2018

Report on Cancer Statistics in Prince Edward Island:

Lung Cancer

Prince Edward Island
CANADA

Health PEI
One Island Health System

Acknowledgments

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Forward

I am pleased to introduce a statistical report on Lung Cancer in Prince Edward Island. This is one report in a series of cancer statistical reports being developed to provide a meaningful look at the four most frequently diagnosed cancers in Prince Edward Island (lung, colorectal, breast and prostate cancers). This is the result of the report on ***PEI Cancer Trends: 1980-2009*** and recommendations of the ***PEI Cancer Strategy 2016-2019*** and is made possible by a partnership between Health PEI and the Department of Health and Wellness.

Lung cancer is the leading cause of cancer death in Island men and women. Though the rate of diagnosis has started to decrease for men, it has only stabilized for women. The burden of this disease on those diagnosed, their families, and the health system is immense.

Overtime, it is projected that the number of people diagnosed with lung cancer will decrease as fewer Islanders are using tobacco. However, like most other cancers, this is a disease of the older population and it will take time to see this decline. The most significant impact of a diagnosis of lung cancer is the largely late stage diagnosis meaning the quality of life of those diagnosed can be poor and the treatment options to improve outcomes and survival are limited.

As we learn more about cancer in PEI, we find there are more questions. The intention of this series of statistical reports is to provide a robust information base for optimal program planning, investments, and monitoring, so Islanders have access to effective, sustainable and high quality care.

Dr. Carol McClure, PhD, DVM, MS
Provincial Cancer Surveillance Epidemiologist

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Introduction

Lung cancer is the leading cause of cancer death in PEI and the second most frequently diagnosed cancer in Island men and women. The impact and burden of lung cancer in PEI is significant which was identified in the ***PEI Cancer Trends: 1980-2009*** report. In an effort to advance information on the disease and its burden, further investigation was needed into this leading type of cancer.

Carcinogens such as radon gas, asbestos, and arsenic increase the risk of lung cancer. However, smoking and exposure to tobacco smoke (secondhand smoke) are the most significant risk factors for lung cancer[1]. The risk of lung cancer increases as the number of cigarettes and the years of smoking increases. Approximately 80-90% of all lung cancers are caused by smoking[2]. To reduce the risk of lung cancer, it is important to never start smoking and for current smokers to quit. Smoking cessation, even after years of smoking, will still reduce the risk of developing lung cancer[3].

There are two major categories of lung cancer based on the type of cell that has become cancerous. Non-small cell lung cancer (NSCL) is more common and consists of multiple types of lung cancers and small cell lung cancer (SCLC) is less common and almost all are associated with smoking[3]. It is important to distinguish NSCL from SCL because treatment is different[1].

This report is part of a series of four cancer statistical reports which supports the ***PEI Cancer Strategy 2016-2019*** [4] strategic recommendation to increase capacity to monitor cancer trends. It is intended to provide insight into the current state of incidence, mortality, survival and prevalence with an overview of the risk factors that intensely influence lung cancer rates.

In this report the word lung cancer refers to invasive lung cancers unless otherwise specified. The information is largely from the PEI Cancer Registry.

Examining the lung cancer experience in PEI using the most recent statistics available will assist in guiding efforts and improvement in prevention and early detection, diagnosis, treatment and supportive care, including palliative care. The information is intended for use by health professionals, decision makers and researchers to guide policy, evaluation and planning in PEI, and as an opportunity to educate interested public.

Data Sources

Full details on data sources, methods and glossary of terms can be found in Appendices.

Prince Edward Island Cancer Registry

As cancer is a notifiable disease in PEI, all new cases of cancer are registered with the PEI Cancer Registry which will be referred to as the "Registry" in this report[5]. Analyses of new lung cancer cases from 1982 through 2015 and lung cancer deaths from 1992 through 2014 from the Registry are presented. Staging data is only available from 2005 and later. Full details on methodology can be found in Appendix I. Anatomic site of origin and microscopic cellular structure of all cancers counted as lung cancers are listed in Appendix II.

PEI Population Health Assessment and Surveillance Unit

As part of the PEI Chief Public Health Office, this unit is responsible for monitoring and reporting on health status and health trends in PEI. The unit supports evidence-based decision making, and promotes continuous improvement by generating, analyzing, and interpreting information. The scope of the program and services within the section are: production of technical population health reports, interpretation and analysis of national reports to make information relevant to PEI surveillance of communicable and non-communicable diseases, population research, development of population health databases, and evaluation of health initiatives.

For this report the unit provided information on lung cancer risk factors. The provincial and national information is the outcome of surveys and information compiled by Health Canada.

Statistics Canada

Under the Statistics Act, Statistics Canada is required to collect, compile, analyze, abstract and publish statistical information relating to the commercial, industrial, financial, social, economic, health, and general activities and condition of the people of Canada. It also requires that Statistics Canada conduct a census of population every fifth year, and that the Agency protect the confidentiality of the information with which it is entrusted. For the purpose of this report, population census information was used to support age-standardized rates. In addition, Statistics Canada provides the data for Canadian lung cancer rates for incidence and mortality.

Lung Cancer Surveillance

Understanding Cancer Measurements

The burden of cancer to Islanders and the health care system can be measured by the number of cases of cancer and people living with cancer. If you are an Islander and you wanted to know the risk of being diagnosed with cancer or dying from cancer in PEI, you would want to know the crude incidence or mortality rate. The crude rate is the number of new cases or deaths per 100,000 Islanders. However, if you wanted to know if the risk of being diagnosed with cancer or dying from cancer was different in PEI compared to other provinces or all of Canada, you would want to compare the age-standardized rates. Age-standardized rates are used to describe the rate of cancer in Islanders if our population was a standard population. To compare them appropriately, provincial and Canadian rates must be age-standardized. To compare the rate in one year to another, rates must also be age-standardized. Age-standardized rates should not be used to allocate funds to cancer prevention, screening, and treatment programs for PEI. Because the population of PEI is older than the standard population (Canadian population in 2011), the actual or crude incidence rate in PEI is higher than the age-standardized rate. Prevention and treatment programs should be based on crude incidence rate and the actual number of cases to be sure that all Islanders have access to the programs they need.

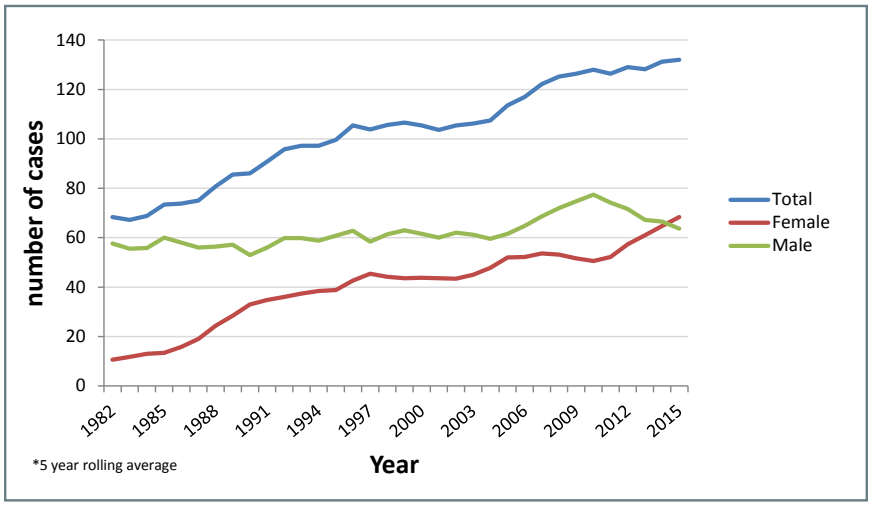
In many measurements, a 5-year rolling average was used to smooth the trend line. Each yearly estimate is an average of the two years before, the year, and two years after the estimated year.

