2020

Report on Cancer Statistics in Prince Edward Island:

Prostate Cancer

Prince Edward Island CANADA

Health PEI

Acknowledgments

Shilo McBurney, Health Information Specialist for Oncology

Dr. Carol McClure, PEI Cancer Surveillance Epidemiologist

Kim Vriends, PEI Cancer Registry Manager

Marla Delaney, Provincial Cancer Coordinator

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Health PEI

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Health PEI
P.O. Box 2000
Charlottetown, PE, C1A 7N8
902-368-6130
healthpei@gov.pe.ca
www.princeedwardisland.ca

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Forward

I am pleased to introduce a statistical report on Prostate Cancer in Prince Edward Island. This is a 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 (breast, colorectal, lung 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 made possible through contributions from various departments and professionals of Health PEI and the work of Health Information Specialist, Shilo McBurney.

Prostate cancer is the most frequent type of cancer diagnosed in Island men. As this report shows, the number of newly diagnosed cases of prostate cancer in PEI increased until its peak in 2011 followed by a dramatic drop. This report will analyze the trends in prostate cancer in PEI. Supplementary investigation on methods of detection and the management of prostate cancer in PEI has also been done to support this report and to inform clinical practice.

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

Table of Contents

List of Figures

Introduction

Prostate cancer is a leading cause of morbidity and mortality, with its burden increasing worldwide.[1–4] Globally, there are half a million new cases every year, making it the third most frequently diagnosed cancer in males. While incidence around the world substantially varies, the United States and Canada are documented as having the highest rates.[3,4] It is the most common non-skin cancer in Canadian males, with approximately 1 in 8 males in Canada predicted to have prostate cancer during their lifetime.[5–8] Prostate cancer is currently the third leading cause of cancer death among males in Canada, with a lifetime risk of death from prostate cancer of 3.7%.[6–9] Approximately 21,300 new cases are predicted to have occurred in Canada in 2017, and this number is expected to increase along with the aging population.[10] However, many of these males will die of comorbidities before they can succumb to prostate cancer, with most cases experiencing only localized disease.[11,12]

For many of the 10 years between 2008 and 2017, Prince Edward Island (PEI) had the highest incidence of prostate cancer compared to other provinces in Canada and a much higher incidence than the national average.[13] A Canadian Partnership Against Cancer (CPAC) report, Prostate Cancer Control in Canada (2015), reported a very high rate of Stage I prostate cancer diagnosed in PEI.[6] PEI was also determined to have the highest rate of low risk prostate cancer cases and a high rate of high risk cases.[6] Risk level stratifications for prostate cancer cases determine the likelihood of a cancer spreading beyond the prostate into other tissues and are derived through a combination of different test results. It is important to establish the cause of these high rates as part of cancer control in PEI. The increased risk of a prostate cancer diagnosis on PEI could be due to environmental or genetic causes, but it could also be a product of prostate cancer screening or diagnostic practices. Most of the recent changes and variation in prostate cancer incidence around the world has been attributed to prostate-specific antigen (PSA) screening practices.[4,14] One potential cause of PEI's high rate of Stage I and low risk cases is the high rate of PSA testing measured around the same time period.[6]

This report is part of a series of four cancer statistical reports which supports the *PEI Cancer Strategy 2016-2019* 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 of prostate cancer in PEI. Supplementary reports investigating the trends in detection and management of prostate cancer in PEI have also been developed. This was a special study made possible through contributions of the Canadian Partnership Against Cancer (CPAC) to build capacity in PEI to create and mobilize data for quality improvement.

Examining the prostate cancer experience in PEI using the most recent statistics available will assist in guiding efforts and improvements 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 the public.

Data Sources

Prince Edward Island Cancer Registry Data
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.[15] Analyses of new prostate cancer cases from 1982 through 2017 and prostate cancer deaths from 1992 through 2017 from the Registry are presented. Staging and risk level stratification 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 for prostate cancer are listed in Appendix II.

Health PEI Clinical Information System
Information on laboratory testing, particularly prostate-specific antigen (PSA) test data, was used during analysis of trends in PSA use and risk stratification. The Clinical Information System (CIS) is the cornerstone of Health PEI's electronic health record which provides a real-time exchange of clinical information between all Island hospitals including information from provincial laboratory and diagnostic imaging services.

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 PEI and Canadian prostate cancer rates for incidence and mortality for all males.

Prostate Cancer Surveillance

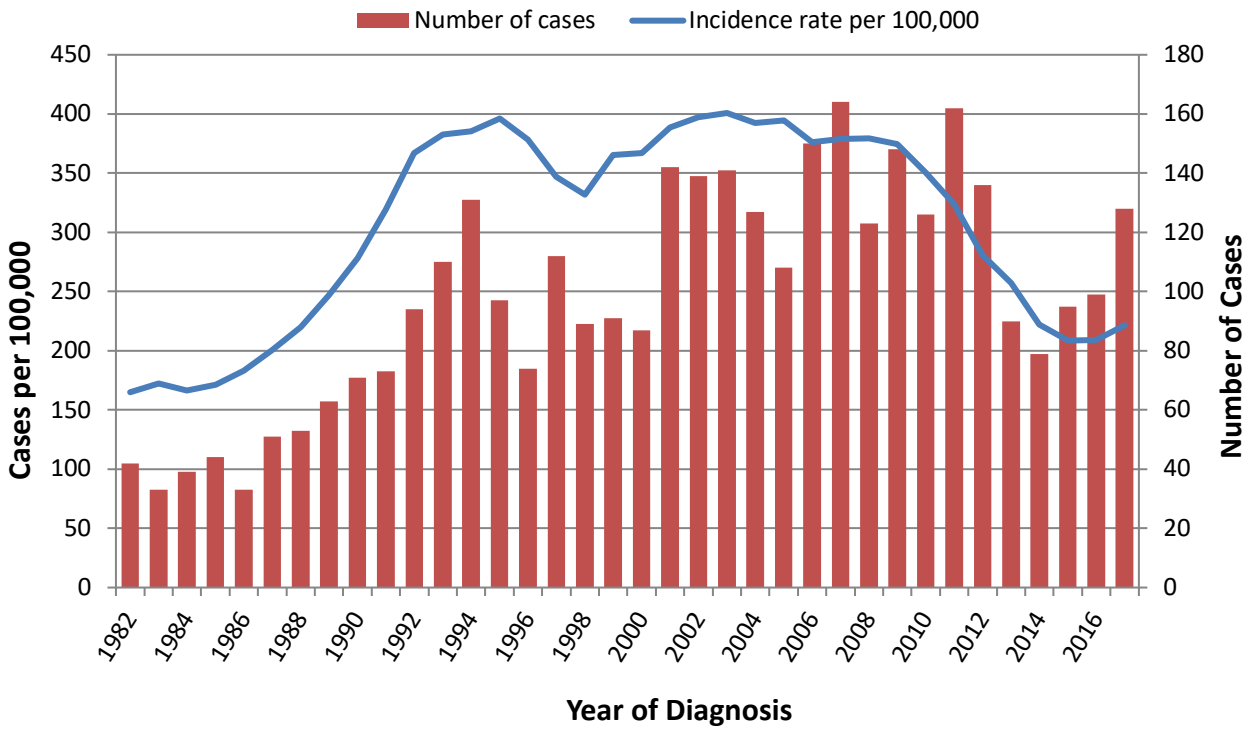
Understanding Cancer Measurements
The burden of cancer to Islanders and the health care system can be measured by the number of cases of cancer and people living with cancer. If you are an Islander and you wanted to know the risk of being diagnosed with cancer or dying from cancer in PEI, you would want 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 Methods (Appendix I).

