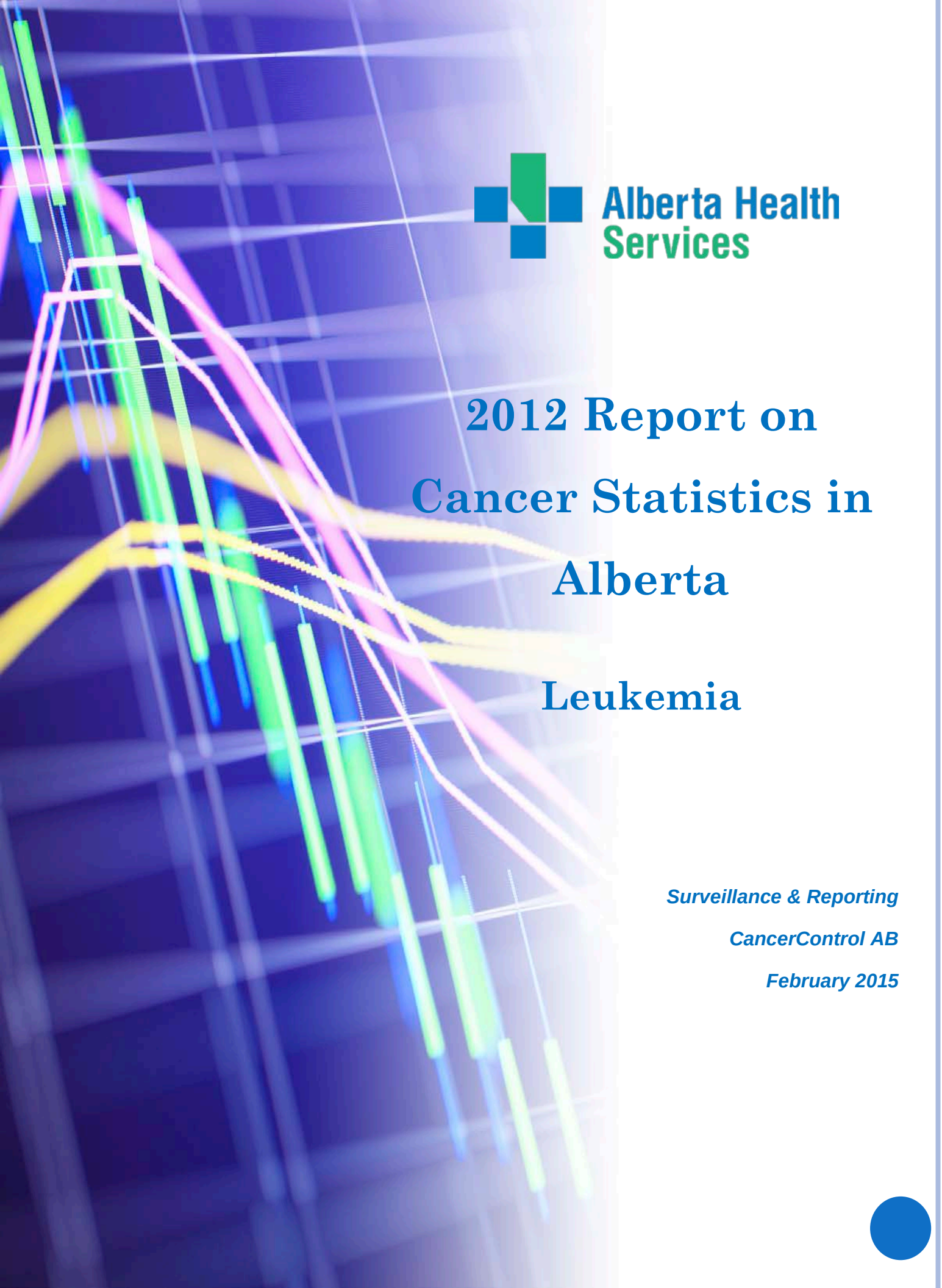

Alberta Health Services

2012 Report on Cancer Statistics in Alberta

Leukemia

Surveillance & Reporting

CancerControl AB

February 2015

Acknowledgements

This report was made possible through Surveillance & Reporting, Cancer Measurement Outcomes Research and Evaluation (C-MORE), CancerControl AB, Alberta Health Services, and the many contributions of individuals across Alberta Health Services as well as external agencies and individuals.

The authors wish to thank individuals working in the following AHS departments and partner agencies for their contributions to this report: Alberta Cancer Registry; Population, Public and Aboriginal Health; Alberta Health and Statistics Canada. Contributions included provision of information, analysis and interpretation, and assistance with consultation sessions and communication of the report.

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Suggested Citation:

Surveillance & Reporting: *2012 Report on Cancer Statistics in Alberta.* Edmonton: CancerControl AB, Alberta Health Services, 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 leukemia* (see **Appendix** for cancer site definitions) statistics in Alberta. 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.

* A previous category has been divided into 2 categories in ICD10. This corresponds to ICDO-3: 980-994.

Summary

- The chance of being diagnosed with leukaemia in a lifetime is approximately **1 in 42** men and **1 in 65** women. As of December 31, 2012, approximately **4,750** Albertans were alive who had previously been diagnosed with leukemia.

- In 2012, there were **557** new cases of leukemia in Alberta and **214** deaths due to the disease. From 1992 to 2012*, **incidence rates for leukemia have increased** while **mortality rates have decreased.** Incidence rates of leukemia are somewhat elevated in those under the age of 15 but remain low for both sexes until the age of 40. Incidence rates in males are higher than in females from age 45 on ward. Approximately **730** cases of leukemia are expected to be diagnosed in 2017.

- The five-year relative survival ratio for leukemia in Alberta has increased from **53%** for those diagnosed in 1992 to 1994 to **71%** for those diagnosed between 2010 and 2012. This means that those diagnosed in 2010 to 2012 are about 71% as likely to be alive 5 years after their diagnoses as someone of the same age who has not been diagnosed with cancer.

- Potential years of life lost (PYLL) is the number of years of life lost when a person dies prematurely from any cause, based on their life expectancy. In 2012, **3,096** potential years of life were lost due to leukemia.