Specific definitions for these measurements and other terms are available at the end of this document in the Appendices.

Lung Cancer Incidence

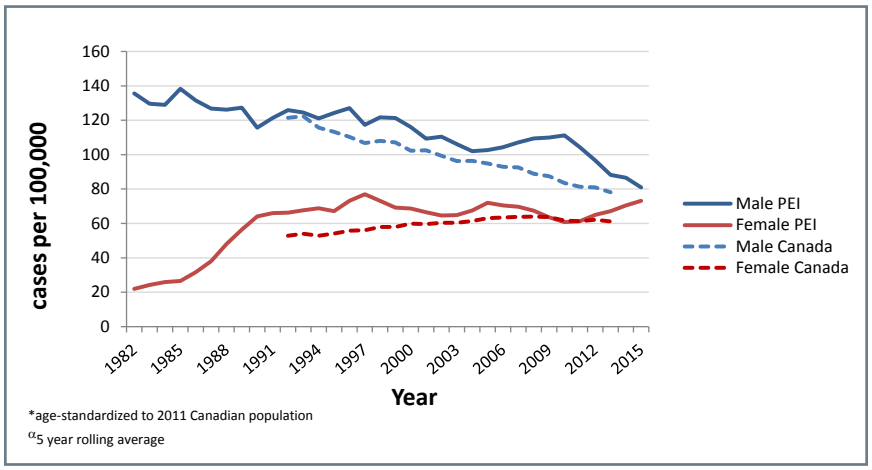
Cancer incidence is the number of new cases of invasive cancer diagnosed in a specific time period in a specific population. In this section of the report incident cases are the actual number of new lung cancer cases diagnosed each year.

Figure 1 Incident cases* of Lung Cancer, 1982-2015, PEI



The number of cases in PEI has been rising; however majority of the increase has been due to the increase in cases in females. This increasing trend is important when we are projecting health care need such as utilization of testing, treatment, equipment, aftercare, palliative needs, etc.

Figure 2 Age-standardized* Incidence Rate of Lung Cancer, 1982-2015, PEI$^{\alpha}$ and Canada



The figure above is the age-standardized incidence rates in PEI (solid lines) and in Canada (dashed lines)[6]. Age-standardized rates are used for two reasons. First, it removes the effect of an increase of the number of cases strictly due to the increasing population. Second, it eliminates the effect of our aging population. For most cancers, the older we become, the more likely we are to get cancer. If we age-standardize the population, the effect of the increasing size and age of our population is removed and we can see the true increase or decrease in risk of getting cancer. The biggest risk factor for lung cancer is smoking.

The decreasing age-standardized rate in men and stable rate in women are likely associated with smoking and cessation rates in PEI[7]. For the most part, the lung cancer rates are higher in PEI than in Canada.

The annual percentage change of the age-standardized incidence rate is an estimate of whether there is a significant increasing or decreasing trend in the rate. The trends can be estimated and tested for significance. Overall, the age-standardized lung cancer incidence in PEI women decreased by 0.1% per year between the years 1996 through 2015. This decrease is not significant, thus the age-standardized rate for women has not significantly changed in the last 20 years.

The trend in males was more complicated in which there was a decreasing trend, followed by a short increasing trend during 2006-2009, and ending with a decreasing trend. Although this short period of increase was not significant, the decrease between 2009 and 2015 of approximately 8% yearly was significant.

The risk of lung cancer in PEI is higher than in Canada. The risk has not changed significantly in women over the last 20 years. The risk has been decreasing in PEI men during the same time period which has been attributed to decreasing smoking rates in men.

Lung Cancer Incidence by Age

Cancer is more common in older people. As our population ages we expect to see more cancers diagnosed. This is also true for lung cancer.

Figure 3 Number and proportion of Lung Cancer Cases by Age Grouping for 5 year periods, 1986-2015, PEI

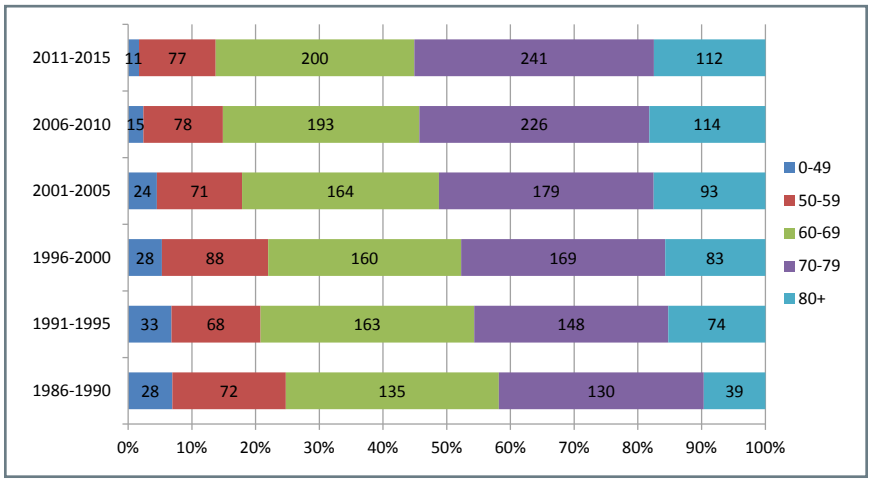
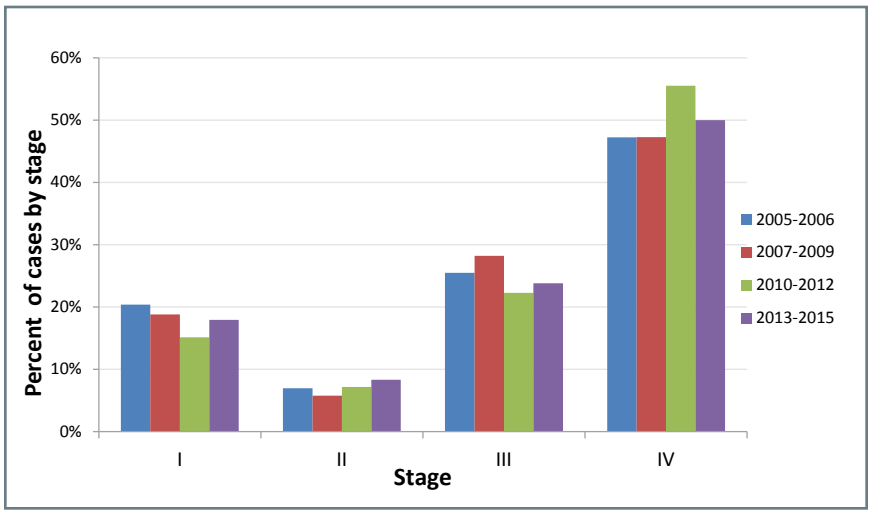