Prostate Cancer Incidence

Figure 1: Newly Diagnosed Cases and Incidence rate* of Prostate Cancer, 1982-2017, PEI, Males ≥35 Years of Age



*age-standardized to 2011 Canadian population, 5-year moving average

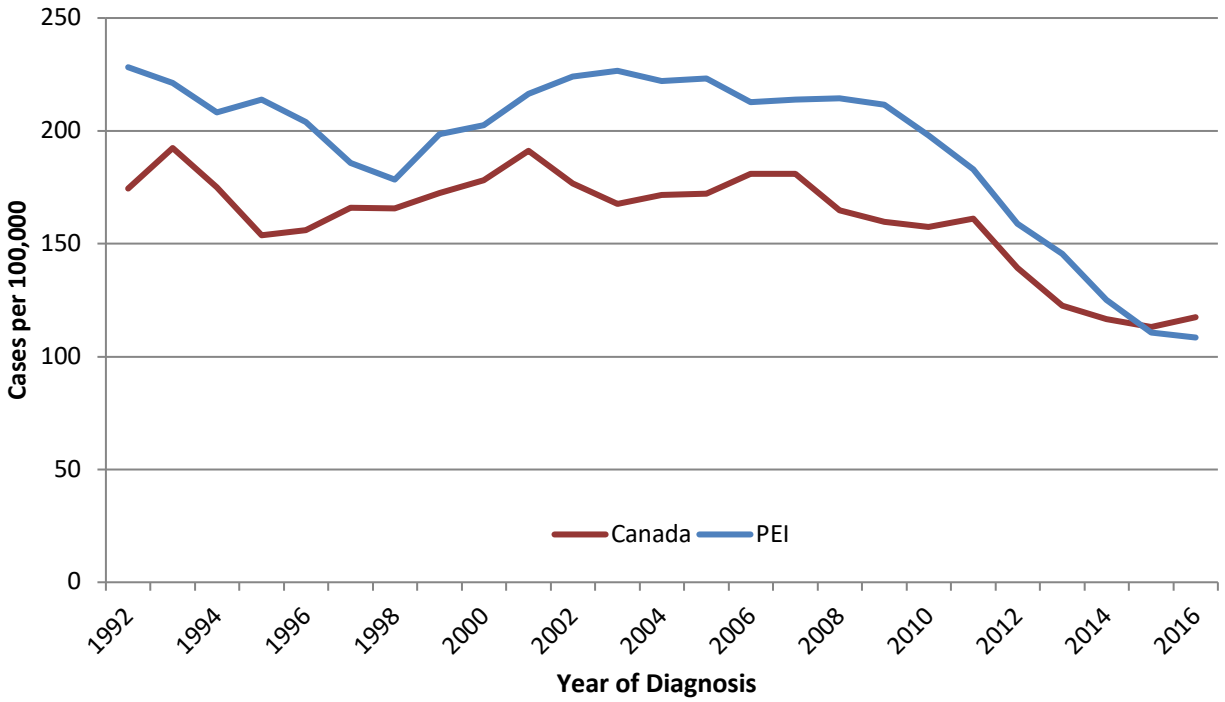
Figure 1 presents the number of newly diagnosed cases of prostate cancer (red bars) in PEI by year of diagnosis. After increasing during the early 1980's into the 2000's, the number and rate of newly diagnosed cases of prostate cancer became stable. Since 2011, the incidence decreased dramatically, but has started to increase again in 2015. The age-standarized incidence rate (ASIR) per 100,000 (blue line) follows the same pattern as the number of cases.

In comparison, CPAC's 2015 report, Prostate Cancer Control in Canada[6] reported the average age-standardized incidence rate for the years 2008-2010 was 263 cases in 100,000 males ≥35 years of age in Canada compared to 337 in 100,000 PEI males. PEI had the second highest incidence rate while Quebec had the lowest at 219 in 100,000 males. Additionally, from Statistics Canada 2001-2016 data, PEI had the highest provincial ASIR for prostate cancer in 8 of the 16 years examined.[13]

Prostate cancer incidence has historically been highly influenced by prostate-specific antigen (PSA) testing practices.[14,16] Figure 1 illustrates this trend in prostate cancer incident cases, as they increase beginning in 1986 with the first prominent peak in 1994. As a result, it is possible that the number of incident cases of prostate cancer in PEI is highly influenced by PSA testing practices in the province. There was a large drop in cases after 2012 when PSA testing was declining. In the most recent years, there has been an increasing trend in incidence rate. This rate will be monitored to ensure it does not continuously increase.

KEY MESSAGE:
After increasing during the early 1980's into the 2000's, the rate of newly diagnosed cases of prostate cancer became stable. Since 2011, the incidence decreased dramatically, but has started to increase in 2015.

Figure 2: Incidence Rate* of Prostate Cancer in Males, 1992-2017, PEI# and Canada

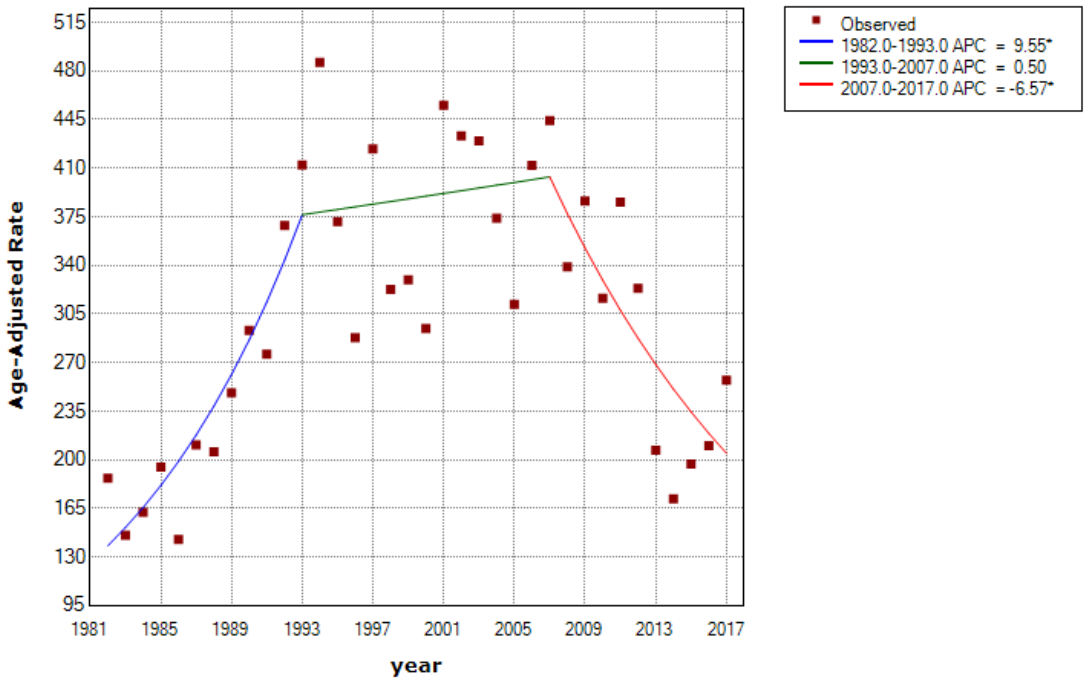


*age-standardized to 2011 Canadian population
5-year moving average

Figure 2 displays the annual incidence rate of prostate cancer in PEI and Canada for all males. After using a five-year moving average to smooth the PEI rate, and age-standardizing to the 2011 Canadian population, trends in risk over time become clearer. The incidence rate of prostate cancer peaked in the mid-1990's and again in the early 2000's, but has declined in recent years. This pattern likely reflects PSA testing practices on PEI, since this variation in prostate cancer incidence is thought to largely be attributable to changes in PSA testing and screening practices, which began in the 1990's.[4,14,16] The incidence rate in PEI was consistently higher than in Canada until very recently when the rates appear similar. For some of the years, the PEI rates were significantly higher than Canada.[13]

KEY MESSAGE:
The incidence rate of prostate cancer in Canada peaked in the mid-1990's and again in the early 2000's, but has declined over the last five years. This pattern likely reflects PSA testing practices.