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

Probability of Developing or Dying from Leukemia

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 upon the person being leukemia-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 10-1: Probability of Developing Leukemia by Age and Sex, Alberta, 2008-2012

Age Group	Males	Females
Lifetime Risk (all ages)	**1 in 42**	**1 in 65**
0 - 20	**1 in 994**	**1 in 1,285**
20 - 30	**1 in 2,872**	**1 in 5,277**
30 - 40	**1 in 3,138**	**1 in 2,933**
40 - 50	**1 in 1,260**	**1 in 1,612**
50 - 60	**1 in 425**	**1 in 749**
60 - 70	**1 in 179**	**1 in 333**
70 - 80	**1 in 111**	**1 in 184**
80+	**1 in 80**	**1 in 146**

Data Source: Alberta Cancer Registry, Alberta Health Services

The probability of developing leukemia increases for both males and females with age after an initial peak as a child (**Table 10-1**). Approximately 1 in 42 males and 1 in 65 females will develop invasive leukemia in their lifetime.

Males have a higher chance of developing leukemia than females. On a population basis, the probability of developing leukemia by the end of the age range for a leukemia-free individual at the beginning of the age range are shown in **Table 10-1**. For instance, a leukemia-free female at age 40 has a 1 in 1,612 chance of developing leukemia by the time she is 50.

Table 10-2: Probability of Dying from Leukemia by Age and Sex, Alberta, 2008-2012

Age Group	Males	Females
Lifetime Risk (all ages)	1 in 98	1 in 130
0 - 20	1 in 6,536	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 6,566	1 in 6,187
50 - 60	1 in 2,081	1 in 3,013
60 - 70	1 in 675	1 in 1,058
70 - 80	1 in 251	1 in 397
80+	1 in 117	1 in 176

Data Source: Alberta Cancer Registry, Alberta Health Services

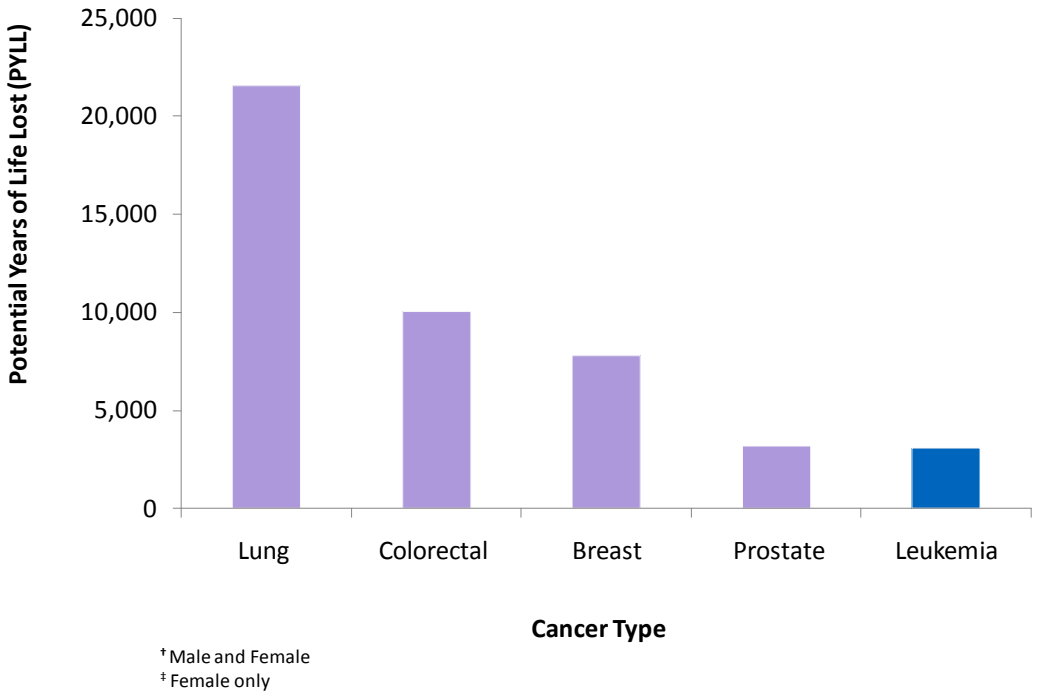
The probability of dying from leukemia increases for both males and females with age (**Table 10-2**). Approximately 1 in 98 males and 1 in 130 females will die of invasive leukemia.

Males have a higher chance of dying from leukemia than females. On a population basis, the probability of a cancer-free individual at the beginning of the age range dying from leukemia by the end of the age range are shown in **Table 10-2**. For example, a cancer-free female at age 40 has a 1 in 6,187 chance of dying from leukemia 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 10-1: Potential Years of Life Lost (PYLL) from Leukemia† Compared with Lung†, Colorectal†, Breast‡ and Prostate Cancers, Alberta, 2012



Data Source: Alberta Cancer Registry, Alberta Health Services

In 2012, **3,096** potential years of life were lost due to leukemia, which constitutes 3.3% of PYLL for all cancers (**Figure 10-1**).

Prevalence

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

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

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

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, which can affect the whole community.

As of December 31, 2012, approximately **4,750** Albertans were alive who had previously been diagnosed with leukemia (**Table 10-3**). In addition, there were **900** Albertans alive who had been diagnosed with leukemia 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 10-3: Limited-Duration and Complete Prevalence for Leukemia, Both Sexes, Alberta, 2012

Duration	Prevalence (#)
2-Year	900
5-Year	1,900
10-Year	3,050
20-Year	4,100
Complete (Ever Diagnosed)	4,750

Data Source: Alberta Cancer Registry, Alberta Health Services

Leukemia 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 leukemia 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 leukemia 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.