Figure 3 demonstrates how the age of those diagnosed has increased. This is likely because we have an aging population. The numbers inside the bars are the actual numbers of Islanders diagnosed with lung cancer in the age group. There are fewer people diagnosed with lung cancer and a smaller proportion in the 0-49 year old group in the recent years. This may be reflective of the decreasing smoking rate in the younger age groups. If the smoking rate continues to decrease, it may be possible to see a smaller number of cases and proportion of people diagnosed in the next age group (50-59) over time.

Lung Cancer Incidence by Stage

Cancer staging helps predict the risk of disease spreading and informs treatment planning. Information on whether the cancer is contained to one location or if it has spread to other parts of the body is collected to help determine the stage. The earlier the stage at time of diagnosis the better the prognosis is and the least amount of treatment will be required.

Figure 4 Lung Cancer Incident Cases by Stage, 2005-2015, PEI



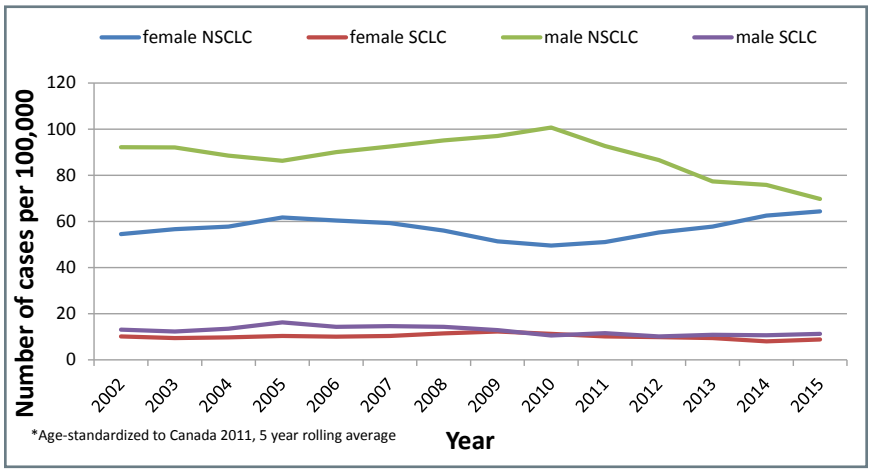
The percentage of the different stages indicates that most of the lung cancers are diagnosed at stage IV followed by stage III. This could be indicative of longer times in the diagnostic phase of the disease.

Approximately 75% of cases of lung cancer are diagnosed at a late stage (stages III and IV). Finding cancer at an early stage will improve survival.

Lung Cancer Incidence by Type

Lung cancers are divided into small cell (SCLC) and non-small cell (NSCLC) cancers. Small cell cancers are named so because the size of the cancer cell when viewed by a microscope[8]. These cancers usually start in the center of the chest and spread through the body early in the disease[1]. Non-small cell cancers can start in different areas of the lung and are not all associated with smoking[9].

Figure 5 Age-standardized Incidence* Rate by Sex of Small Cell and Non-Small Cell Lung Cancer, 2002-2015, PEI



Most lung cancers are NSCLC. The decrease in NSCLC in men is notable. This decrease likely corresponds to the declining rate of smoking seen decades earlier.

Non-Small Cell lung cancer is more common than Small Cell cancer. The rate of Non-small Cell cancer in men has been decreasing over time.

Lung Cancer Mortality

This section of the report provides information on the number of deaths due to lung cancer in PEI. Cancer mortality is based on lung cancer as the cause of death as it is reported on a person's death certificate.

Figure 6 Deaths from Lung Cancer, 1992-2014, PEI

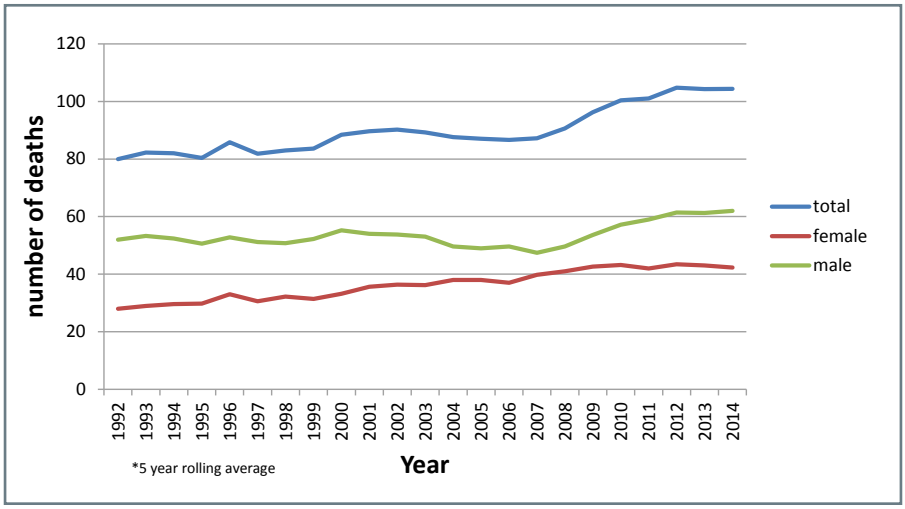
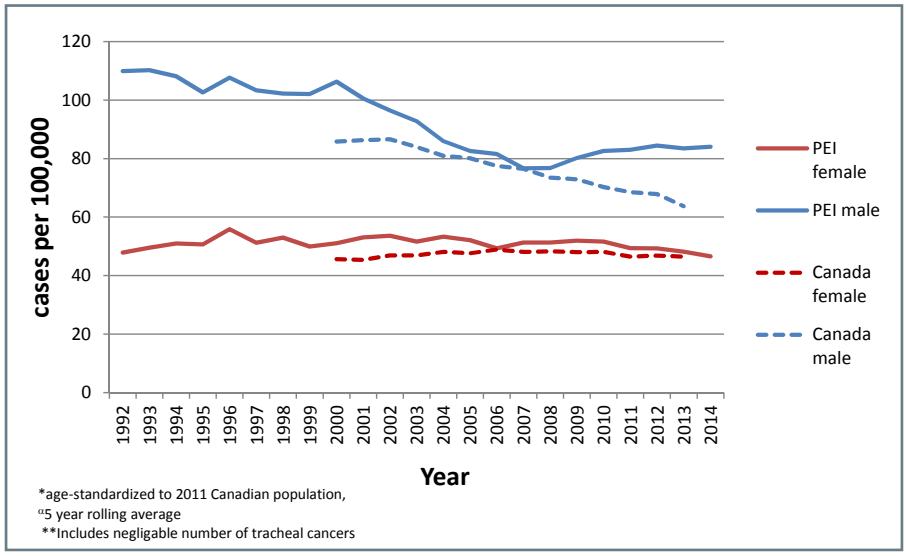


Figure 6 depicts how the number of deaths in PEI due to lung cancer increased rapidly in the late 2000's ("total" line). This increase in deaths corresponds to the rising number of new lung cancer cases diagnosed just before the start of this period. After 2010 the increase appears to slow. The average number of deaths due to lung cancer between 2010 and 2014 was 105 deaths each year.