Figure 3: Annual Percent Change of Incidence Rate, 1982-2017, PEI, Males ≥ 35 Years of Age



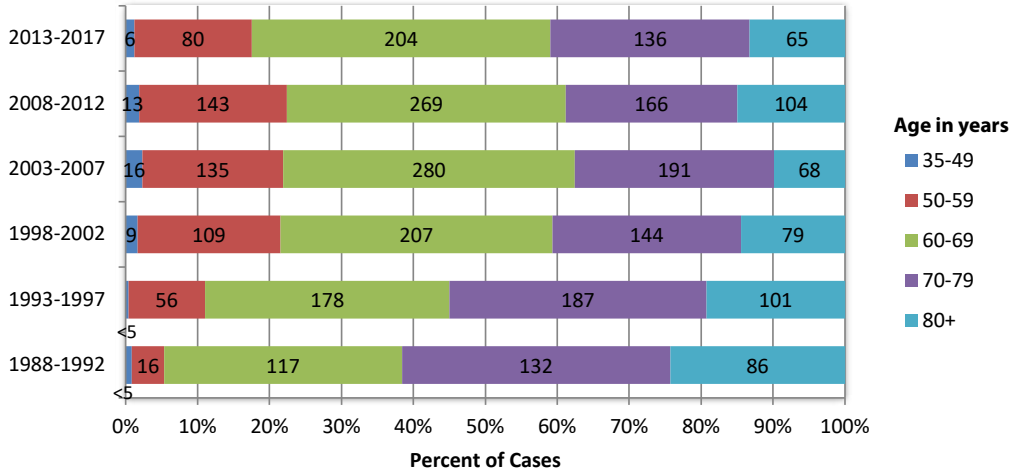
* Indicates that the Annual Percent Change (APC) is significantly different from zero at the alpha = 0.05 level.
Final Selected Model: 2 Joinpoints.

The annual percentage change (APC) of the age-standardized incidence rate is an estimate of whether there is a significant change in the rate over time. Using regression modeling, trends can be estimated and tested for significance. A further explanation of this methodology is available in Appendix I. From 1982-1993, the age-standardized incidence of prostate cancer in PEI (Figure 3) increased significantly on average by 9.6% per year. It then remained stable until 2011 when it decreased significantly by 6.6% per year on average.

Prostate Cancer Incidence by Age

Figure 4 displays the proportion of newly diagnosed cases of prostate cancer by age groups at diagnosis for five year periods, where the numbers inside the bars are the actual number of people diagnosed in each age group. Approximately 80% of prostate cancer cases diagnosed in the last five years were in males older than 60 years of age, which reflects what is reported for other regions.[1,3] Prostate cancer is uncommon in younger individuals.[17,18] For older individuals, the potential benefits of diagnosing and treating this slow growing type of cancer need to be carefully considered compared to the drawbacks.[19] As a result, most effective prostate cancer diagnoses should occur in males between 60-79 years of age, the population most likely to benefit from treatment. Despite having an aging population on PEI, the number of cases diagnosed in people above 80 years of age is decreasing over time. This could indicate less of a focus on diagnosing males in this age group; however, another explanation is that many people are now diagnosed before they reach this age using PSA testing.

Figure 4: Prostate Cancer Cases by Age Group at Diagnosis for 5-Year Periods in Males ≥ 35 Years of Age, PEI



KEY MESSAGE:
Prostate cancer is uncommon in younger individuals. Approximately 80% of prostate cancer cases recently diagnosed were in males older than 60 years of age.

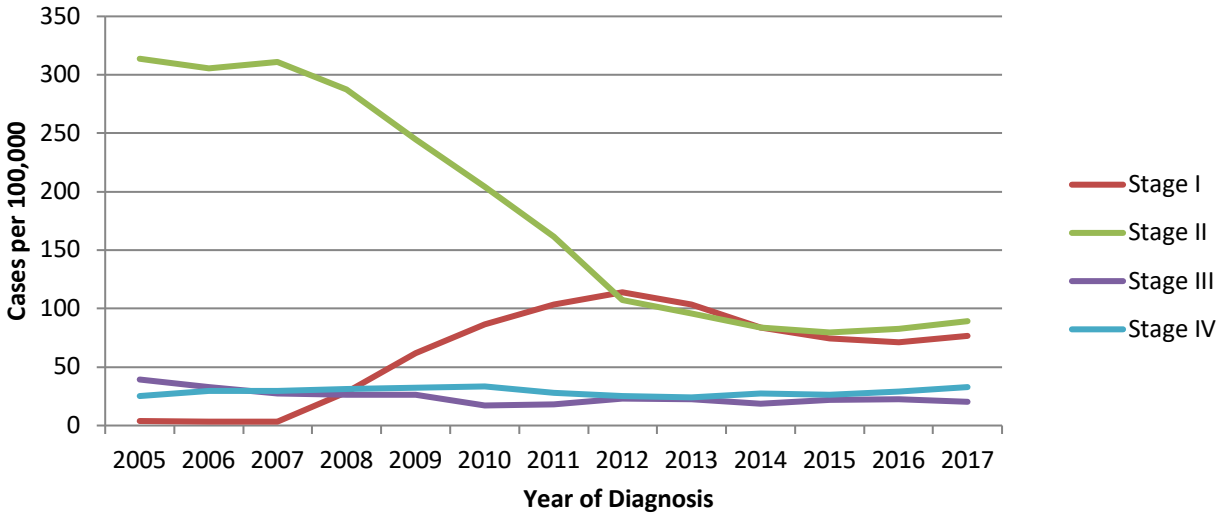
Prostate Cancer Incidence by Stage

Cancer staging is used to predict the chance of disease spreading before patients receive treatment.[20] It occurs both before and after tumor removal, which are respectively referred to as the clinical and pathological stages. For prostate cancer, TNM staging is used most commonly, which is supported by the Union for International Cancer Control (UICC) and the American Joint Committee on Cancer (AJCC). TNM staging is based on the primary tumor (T-stage), regional lymph node involvement (N-stage), and distant metastases (M-stage). Using these factors, a stage of I (early disease) to IV (advanced disease) is given to a case (see Table A1, Appendix I). In Stages I and II, cancer is localized to the prostate. Men in Canada have been found to be most commonly diagnosed at Stage II, with Stage IV diagnoses the least frequently.[6] Approximately 90% of prostate cancers are diagnosed when they are still localized.[21] Details on staging methodology are available in Appendix I.

When examining newly diagnosed cases of prostate cancer by stage at diagnosis in PEI, most cases were diagnosed at Stage I or Stage II between 2005 and 2015, which is similar to what is generally reported in Canada.[6] It appears that cases were primarily diagnosed at Stage II until 2010, when more cases began to be diagnosed at Stage I. This can be accounted for by historical changes to cancer staging rules. Beginning with cases diagnosed on January 1, 2010, the 7th edition of the AJCC cancer staging manual was used instead of the 6th edition. This resulted in a stage shift in which many cases that would have been previously classified as Stage II at diagnosis became classified as Stage I. Diagnosing prostate cancer at a stage when treatment is likely to be successful is the goal while reducing the diagnoses that are less clinically important (i.e., require no treatment). Approximately 17% of cases are diagnosed in PEI at Stage III and Stage IV, when the cancer has started to spread beyond the prostate.[20]

Figure 5 displays the age-standardized incidence rate of prostate cancer by stage. After smoothing to make trends more visible, similar rates are found for Stage I and Stage II cases since 2012. Comparatively few prostate cancer cases are diagnosed at later stages, Stages III and IV.