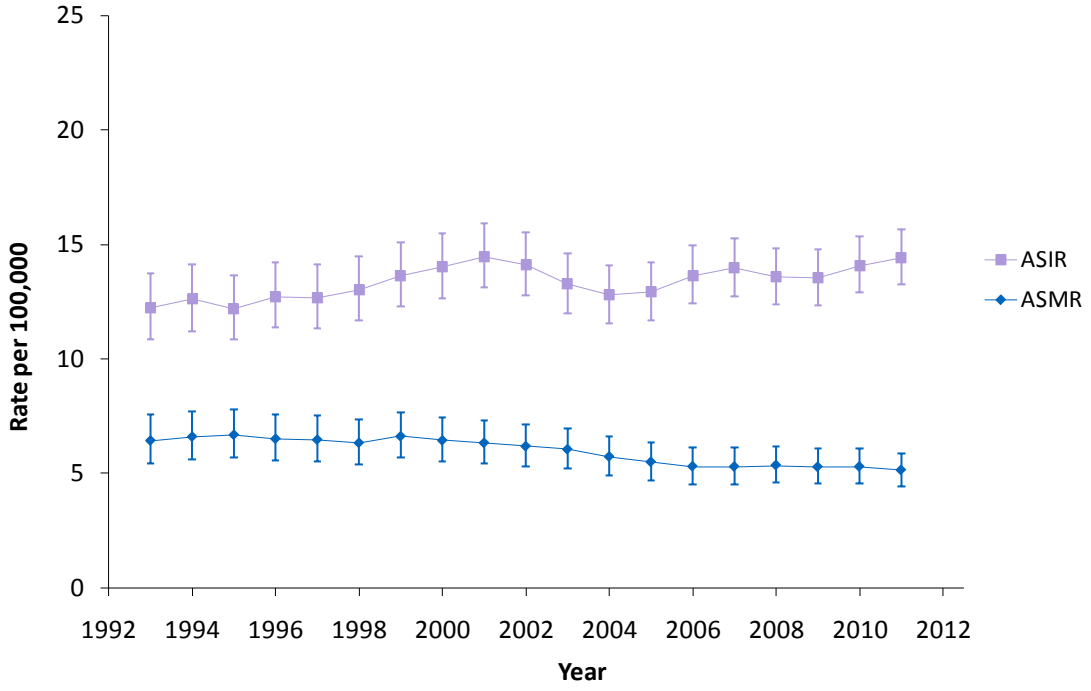
Three-year moving averages are used to smooth out year-to-year fluctuations so that the underlying trend may be more easily observed. They are calculated based on aggregating three years of data. Age-standardized incidence rates (ASIRs) and age-standardized mortality rates (ASMRs) are presented as three-year 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 and 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. Incidence and mortality are also affected by the development of cancer treatment programs, which 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 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 10-2: Age-Standardized Incidence Rates (ASIRs)[*†] and Mortality Rates (ASMRs)[*†] with 95% Confidence Intervals (CI) for Leukemia, Both Sexes, Alberta, 1992-2012



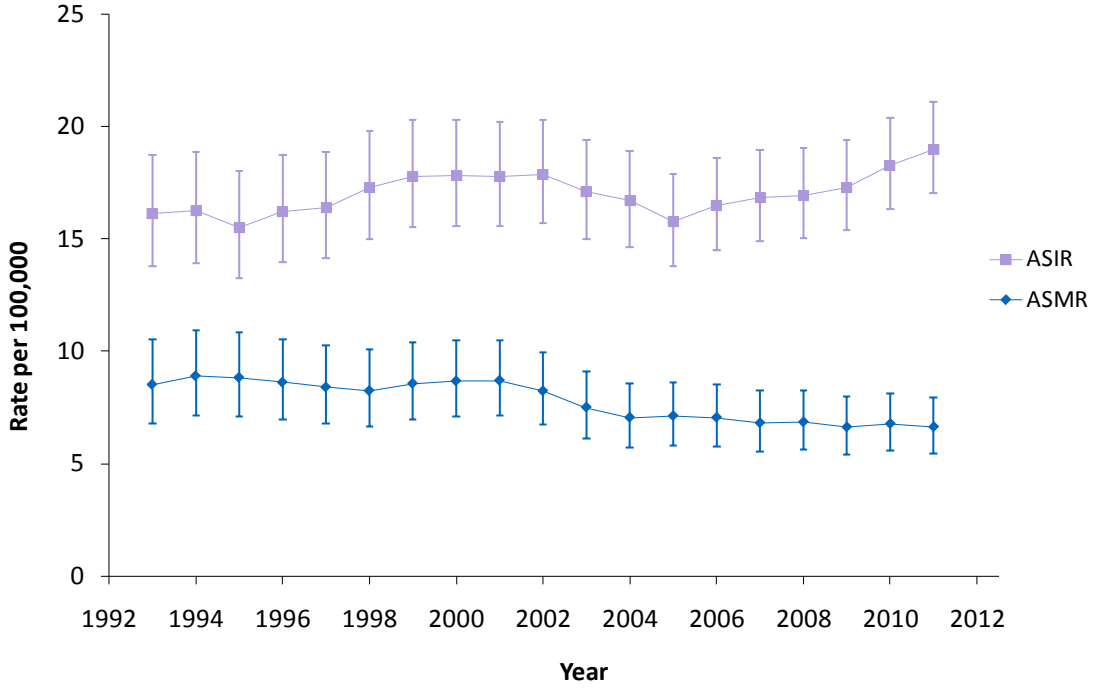
[*] Three-year moving average.
[†] Standardized to 1991 Canadian population.

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

Leukemia ASIRs increased significantly since 1992 (**Figure 10-2**). Between 1992 and 2012, leukemia ASIRs increased by 0.7% annually. In 2012, the ASIR for leukemia was 13.8 per 100,000 in the population.

Leukemia mortality rates are lower than incidence rates (**Figure 10-2**). Leukemia ASMRs decreased significantly between 1992 and 2012, by 1.5% annually. In 2012, the ASMR for leukemia was 5.2 per 100,000 in the population.

Figure 10-3: Age-Standardized Incidence Rates (ASIRs)[*†] and Mortality Rates (ASMRs)[*†] with 95% Confidence Intervals (CI) for Leukemia, Males, Alberta, 1992-2012