Over 100 Islanders a year die from lung cancer.

Figure 7 Age-standardized Mortality Rate* of Lung Cancer, 1992-2014, PEI[α] and Canada**



The figure above (figure 7) is the age-standardized mortality rates in PEI (solid lines) and in Canada (dashed lines)[10]. Adjusting for the increasing age and size of the population, the risk of mortality in PEI appears stable for females and an overall decrease for males from 1992-2014. The pattern of PEI mortality corresponds to the changes in incident rates. The mortality rate for Canadian females is similar to that of PEI, but the pattern in Canadian males is consistently decreasing compared to that of PEI males.

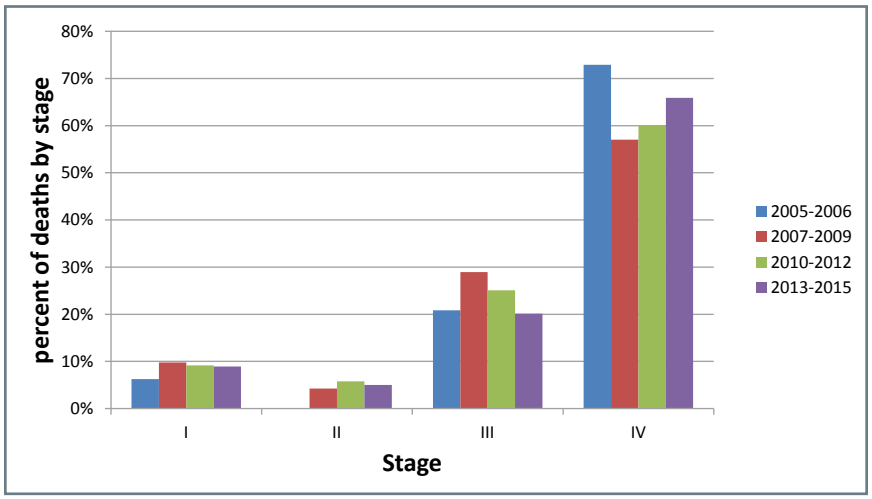
Any increasing or decreasing trend in the PEI mortality rate over the years was estimated by the annual percent change for age-standardized mortality rate for lung cancer. On average, lung cancer mortality in women decreased by 0.25% per year between 1992 and 2014. This decrease is not statistically significant; indicating the trend in mortality rates was stable.

Unlike women, the men have a signficant decrease in the annual percent change. There was a significant decrease of 1.7% lung cancer deaths per year between 1992 and 2014. This decrease corresponds with the decrease in incidence likely due to the decrease in smoking rates.

Deaths due to lung cancer have been decreasing in men in association with the decrease in rate of new diagnoses of lung cancer.

Lung Cancer Mortality by Stage

Figure 8 Lung Cancer Deaths by Stage, 2005-2014, PEI



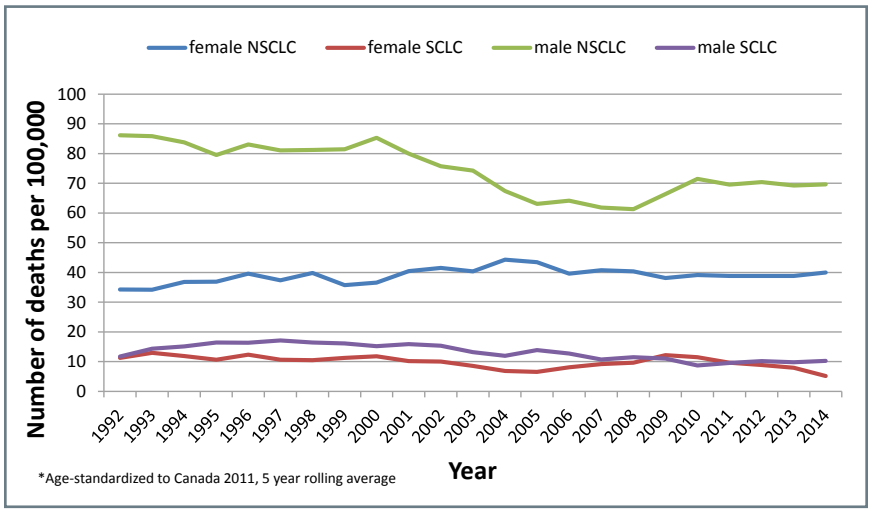
The largest proportion of deaths occurs in people who were diagnosed at stage IV which is consistent with that most lung cancers are diagnosed at stage IV, the most advanced stage. Although stage II is more advanced than stage I, there are more people diagnosed with lung cancer at stage I accounting for the higher mortality rate.

The largest proportions of deaths due to lung cancer are in people who were diagnosed at stage IV.

Lung cancer is an aggressive disease. More people die of NSCLC than SCLC because more people are diagnosed with NSCLC. The mortality rate is directly associated with the diagnosis (incidence) rate.

Lung Cancer Mortality by Type

Figure 9 Age-Standardized Mortality rate* of Small Cell and Non-Small Cell Lung Cancer, 1992-2014, PEI



In general, the number of people dying from non-small cell lung cancer (NSCLC) has been increasing. However, when the data is age-standardized, the risk of dying from NSCLC only appears to increase in the late 2000's in the males, but not at all in females. This increase in males is consistent with the increase in incidence in NSCLC in males at that time.

Lung Cancer Survival

Relative survival ratio (RSR), which is often referred to as net survival, is a measure of disease severity and thus prognosis (Table 1). It indicates the probability of an average person with a lung cancer surviving to a certain time after diagnosis compared to the average person without cancer. It is based on a large group of people and is only an average estimate. As an example, the five-year relative survival for an average woman in PEI with lung cancer is 15% indicating that a women diagnosed with lung cancer has, on average, a 15% chance of surviving to 5 years compared to women without lung cancer on PEI. Relative survival measured over time can be used to measure improvements in cancer screening and early detection, diagnosis, and treatment.