Figure 5: Incidence Rate* of Prostate Cancer by Stage, 2005-2017, PEI, Males ≥ 35 Years of Age



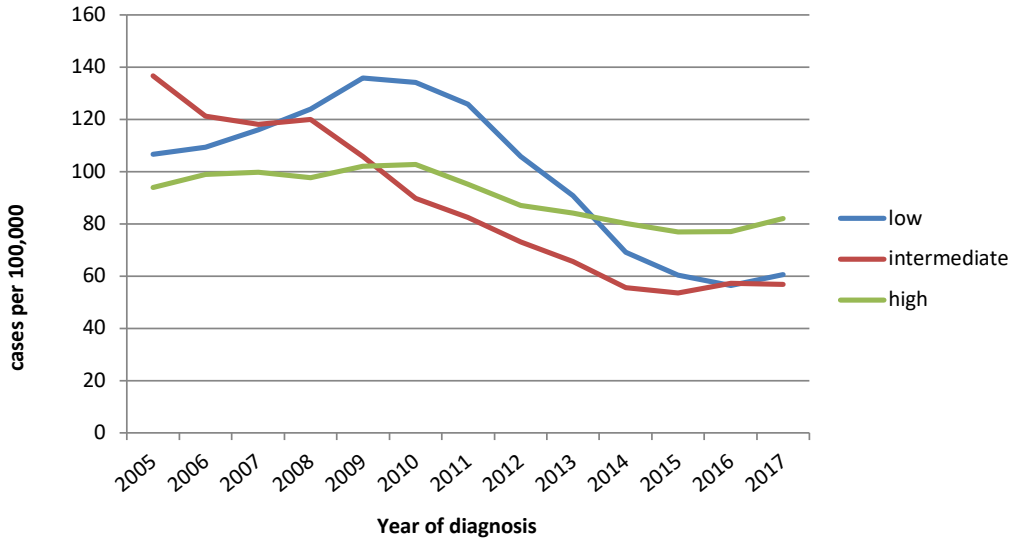
KEY MESSAGE:
Beginning in 2010, staging methods changed resulting in a stage shift in which many cases that would have been classified as Stage II at diagnosis became classified as Stage I. Diagnosing prostate cancer at an early stage when treatment is likely to be successful is the goal while reducing the diagnoses that are less clinically important (i.e., require no treatment).

Prostate Cancer Incidence by Risk Level

Stratification by prostate cancer risk level is another way to describe the prognosis (the likely outcome from the cancer). Risk categorization for prostate cancer is based on a combination of values for the clinical T-stage, PSA test, and Gleason score (see Table A1, Appendix I). A number of risk stratification systems currently exist[22], but this report uses the consensus risk assessment developed by the Genitourinary Radiation Oncologists of Canada (GUROC) in 2001.[6,22,23] Using this system, low-risk patients have cancer that is not likely to spread or grow for a long time, while intermediate-risk patients have tumors that are unlikely to grow or spread for a few years.[6] Most prostate cancers are low-or intermediate-risk at diagnosis.[7] Risk categorization is particularly useful for localized cancer, as it is a better descriptor of prognosis than staging at this point in disease progression and can indicate how likely a specific cancer is to respond to treatment. It can also assist with determining the risk of reoccurrence after treatment. Details on risk level stratification methodology are available in Appendix I.

During 2011-2012, PEI had the highest rates of low risk prostate cancer in Canada.[6] However, the number of low risk cancer cases has been primarily decreasing since then associated with decreasing use of PSA testing. In Figure 6 the age-standardized incidence of prostate cancer by risk level is presented. In 2017, the incidence rate was highest in high risk cases followed by the rate of low and intermediate risk cases.

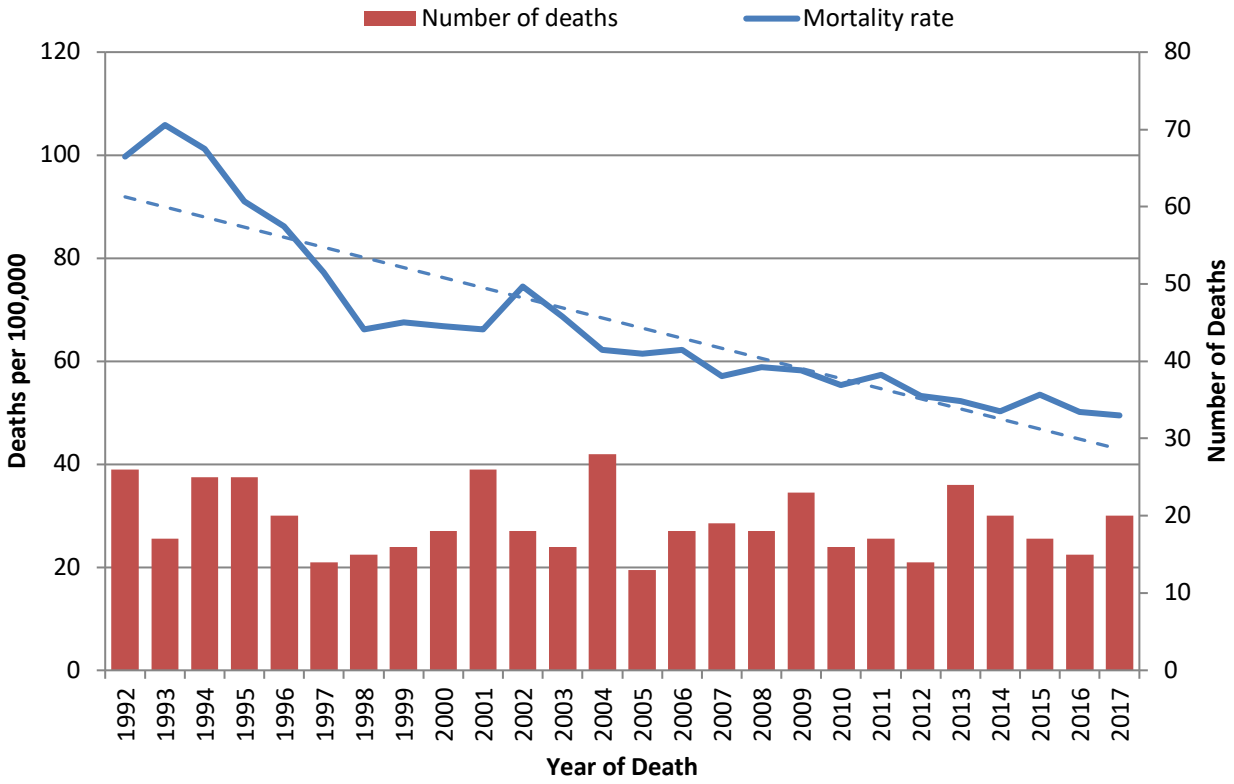
Figure 6: Incidence Rate* of Prostate Cancer by Risk Level, 2005-2017, PEI, Males ≥ 35 Years of Age



*age-standardized to 2011 Canadian population, 5-year moving average

Prostate Cancer Mortality

Figure 7: Morality Rate* and Deaths from Prostate Cancer, 1992-2017, PEI, Males ≥ 35 Years of Age