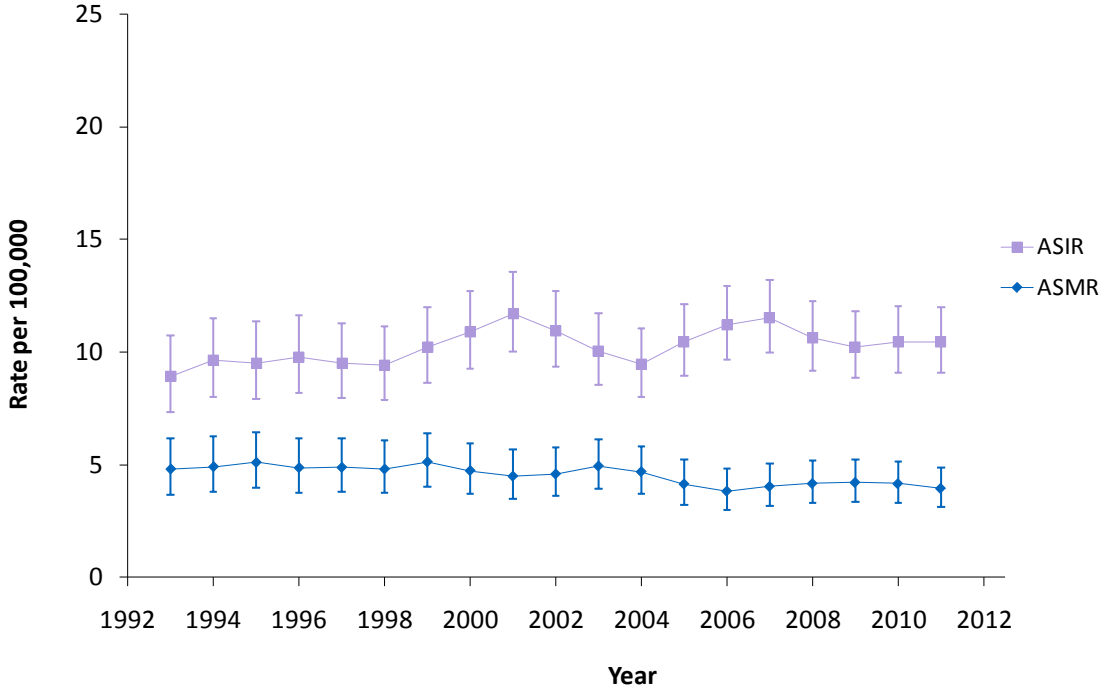
[*] Three-year moving average.
[†] Standardized to 1991 Canadian population.

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

Male leukemia ASIRs have not changed significantly since 1992 (**Figure 10-3**). In 2012, the ASIR for leukemia in males was 18.2 per 100,000 males in the population.

Over the period 1992 to 2012, male leukemia ASMRs decreased significantly by 1.7% annually (**Figure 10-3**). In 2012, the ASMR for leukemia in males was 7.0 per 100,000 males in the population.

Figure 10-4: Age-Standardized Incidence Rates (ASIRs)[*†] and Mortality Rates (ASMRs)[*†] with 95% Confidence Intervals (CI) for Leukemia, Females, Alberta, 1992-2012



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

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

Female leukemia ASIRs have not changed significantly since 1992 (**Figure 10-4**). In 2012, the ASIR for leukemia in females was 10.0 per 100,000 females in the population.

Female leukemia ASMRs decreased significantly between 1992 and 2012 by 1.3% annually (**Figure 10-4**). In 2012, the ASMR for leukemia in females was 3.7 per 100,000 females in the population.

Leukemia Incidence

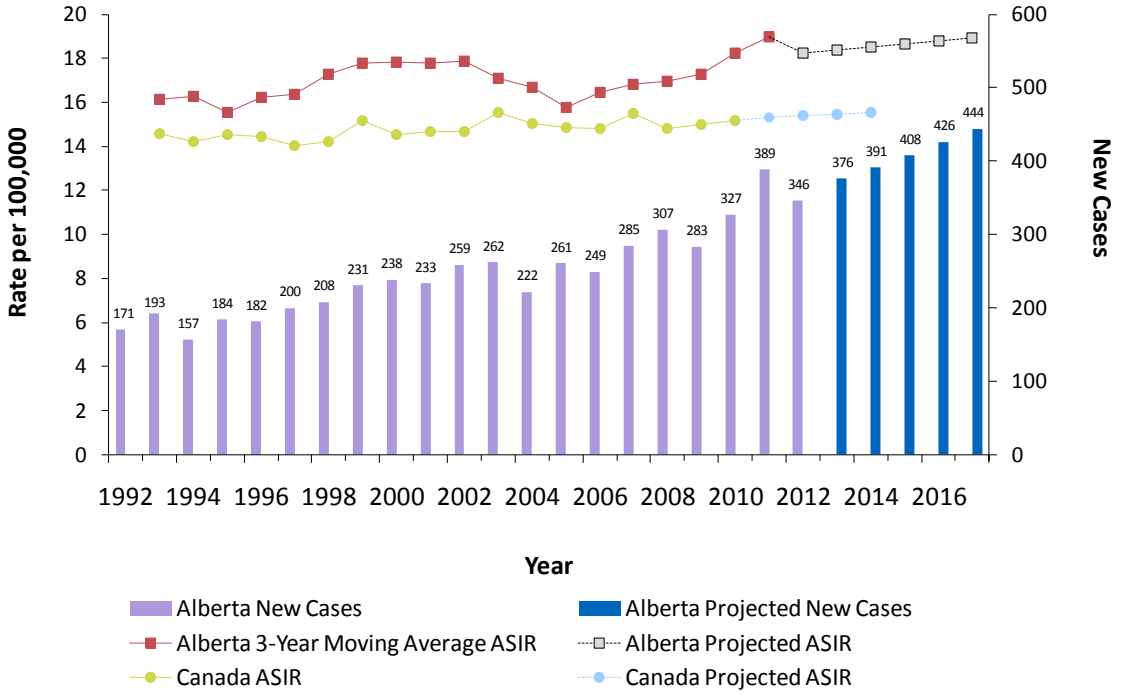
The following three figures (**Figures 10-5** to **10-7**) provide information on leukemia incidence in Alberta. The number of new cancer cases in Alberta is affected not only by changes in the underlying risk of developing leukemia, but also by the changes in the age structure and growth of the population. In order to compare trends over time, age-standardized incidence rates (ASIRs) are provided.

In **Figures 10-5** and **10-6** observed age standardized incidence rates are shown for 1992 to 2011 (three-year moving averages), ***projected*** rates for 2012 to 2017, and observed numbers of new leukemia 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 leukemia incidence rates were calculated by extrapolating the historical trends in age-specific rate based on data from 1987 to 2011.