Table 1 Interpretation of relative survival rations in cancer research

Prognosis	5-year relative survival ratio
Excellent	≥ 85%
Good	70-84%
Fair	30-69%
Poor	<30%

Figure 10 Five-year Relative Survival Rate*, All cancer and Lung Cancer, PEI

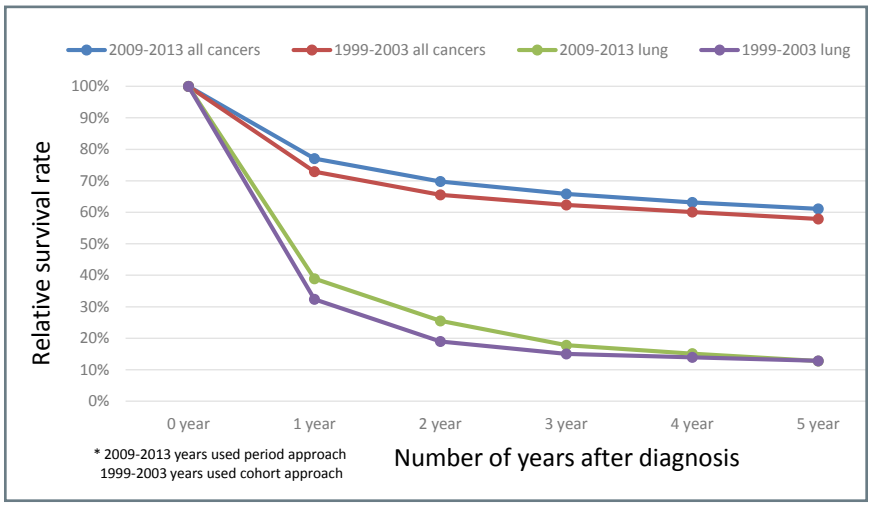
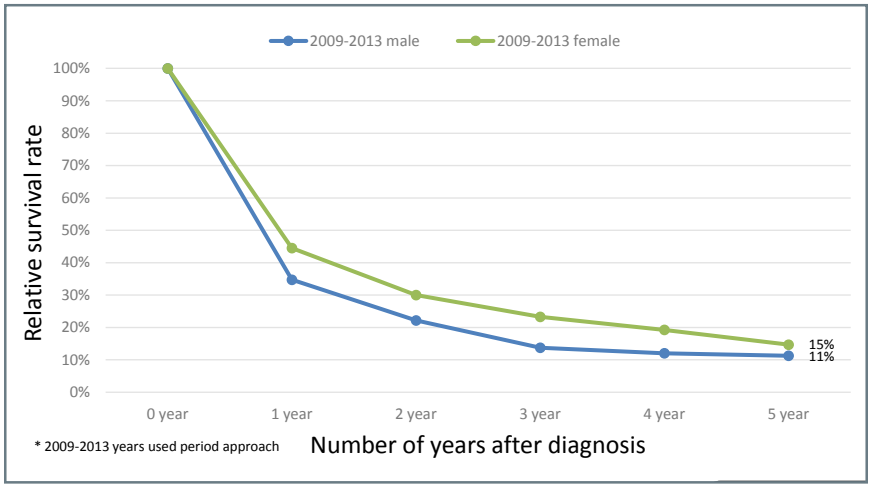


Figure 10 has RSRs for each year up to 5-years after diagnosis for both lung cancer and all cancers combined for cancers diagnosed from 2009 through 2013. Lung cancer is one of the most aggressive cancers and the survival is much less than all cancers combined. The 5-year RSR for lung cancer is 12.8%. In addition, the historical information is provided from cancers diagnosed from 1999 through 2003. For lung cancer, there is significantly better survival in the most recent period (those lung cancers diagnosed 2009-2013) in the first two years after diagnosis compared to the earlier period (lung cancers diagnosed in 1999-2003). Unfortunately this effect does not last. By 5 years, the RSR is exactly the same indicating that the more recent group does not survive to 5 years post diagnoses at any higher rate than the earlier group. In contrast, most of the small improvement in relative survival in all cancers remains after 5 years.

Although survival is poor, more people are living to two years compared to earlier times.

Long-term survival can be measured by 10- and 15- year relative survival. For all patients diagnosed with lung cancer between 1995-2013, the 10-year relative survival is just under 8%. For all patients diagnosed between 1991 and 2013, the 15-year relative survival is just under 6%.

Figure 11 Five-year Relative Survival Rate* for Lung Cancer by Sex diagnosed 2009-2013, PEI

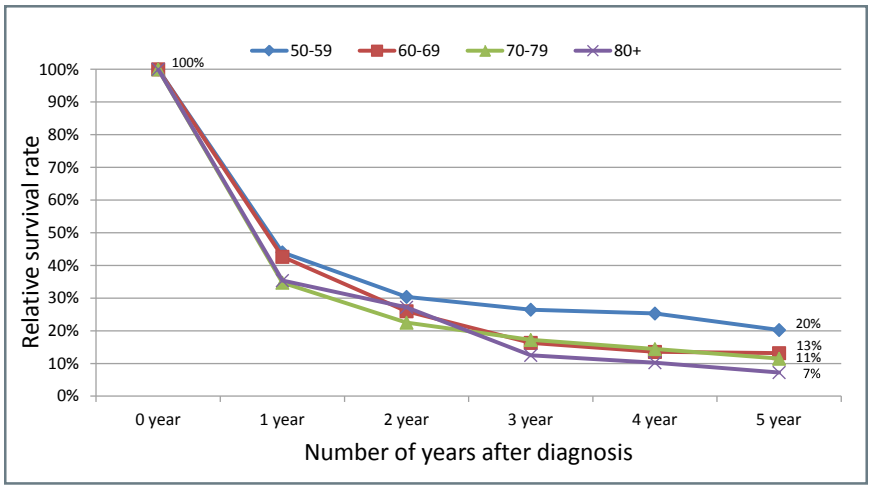


Survival in both men and women is poor. Although survival appears better in women in the first few years after diagnosis, 5-year survival is very similar.

Women have better survival than men early after diagnosis.

Lung Cancer Survival by Age

Figure 12 Five-year Relative Survival Rate for Lung Cancer by Age Group, diagnosed 2009-2013, PEI



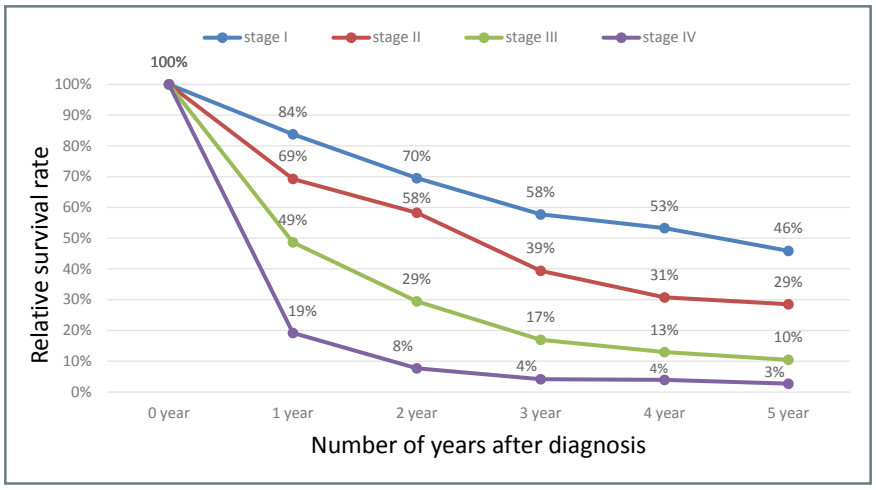
Those diagnosed with lung cancer at a younger age (50-59 years) tend to have a higher relative five-year survival rate than those diagnosed in later years of life.