*age-standarized to 2011 Canadian population, 5-year moving average

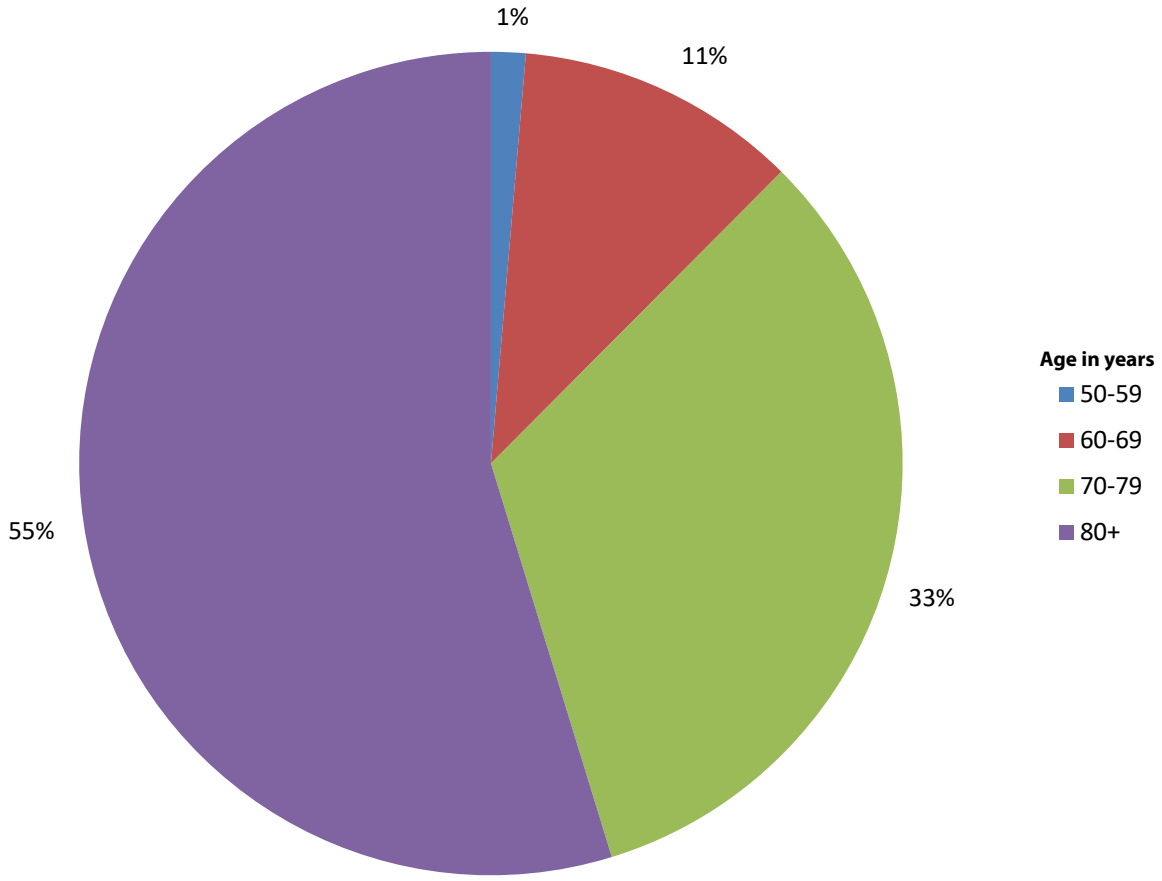
By examining the number of deaths (red bars) in figure 7, it appears the highest number of prostate cancer deaths occurred in the early 1990's and early 2000's. In the most recent year for which death data is available, 2017, there were 20 prostate cancer deaths in PEI.

The age-standardized mortality rate (blue line) was smoothed using 5-year moving averages to better visualize trends over time (Figure 7). The mortality rate of prostate cancer in PEI has been generally declining since the early 1990's, with a small increase around 2002. From 1992-2017, the age-standardized mortality rate for prostate cancer in PEI declined significantly by 2.8% per year on average. This is supported by evidence from other scientific reports, which states that age-adjusted prostate cancer mortality rates have been more consistent than incidence rates, with a downward trend since the early 1990's.[8,11,16] With close to 100 deaths per 100,000 males in 1992, currently the prostate cancer mortality rate in PEI is approximately 49 deaths per 100,000 males. During the five-year period, 2013-2017, PEI had a 21% higher age-standardized mortality rate from prostate cancer compared to the Canadian rate.[24]

Prostate Cancer Mortality by Age

Figure 8 presents the proportion of prostate cancer deaths by age group at death, with the majority of deaths occurring in those 80 years of age or greater. Over the last twenty years for which data were available, over 50% of prostate cancer deaths occurred in this age group. Very few males die of prostate cancer in the younger age groups, with only 1% of the total deaths occurring before 60 years of age. Prostate cancer is considered to be a slowly progressing disease, and with others reporting that more than 75% of cases are diagnosed in males 65 years of age and older[1,3,11,] it is expected that most deaths would occur in the oldest age groups. In PEI, 87% of the prostate cancer deaths between 1998-2017 occurred in males 70 years of age or greater.

Figure 8: Prostate Cancer Deaths by Age Group at Death, 1998-2017, PEI

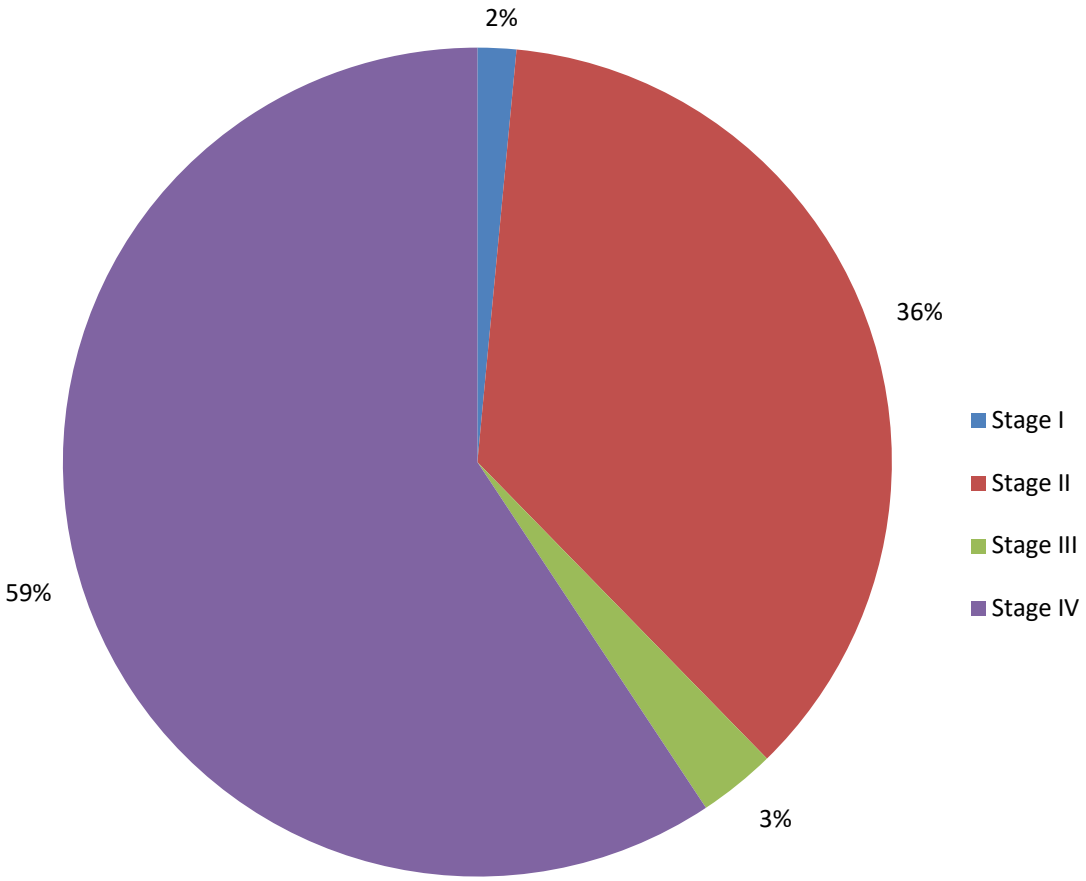


*age group 35-49 was responsible for <1% of deaths

KEY MESSAGE:
Between 1998 and 2017, 87% of the prostate cancer deaths occurred in males 70 years of age or greater.