Figure 10-5: Actual and Projected Number of New Cases and Age-Standardized Incidence Rates (ASIRs)*† for Leukemia, Males, Alberta, 1992-2017



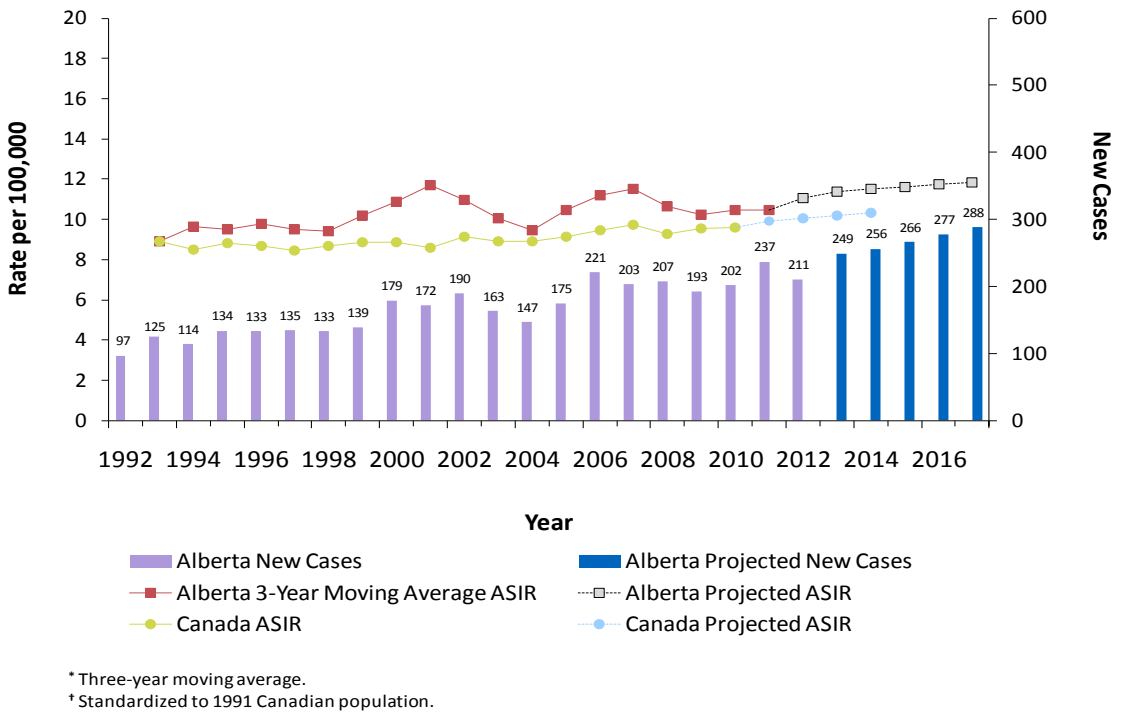
* Three-year moving average.
† Standardized to 1991 Canadian population.

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

In 2012, 346 cases of male leukemia were diagnosed in Alberta (**Figure 10-5**). ASIRs for male leukemia cancer in Alberta were higher than ASIRs in Canada.

It is estimated that 440 cases of leukemia will be diagnosed in males in Alberta in 2017.

Figure 10-6: Actual and Projected Number of New Cases and Age-Standardized Incidence Rates (ASIRs)*† for Leukemia, Females, Alberta, 1992-2017



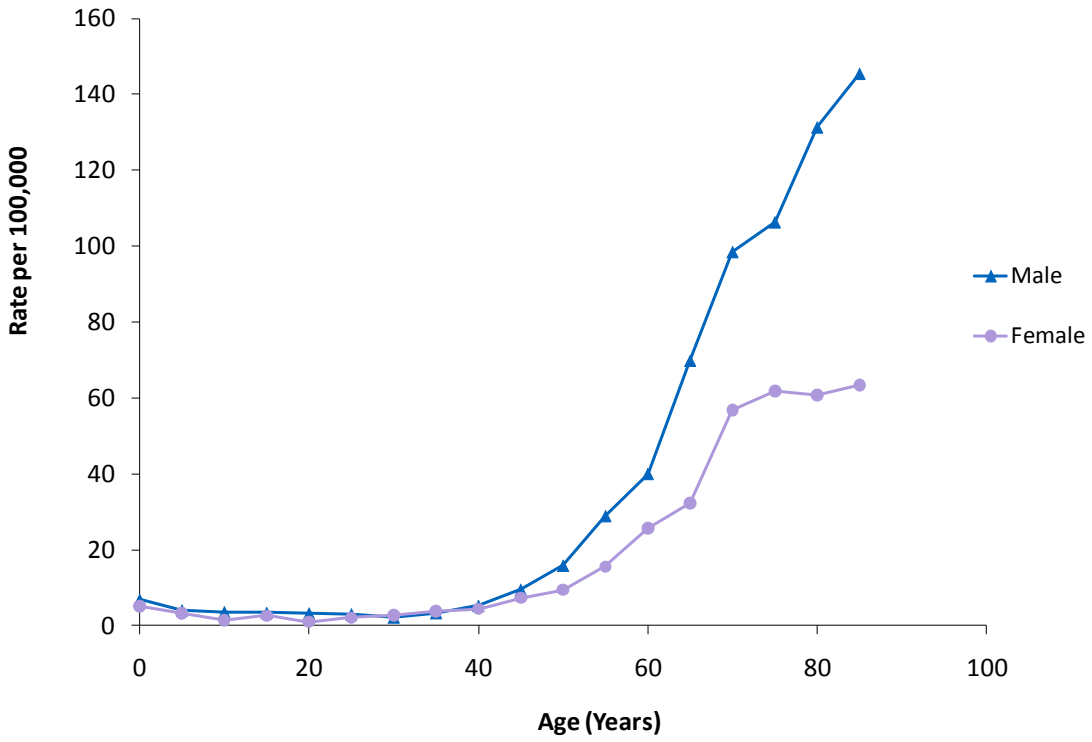
* Three-year moving average.
† Standardized to 1991 Canadian population.

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

In 2012, 211 cases of female leukemia were diagnosed in Alberta (**Figure 10-6**). ASIRs for female leukemia cancer in Alberta were higher than ASIRs in Canada.

It is estimated that 290 cases of leukemia will be diagnosed in females in Alberta in 2017.

Figure 10-7: Age-Specific Incidence Rates for Leukemia by Sex, Alberta, 2008-2012



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

Incidence rates of leukemia change with age in males and females (**Figure 10-7**). Age-specific incidence rates for leukemia are somewhat elevated in those under age 15, but remain low in both sexes until age 40. Female rates are similar to male rates until about age 45, after which females have lower incidence rates. Incidence rates are highest for both sexes in the oldest age groups.