There is a pattern that younger patients have a higher RSR compared with older patients. One contributing reason could be that younger patients are diagnosed at a lower stage level or with a higher proportion of

non-small cell lung cancers; however, this does not prove true because the youngest group had the highest proportion of Stage IV and small-cell lung cancers. It is possible that the improved 5-year RSR may be due to fewer comorbidities or improved ability to tolerate the treatments in the younger age group[2].

Lung Cancer Survival by Stage

Figure 13 Five-year Relative Survival Rate for Lung Cancer by Stage, 2009-2013, PEI



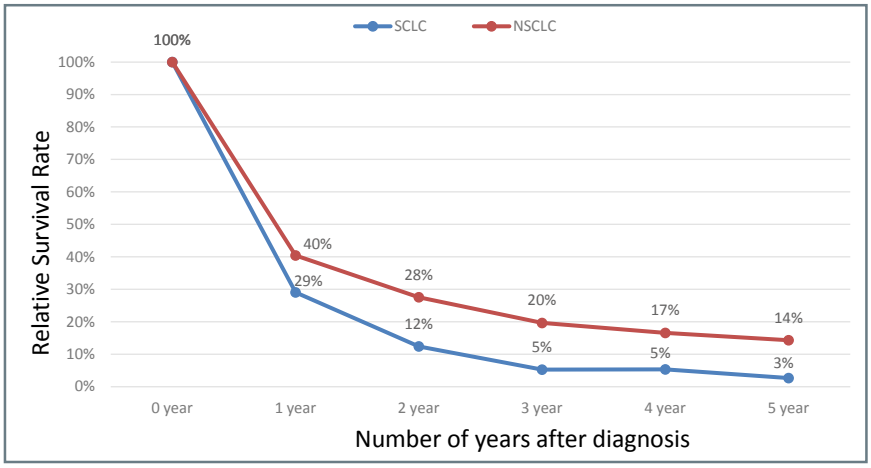
Relative survival rate for the different stages at diagnosis follow the pattern of lowest stage has the highest RSR while highest stage has the lowest RSR. Staging may be useful for prognosis. When Stage III is divided into Stage IIIa and Stage IIIb, RSR ratios are slightly higher (but not significantly higher) for Stage IIIa than Stage IIIb. However, by 5-year RSR, the outcomes are similar. The earlier the stage at diagnosis is, the better the survival is.

Detecting lung cancer at its earliest stages increases the relative five-year survival rate.

Although both SCLC and NSCLC have poor prognosis, survival is slightly better in cases of NSCLC.

Lung Cancer Survival by Type

Figure 14 Five-year Relative Survival Rate for Small Cell and Non-small Cell Lung Cancer, 2009-2013, PEI

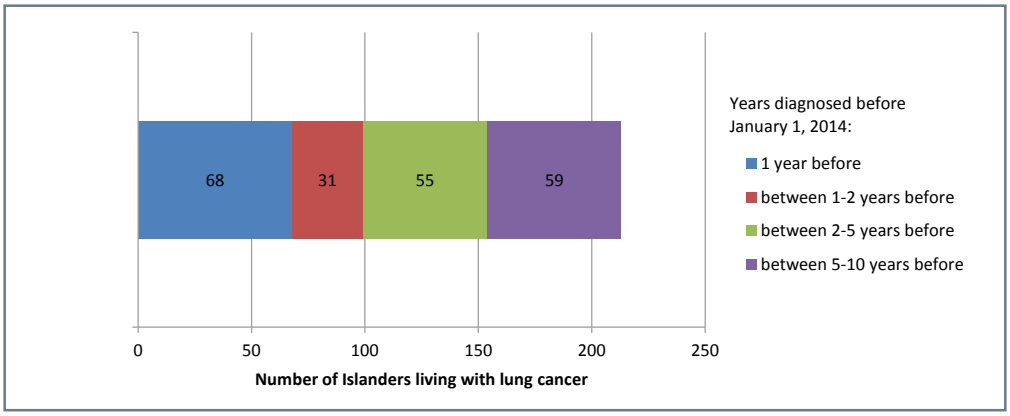


The relative survival rate for small cell lung cancer is lower than that of non-small cell lung cancer.

Prevalence

The ten-year prevalence of cancer is the proportion of Islanders diagnosed from 2004 through 2013 who are still alive on January 1, 2014. The level of prevalence is determined by the rate of new cases of cancer diagnosed in the 10-year period and the rate of survival for these Islanders. Cancer prevalence is an important measurement of the burden of cancer to Islanders and the health care system.

Figure 15 Number of cases of Lung Cancer diagnosed between January 1, 2004 to December 31, 2013 that are alive on January 1, 2014, PEI



Although the prognosis for lung cancer is poor, there are still a substantial number of Islanders living with lung cancer.

The number of people living with lung cancer diagnosed in the last ten years is 213 (figure 15). Although approximately 15% of all cancer diagnoses in PEI are for lung cancer, the 213 people living with lung cancer represent only 5% of all living cancer patients diagnosed in the ten-year period. Because of the poor prognosis of lung cancer, the proportion of people living with lung cancer compared to other cancers decreases over time.

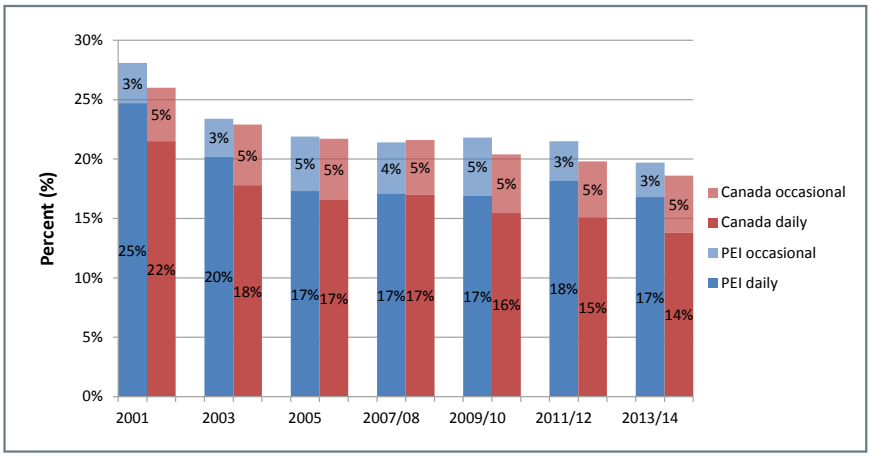
Care for the cancer patient consists of a progression of active treatment, continuous follow-up for recurrences and treatment of recurrences, and possibly palliative and end-of-life care. In addition to medical care, psycho-social and rehabilitative care may be necessary. For the most part, the first two years encompasses the time of treatment and after treatment recovery. Years 3 through 5 are the intermediate years in which follow-up care is high. After 5 years, the greater part of care adjusts to clinical monitoring and the needs of a survivor. Nearly half of all Islanders living with lung cancer are less than 2 years from their initial diagnosis.