Prostate Cancer Mortality by Stage

Figure 9: Prostate Cancer Deaths* by Stage at Diagnosis, 2005-2017, PEI



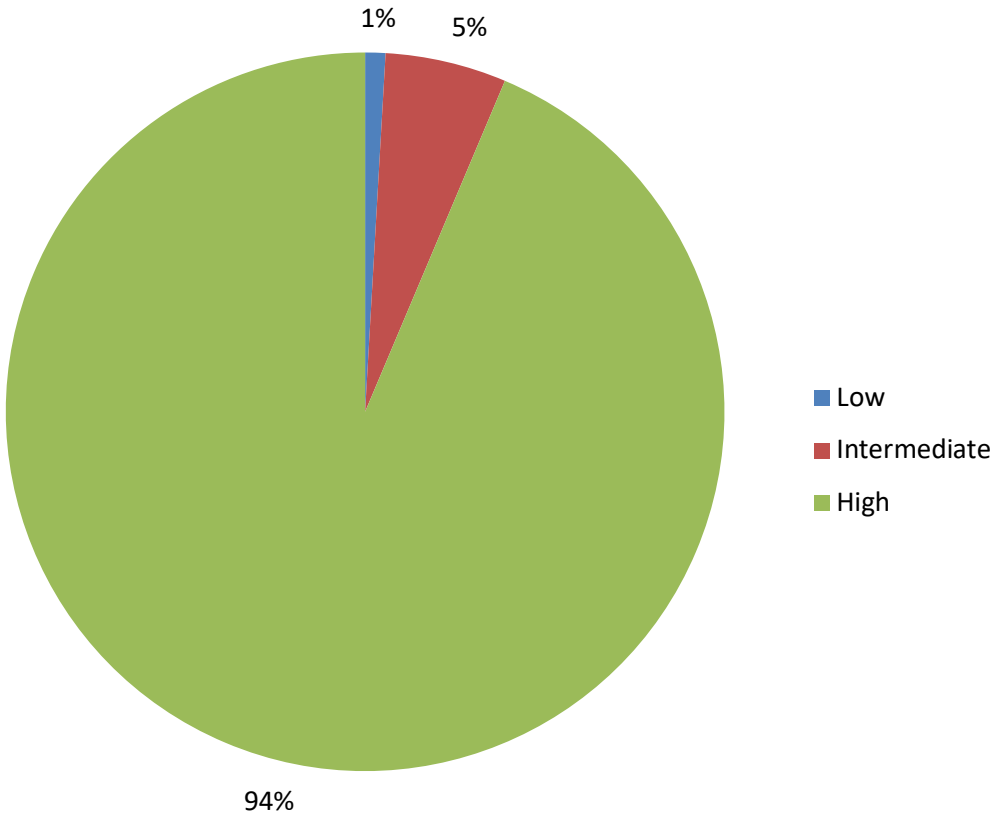
* includes only those diagnosed 2005-2017 who were staged

Figure 9, prostate cancer mortality by stage at diagnosis, shows how most prostate cancer deaths occurred in cases diagnosed at either Stage IV or Stage II. These two groups make up close to 90% of the prostate cancer deaths that occurred between 2005 and 2014 in PEI males diagnosed in 2005 or later, when staging information became available in the Registry. Before 2010, most prostate cancer cases in PEI were diagnosed at Stage II. Because the proportion of diagnoses at this stage was so high, there were a large number of deaths in this stage group. Approximately 2% of prostate cancer deaths occurred in males diagnosed at Stage I. Males with either stage III or unknown stage comprised a relatively small proportion of all prostate cancer diagnoses, thus only a few deaths occurred in these groups.

KEY MESSAGE:
Between 2005 and 2017, 59% of the deaths occurred in males classified as stage IV at the time of their diagnosis.

Prostate Cancer Mortality by Risk Level

Figure 10: Prostate Cancer Deaths* by Risk Level at Diagnosis, 2005-2017, PEI



* includes only those daignosed 2005-2017 who were assigned a risk level

Prostate cancer risk levels are another way to predict the most likely outcome or the prognosis of a case. Figure 10 displays prostate cancer deaths in PEI separated by risk level at diagnosis between 2005 and 2007. Very few deaths occurred in the low and intermediate risk groups. The deaths in the intermediate group are attributable to males who lived with prostate cancer for some time before becoming hormone resistant and developing bone metastases. Ninety-four percent of the deaths between 2005 and 2017 occurred in males classified as high risk at time of diagnosis. In PEI, risk level stratifications include metastatic cases of prostate cancer, all of which were coded as high risk or missing risk. Two-thirds of high risk cancer deaths were metastatic prostate cancer at the time of diagnosis.

KEY MESSAGE:
Between 2005 and 2017, 94% of the deaths occurred in males classified as high risk at the time of their diagnosis.

Prostate Cancer Survival

A relative survival ratio (RSR) is a measure of disease severity and thus prognosis (Table 1). It is often referred to as net survival and it indicates the probability of an average person with a particular cancer surviving to a certain time after diagnosis compared to an 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 rate for an average male with prostate cancer on PEI is 91%, indicating that a male diagnosed with prostate cancer has, on average, a 91% chance of surviving to 5 years compared to PEI males without prostate cancer. Relative survival trends over time can be used to measure improvements in cancer screening, diagnosis, and treatment. However, it should be noted that prostate cancer screening practices have been demonstrated to artificially improve RSRs, especially when longer periods of time to survival are used, so they should be interpreted with caution.[11,25]

Table 1: Interpretation of relative survival ratios in cancer research

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

Figure 11: Five-Year Relative Survival Rate for Prostate Cancer 2012-2016, PEI, Males ≥ 35 Years of Age