Leukemia Mortality

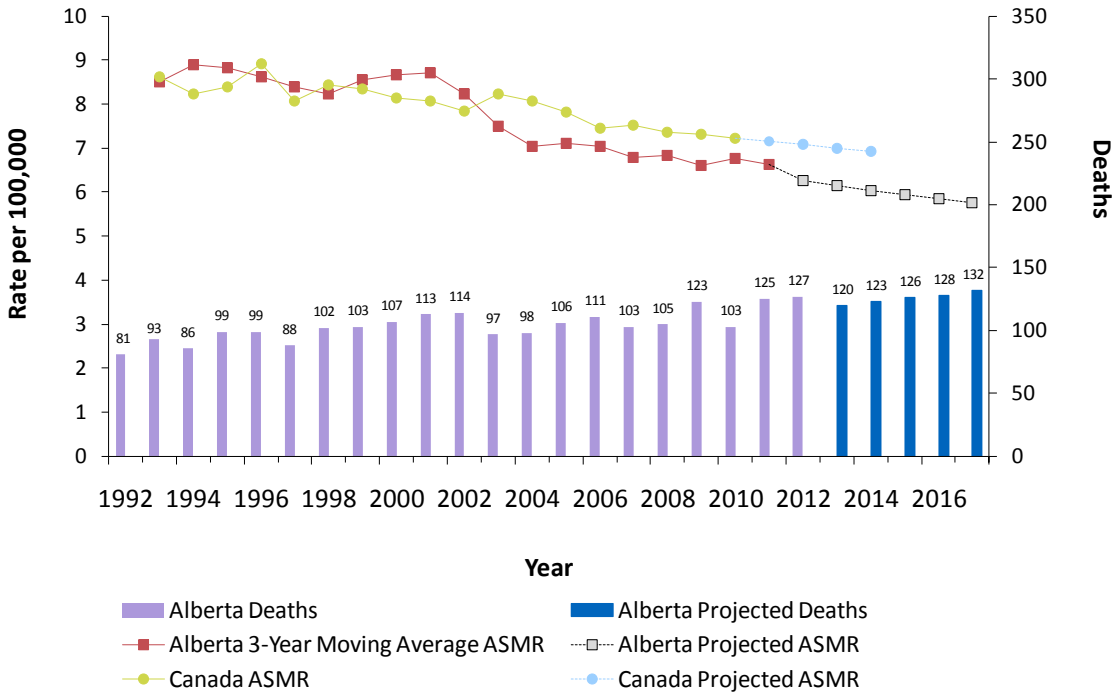
The following three figures (**Figures 10-8** to **10-10**) provide information on leukemia mortality in Alberta. The number of deaths in Alberta is affected not only by changes in the underlying risk of dying from leukemia, but also by the changes in the age structure and growth of the population. In order to compare trends over time, age-standardized mortality rates (ASMRs) are provided.

In **Figures 10-8** and **10-9** observed age standardized mortality rates are shown for 1992 to 2011 (three-year moving averages), ***projected*** rates for 2012 to 2017, and observed numbers of leukemia 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 leukemia mortality rates were calculated by extrapolating the historical trends in age-specific rate based on data from 1987 to 2011.

Figure 10-8: Actual and Projected Number of Deaths and Age-Standardized Mortality Rates (ASMRs)*† for Leukemia, Males, Alberta, 1992-2017



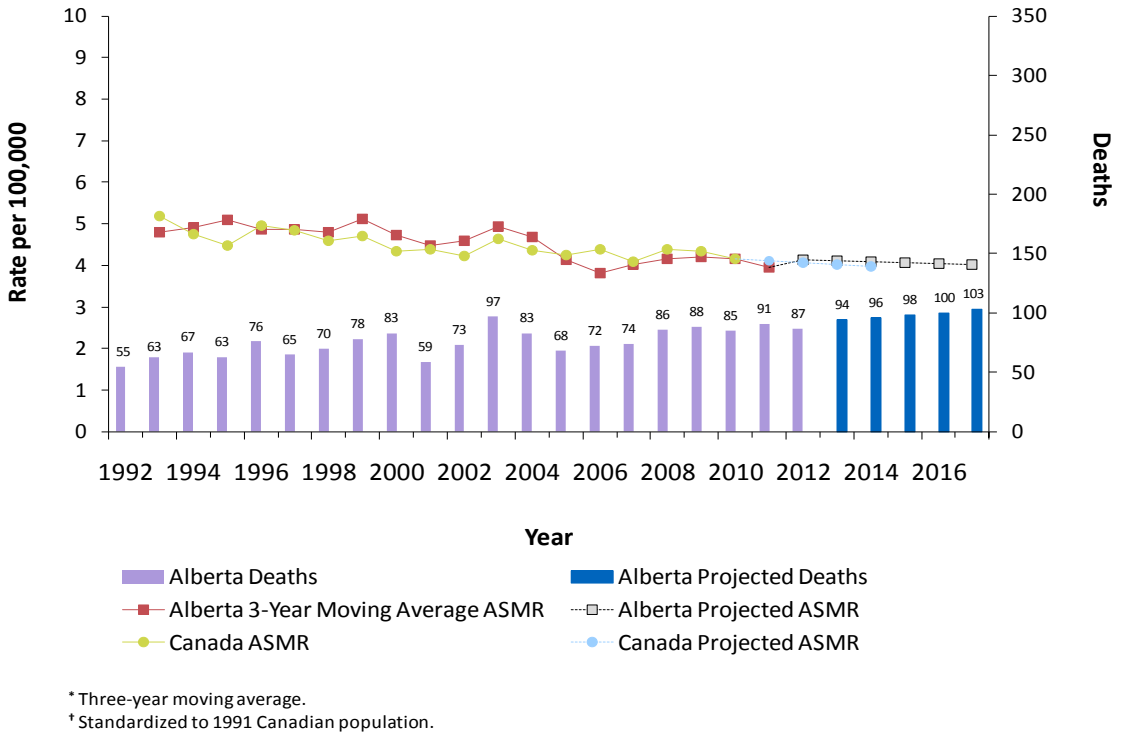
* Three-year moving average.
† Standardized to 1991 Canadian population.

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

In 2012, 127 males died of leukemia in Alberta (**Figure 10-8**). ASMRs for male leukemia cancer in Alberta were lower than ASMRs in Canada over 2003 to 2011.

It is estimated that 130 males will die from leukemia in Alberta in 2017.