Risk Factors

Many risk factors associated with lung cancer have been highlighted in science papers and support websites[8,11]. Living with comorbidities such as HIV infection, pulmonary fibrosis, and chronic obstructive pulmonary disease (COPD) increase the risk of lung cancer. History of previous chest radiotherapy, previous chemotherapy, and a family history of lung cancer are also risk factors. In addition, exposure to environmental substances including asbestos, arsenic, radon, and secondhand smoke contribute to increased risk of lung cancer. There are many other important risk factors, but this report will highlight the most important risk factor, smoking. Approximately 80-90% of all lung cancers are attributed to smoking tobacco[2,8].

Smoking

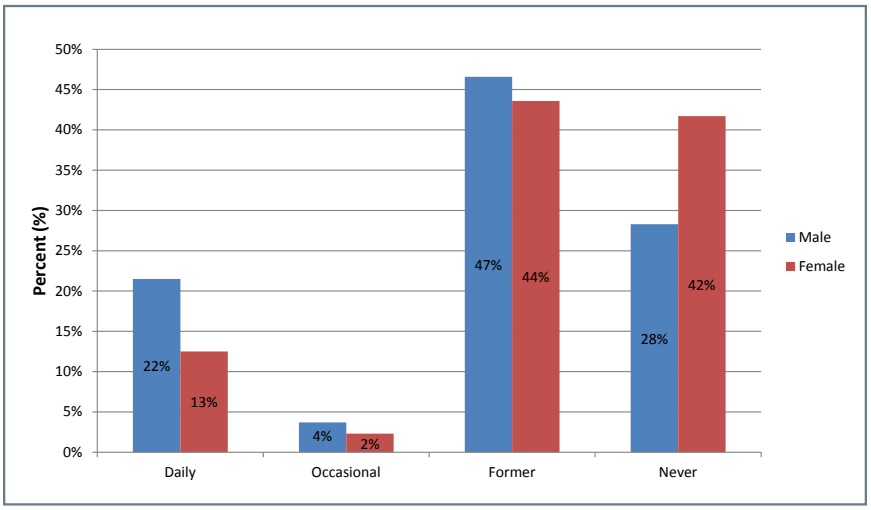
Figure 16 Percentage of Population (aged ≥ 12) Reporting Daily or Occasional Smoking, 2001-2014, PEI & Canada



The PEI Chief Public Health Office analyzes self-reported smoking information from the Canadian Community Health Survey (CCHS)[12]. The smoking rate in PEI is significantly higher than Canada (Figure 16). Smoking is the number one cause of lung cancer. PEI has developed relatively strict legislation regarding smoking in public spaces, but more work on prevention and cessation is necessary.

Daily smoking rates in PEI are higher than Canada.

Figure 17 Percentage of Population (aged ≥ 12) by Smoking Behavior and by Sex, 2013 & 2014, PEI



The CCHS data can be separated by males and females. There is a higher proportion of males who are current smokers compared to females in PEI. However, lung cancer incidence has not shown a decrease in women and a substantial effort in prevention is very important to both males and females to decrease smoking initiation and increase smoking cessation.

PEI Cancer Strategy Recommendations

The ***PEI Cancer Strategy: Let's Make a Difference (2016-2019)*** was developed with guidance by the Provincial Cancer Coordination Steering Committee (the Steering Committee). The strategy goals are to work to:

- Reduce cancer incidence, mortality, and morbidity.
- Enhance the quality of life of individuals at all stages of the cancer continuum.
- Optimize resources and processes to sustain the PEI cancer care system.

Implementation and monitoring of the strategic recommendations are guided by the Steering Committee and reported to the Minister of Health and Wellness and the CEO of Health PEI. While many recommendations support all people experiencing cancer, there are some that are specific to lung cancer including:

- Establish a lung cancer action group.
- Continue to support the prevention and cessation of tobacco use among youth and young adults.
- Ensure that those who want to quit smoking have access to services and supports that meet their needs.
- Monitor evidence and identify what is needed to prepare for lung cancer screening for those who are at high risk of lung cancer in PEI.
- Establish the best process to rapidly and accurately diagnose the four most frequent cancers in PEI (lung, breast, colorectal, and prostate).
- Establish standardized care plans beginning with the four most frequent cancers in PEI (lung, breast, colorectal, and prostate).

For more information on the strategy go to ***www.healthpei.ca/cancercare.***

Conclusions

Lung cancer is the leading cause of cancer death in PEI and the second most frequently diagnosed cancer in Island men and women. Over the last 20 years, the rate of new diagnoses and lung cancer deaths have decreased in men but have stayed stable for women, which is likely associated with smoking and cessation rates in PEI. Because lung cancer is a very aggressive disease and is most commonly diagnosed in stage IV in PEI, the rate of survival is poor. Earlier diagnosis will improve survival while reduction of risk factors is extremely important in preventing the disease.

Approximately 80-90% of all lung cancers are caused by smoking. To reduce the risk of lung cancer, it is important to never to start smoking and for current smokers to quit. Smoking cessation, even after years of smoking, will still reduce the risk of developing lung cancer. PEI has developed relatively strict legislation regarding smoking in public spaces, but more work on prevention and cessation is necessary.

Health PEI will continue to reduce the impact of lung cancer on Islanders following recommendations from the PEI Cancer Strategy. Goals include enhancing the quality of life of individuals and optimizing resources and processes to sustain the PEI cancer care system.

Appendices

Appendix I: Methods

Sources

Prince Edward Island Cancer Registry Data Sources

As cancer is a notifiable disease in PEI, all new cases of cancer are registered with the PEI Cancer Registry which will be referred to as the "Registry" in this report[5]. Although the Registry data is collected for all residents of PEI, the Registry itself is located at the PEI Cancer Treatment Centre at the Queen Elizabeth Hospital in Charlottetown. Registry data sources are listed below. Additional information required to complete the Registry abstracting process is gathered from notification from out-of-province cancer registries.

For this report, analysis of new lung cancer cases from 1982 through 2015 and lung cancer deaths from 1992 through 2014 from the PEI Cancer Registry are presented. PEI cancer data in the PEI Cancer Registry is compiled from multiple sources by the Registrar. Staging data is only available from 2005 through 2015.

Prince Edward Island Provincial Health Care Services

Data are collected from PEI Cancer Treatment Centre patient records, laboratory reports, pathology reports, cytology reports, autopsy reports, and notification from the Discharge Abstract Database. Additional information required to complete the cancer registry abstracting process is gathered from physician offices and health records.