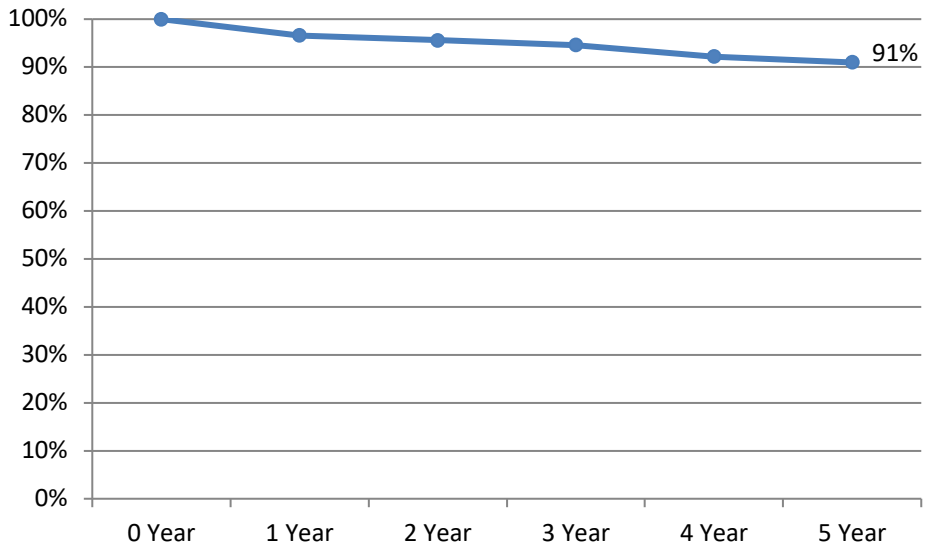


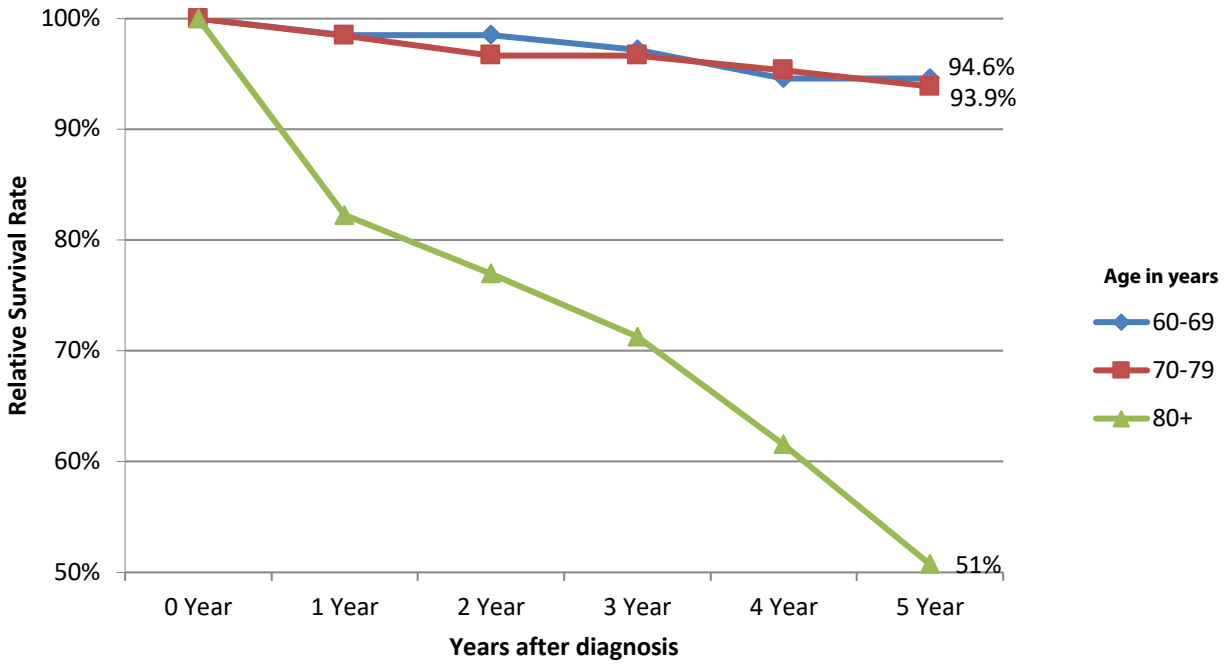
Figure 11 presents the recent five-year relative survival rate of PEI males with prostate cancer.
Overall the five-year RSR demonstrates excellent prognosis, at 91% between the years 2012 and 2016. The ten-year RSR did not decrease much at 88%.

The age-standardized RSR is useful for comparisons between years as it accounts for differences in population structure. The age-standardized 5-year RSR for males aged 15-99 for the diagnosis years 2012-2016 is 89.7% while in the earlier period 2002-2006 is 90.5%. A higher proportion of high risk prostate cancer in the period 2012-2016 likely accounts for the lack of improvement of survival over time.

KEY MESSAGE:
The five-year relative survival rate for prostate cancer is 91%.

Prostate Cancer Survival by Age

Figure 12: Five-Year Relative Survival Rate for Prostate Cancer by Age Grouping*, 2012-2016, PEI



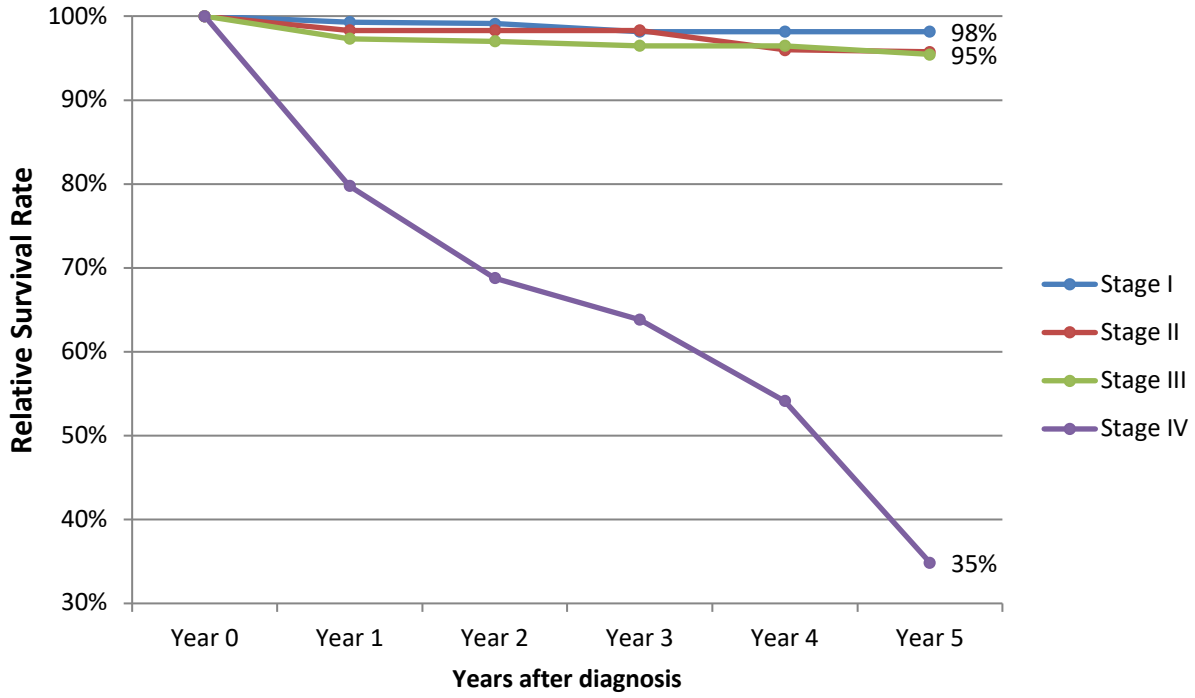
*Age groups 35-49 and 50-59 were omitted because they were >99% for the five-year relative survival

Figure 12 displays the five-year RSRs for males with prostate cancer on PEI by age grouping. It has been demonstrated that age is an important factor in prostate cancer prognosis, along with the comorbidities that may accompany increasing age.[1,2,6,11] The five-year RSR, accordingly, is lowest for those who are diagnosed at 80 years of age or greater, at 51%. In addition, this age group had the highest proportion of advanced stage at diagnosis. The age groups of 35-49 and 50-59 years have the best five-year RSRs at >99%, meaning these individuals have approximately the same probability of surviving for five years as an average PEI male of the same age without prostate cancer. Survival for the next oldest age group of 60-69 is 94.6%, with the 70-79 group following closely at 93.9%.

Prostate Cancer Survival by Stage

Figure 13 displays the five-year RSRs of PEI males with prostate cancer by stage at diagnosis. Males diagnosed with Stage IV prostate cancer have a considerably worse 5-year RSR than the other stages, at 35%. This is also lower than the five-year RSR for those aged 80+, and is considered to be poor prognosis. As such, staging may be a better predictor of prostate cancer prognosis than risk level or age for those in the later cancer stages, as cases with an advanced stage at diagnosis were found to truly have a greater risk of dying of prostate cancer. Stages I-III have excellent prognosis, with five-year RSRs ranging from 95% for Stages II and III diagnoses to 98% for Stage I cases.

Figure 13: Five-Year Relative Survival Rate for Prostate Cancer by Stage, 2012-2016, PEI, Males ≥ 35 Years of Age

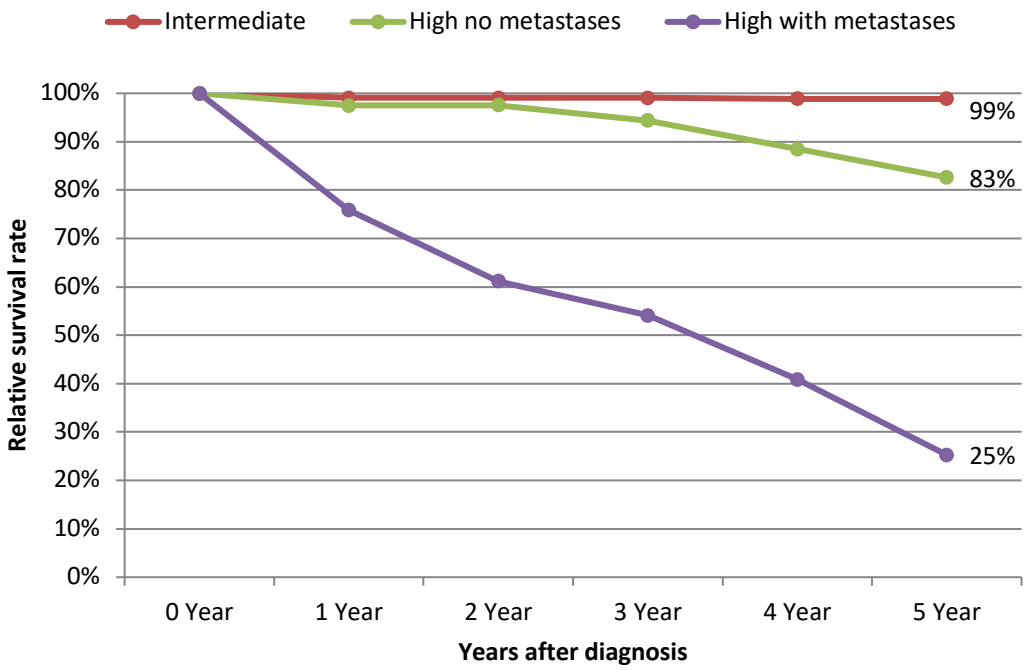


KEY MESSAGE:
The lowest five-year relative survival rates for prostate cancer on PEI are found in males at greater than 80 years of age (51%), and in those diagnosed at stage IV (35%). Older patients may have comorbidities and they are more likely to be diagnosed at an advanced stage.