Figure 10-9: Actual and Projected Number of Deaths and Age-Standardized Mortality Rates (ASMRs)*† for Leukemia, Females, Alberta, 1992-2017



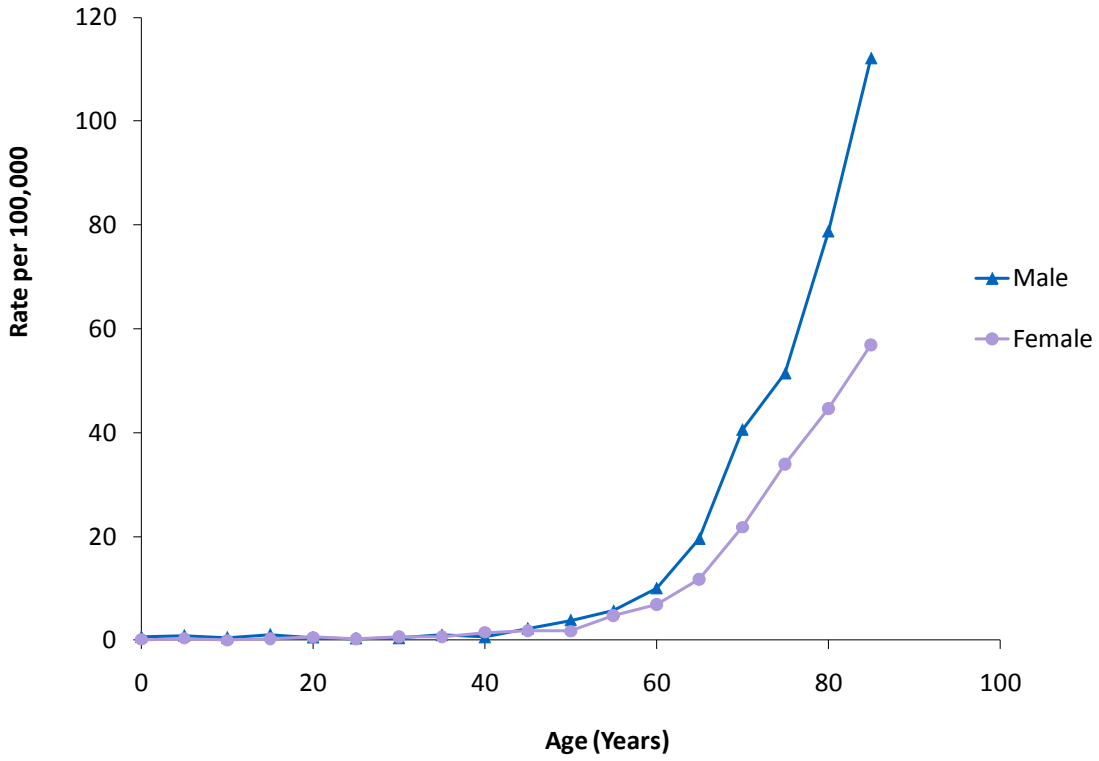
* Three-year moving average.
† Standardized to 1991 Canadian population.

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

In 2012, 87 females died of leukemia in Alberta (**Figure 10-9**). ASMRs for female leukemia in Alberta were similar to ASMRs in Canada.

It is estimated that 100 females will die from leukemia in Alberta in 2017.

Figure 10-10: Age-Specific Mortality Rates for Leukemia by Sex, Alberta, 2008-2012



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

Male and female leukemia mortality rates differ by age and sex (**Figure 10-10**). Age-specific mortality rates for leukemia are low in both sexes until about age 40, when they begin to increase. Female rates are lower than male rates after age 45. The highest leukemia mortality rates occur in the older age groups.

Leukemia 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.

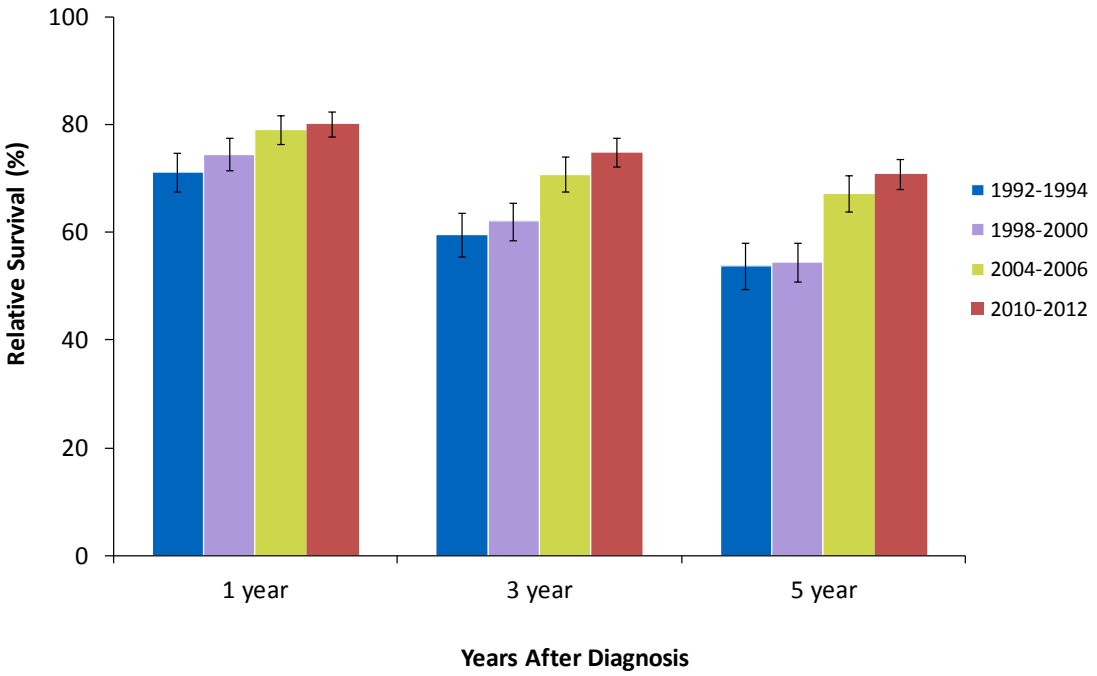
Survival depends on several factors including the cancer type (most importantly site, stage, and morphology at diagnosis), sex, age at diagnosis, health status, and available treatments for that cancer. While ***relative survival ratios*** (RSRs) give a general expectation of survival over the whole 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.[6] 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*** [6] when complete follow-up data (e.g., at least five years of follow-up to estimate the 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***.[7] 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 10-11: Age-Standardized One, Three and Five-Year Relative Survival Ratios with 95% Confidence Intervals (CI) for Leukemia, Both Sexes, Alberta, 1992-1994^, 1998-2000^ and 2004-2006^, 2010-2012*†