Prince Edward Island Vital Statistics

The Registry receives quarterly reports from PEI Vital Statistics. All people who had any type of cancer reported on their death certificate are included in the quarterly report. The Registry will include cancer as the "Cause of Death" (COD) for only those people with cancer as the underlying COD on their death certificate. Information from the quarterly report is matched to the associated patient record in the Registry and information is added to the Registry if not present already. Information in the quarterly report includes date of death, province of death, place of death, underlying COD ICD code if it is cancer, and death registration number.

Statistics Canada

National Death Clearance: The National Death Clearance which contains COD, date of death, underlying COD, province of death, and death registration number, was sent yearly to the Registry between 1992 and 2008. This information was used to verify the Provincial Vital Statistics and to identify other cancer patient that occurred in other provinces except Quebec. Mortality prior to 1992 was not death cleared by Statistics Canada and will not be presented in this report.

Population Tables: The number of people in the population is needed to calculate rates for incidence, mortality, and prevalence. Population counts by sex and 5-year age groups are provided by Statistics Canada and are from the 2011 Census. The census is done every five years by Statistics Canada, and mid-year population estimates are produced for the intercensal years. The 2011 Canadian Standard Population in 5-year age groups (18 groups) is used for age-standardized rates.

CANSIM Tables: The Canadian lung cancer incidence and mortality rates are provided in the Canadian socioeconomic database from Statistics Canada (CANSIM) tables. Estimations for lung cancer mortality rates in CANSIM are based on cancers of the lung and bronchus as well as cancers of the trachea. Deaths from cancers of the trachea are not included in the PEI mortality rate estimates, but are very rare and we considered their effect on the Canadian mortality rate to be insignificant.

Life Tables: Survival rates are calculated using the life tables containing the expected survival of Islanders that are provided by Statistics Canada through the Data Use and Publication Committee (DUPC). The data have the same yearly expected survival from years 2010 through 2013.

Risk Factors: Analysis of smoking behaviors in PEI were provided by the PEI Population Health Assessment and Surveillance Unit of the PEI Chief Public Health Office. The data originated from the Canadian Community Health Survey conducted by Statistics Canada.

Data Quality

The Registry works with the Canadian Cancer Registry which provides data quality reports to the provincial registries. The Registry is also a member of the North American Association of Central Cancer Registries (NAACCR). NAACCR's mission is to enhance the quality and the use of cancer surveillance data in North America[13]. NAACR has presented the Registry with the Gold or Silver standard award in every year but one since 1998 for the "completeness, accuracy, and timeliness" of PEI cancer data.

Analyses

All statistics were performed using Stata version 14.1[14]

Counting Lung Cancer Cases and Deaths: All new lung cancer cases are counted as incident cases of cancer in the Registry; this may include a new cancer in the lung or bronchus in a patient previously diagnosed with a cancer. The PEI Registry follows the National Cancer Institute, Surveillance Epidemiology and End Results (SEER) Program Multiple Primary Rules which were adopted as the Canadian Standard for cases diagnosed beginning in 2007[15]. These rules are quite complex and site specific and may allow counting multiple cancers in the same primary site in the same person and are unlike the International Association of Cancer Registries (IARC) rules which counts multiple tumors in the same primary site only once[16]. The SEER cancer groupings primarily based on anatomical site of origin and microscopic cellular structure were used to identify cases of lung cancer (Appendix II)[17].

Lung cancer rates in PEI: Many different measurements can be used to describe cancer in a population. The number of cases in PEI represents the burden of cancer on society, while the rate of cancer represents the risk of being diagnosed or dying from a cancer. This report will utilize incidence and mortality rates along with any changes in the rates over the last few decades to describe the risk. Five-year relative survival rates are a measure of progress in early diagnosis and improved treatments.

Age standardization is used to adjust the effects of differences in age and population size when comparing incidence rates between different populations such as PEI and Canada and to compare the rate from one year to another year. The incidence and mortality graphs in this report include estimates for the most recent years, and the PEI rates are five-year moving averages. A five-year moving average for a specific year is the mean of the data from the two years prior to that year, the specific year, and two years after that year. Moving averages are used to smooth the line created by looking at a rate over time to make trends over time more apparent. Changes in rates were considered statistically significant if $P<0.05$.

- Lung Cancer Incidence and Mortality

The incidence rate is the number of new cases of cancer per 100,000 Islanders. The incidence rate is a measure of the risk of being diagnosed with cancer and can be specified by the risk in males or females or the risk by age group. Mortality rate is the rate of deaths and is calculated by dividing the number of lung cancer deaths by the number of people in that age group in PEI. Both incidence rates and mortality rates are age-standardized to the standard population (2011 Canadian population).

- Annual percent change (APC) in lung cancer incidence and mortality

The yearly change in age-standardized incidence and mortality rates over a fixed period of time is the annual percent change. The APC assumes that the rate of change is constant from year to year and is calculated using a log-linear regression model in the Joinpoint software[18]. If a single APC does not characterize the trend, Joinpoint is capable of identifying changes in the trend and estimating APC for each time period of the trend.

Yearly age-standardized rates and standard errors from 1996 through 2015 for incidence and from 1992 through 2014 for mortality were used to calculate APC for lung cancers in men and women separately. Significant APCs are those statistically different from 0% at $P<0.05$.

- Five-year lung cancer relative survival ratio

One method to measure cancer survival is the five-year relative survival ratio (RSR), which is also referred to as net survival. Five-year RSR measures the likelihood of a person with cancer being alive five years after diagnosis compared to a person who does not have cancer. A five-year period (2009-2013) was used for the analysis. For cases diagnosed during the years 2009-2013, the period method was used to give the most up-to-date relative survival information available[19,20]. The actuarial method was used to develop the life table and the Ederer II method to calculated expected survival[21]. Excluded from the analyses were people identified with cancer by death certificate only or autopsy only, and people that were alive during the time period, but their time from diagnosis was unknown.

Five-year relative survivals were calculated for lung cancer and for all cancers for men and women. Relative survivals were also compared with RSR for all cancers diagnosed between 1999 and 2003. The RSR for cancers diagnosed in the earlier period were calculated using the cohort method[22].

In addition, five-year RSR was calculated by age-group, stage, and type of lung cancer (NSCLC vs. SCLC).

- Prevalence of cancer

Prevalent cases are the number of Islanders alive with a diagnosis of lung cancer making it a useful measure for health care systems planning. A limited duration of 10 years for the prevalent cases of lung cancer is the number of Islanders that were diagnosed with a lung cancer in the period from January 1, 2004 through December 31, 2013 who were still alive on January 1, 2014. A person was counted in the prevalence if their diagnosis was within the time range and they were still alive even if they were considered cancer-free. If a person has been diagnosed with two or more of the same type of cancer in the period, the cancer is only counted once in the prevalence count.

Appendix II: Description of Lung Cancer Codes

SITE:	DESCRIPTION:	ICDO-3 CODES for site or histology* (Incidence)	ICD-9 (Mortality)	ICD-10 (Mortality)
LUNG	bronchus, lung	C34 (excluding histology 9050-9055, 9140, 9590-9992)	162.2-162.5, 162.8, 162.9	C34

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