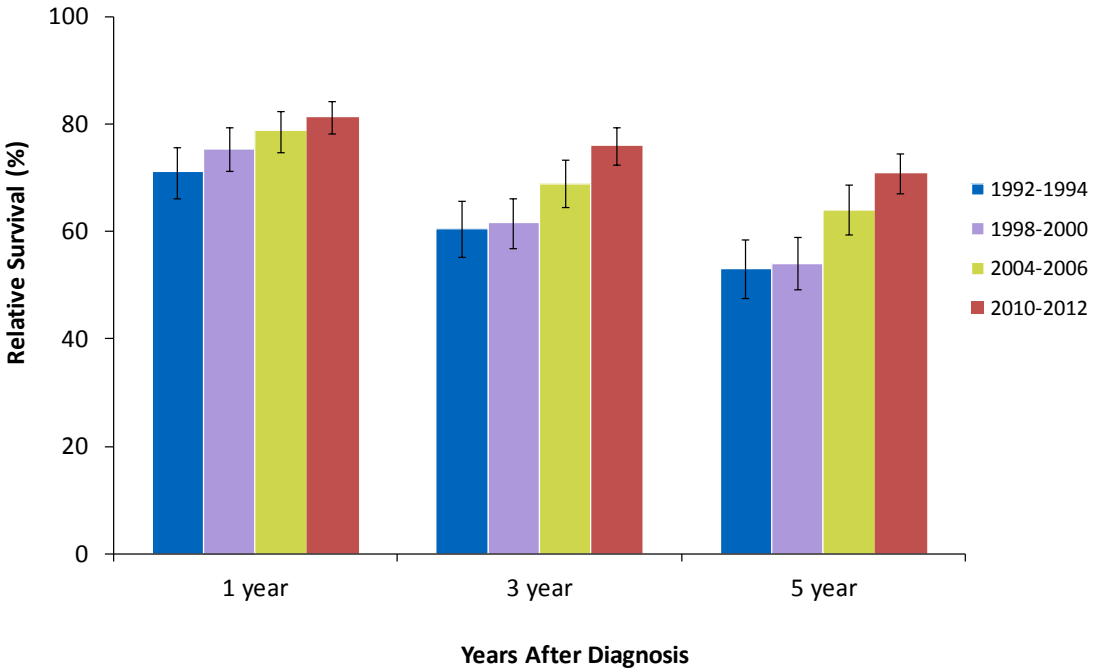
^ Ratios calculated by cohort method, where complete follow-up data are available.
†* Ratios calculated by period method, where complete follow-up data are not available.

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

The five-year relative survival ratio for individuals diagnosed with leukemia in the period of 2010 to 2012 is estimated to be 71%.

The five-year relative survival ratio for individuals diagnosed with leukemia in Alberta has improved from 2010 - 2012 compared to those diagnosed in the 1992 - 1994 cohort years (**Figure 10-11**).

Figure 10-12: Age-Standardized One, Three and Five-Year Relative Survival Ratios with 95% Confidence Intervals (CI) for Leukemia, Males, Alberta, 1992-1994^, 1998-2000^ and 2004-2006^, 2010-2012*†



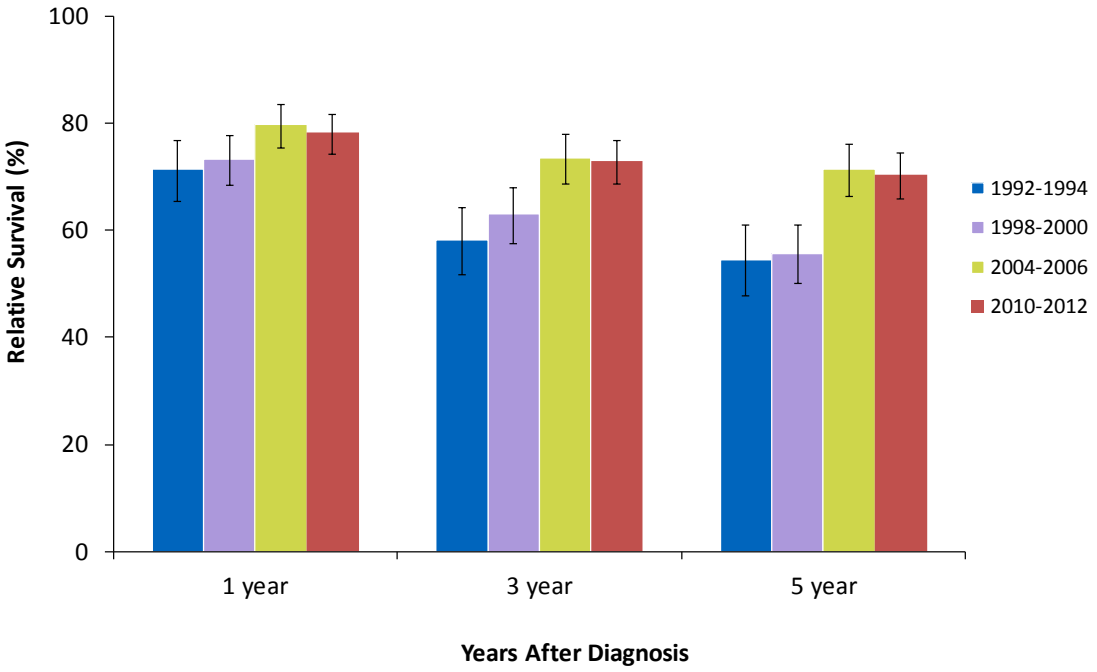
^ Ratios calculated by cohort method, where complete follow-up data are available.
†* Ratios calculated by period method, where complete follow-up data are not available.

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

The five-year relative survival ratio for males diagnosed with leukemia in the period of 2010 to 2012 is estimated to be 71%.

The five-year relative survival ratio for males diagnosed with leukemia in Alberta has improved from 2010 - 2012 compared to those diagnosed in the 1992 - 1994 cohort years (**Figure 10-12**).

Figure 10-13: Age-Standardized One, Three and Five-Year Relative Survival Ratios with 95% Confidence Intervals (CI) for Leukemia, 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 leukemia in the period of 2010 to 2012 is estimated to be 70%.

The five-year relative survival ratio for females diagnosed with leukemia in Alberta has improved from 2010 - 2012 compared to those diagnosed in the 1992 - 1994 cohort years (**Figure 10-13**).

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

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