Prostate Cancer Survival by Risk Level

Figure 14 presents the five-year RSRs of PEI males with prostate cancer by risk level. Low risk prostate cancer cases had no decreased relative survival over five years compared to the general population (100% survival), and thus was not shown. Intermediate risk prostate cancer cases have a five-year RSR of 99%. This indicates that risk level may be a better measure of prognosis than staging for less advanced prostate cancer cases, as cases with lower risk designations appear to truly have a very low risk of dying of prostate cancer.[6] PEI high risk prostate cancer cases were stratified into those with and without distant metastases, since their prognosis is very different. PEI high risk prostate cancer cases without distant metastases have a five-year RSR of 83%, which is considered to be good prognosis. However, high risk prostate cancer cases with distant metastases only have a five-year RSR of 25%, which means they have poor prognosis. As a result, there is value in further stratifying high risk cases into those with and without distant metastases so that risk level stratifications have clinical utility for predicting prognosis in advanced cases.

Figure 14: Five-Year Relative Survival Rate for Prostate Cancer by Risk Level*, 2012-2016, PEI, Males ≥ 35 Years of Age



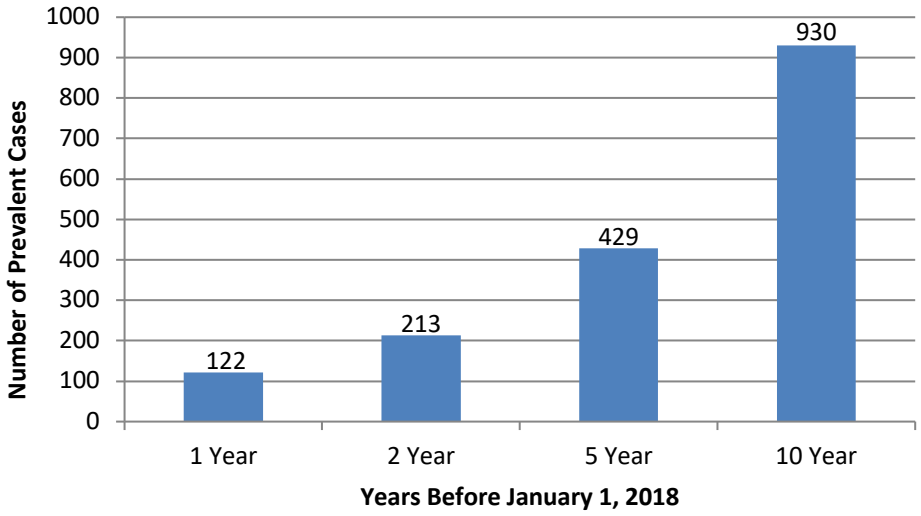
*Low risk was omitted RSR remained 100% for the five-year relative survival

KEY MESSAGE:
Individuals on PEI diagnosed with low risk prostate cancer had a five-year relative survival rate of 100%. Risk level may be a better measure of prognosis than staging for less severe cases.

Prostate Cancer Prevalence

The ten-year limited duration prevalence of prostate cancer is the proportion of males on PEI diagnosed from 2008 through 2017 that are still alive on January 1, 2018. The level of prevalence is determined by the rate of new cases of prostate cancer diagnosed in the 10-year period and the rate of survival for these individuals. Cancer prevalence is an important measurement of the burden of prostate cancer on PEI and to the health care system.

Figure 15: Prevalent cases of Prostate Cancer Diagnosed on or after January 1, 2008 and Alive on January 1, 2018, PEI



Presented in Figure 15 is the ten-year limited duration of prevalent cases of prostate cancer on PEI for 2008-2017. The number of prevalent cases alive on January 1, 2018 is broken down by the number of years before January 1, 2018 that a person was diagnosed. The total 10-year prevalence for prostate cancer is 930 cases. A total of 429 prevalent cases were diagnosed in the five years before January 1, 2018, with 122 prevalent cases in 2017.

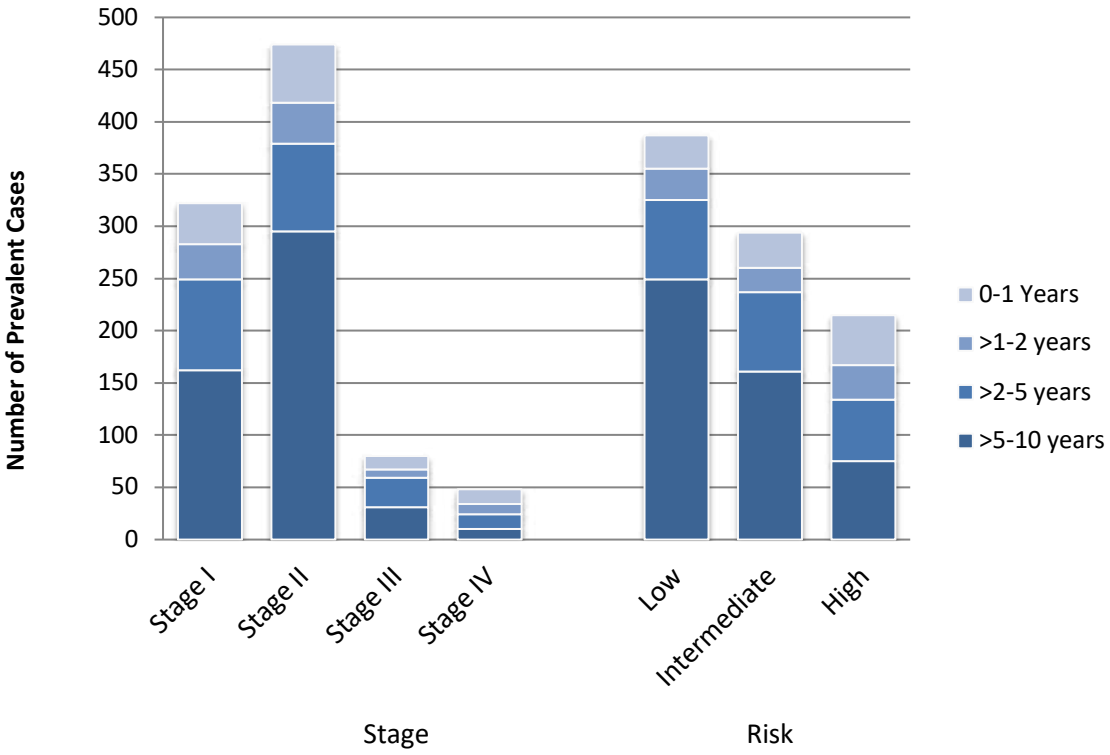
Another way to report prevalence is the crude prevalence proportion. This reflects the total annual number of prevalent cases divided by the annual population of PEI males, multiplied by 100 to get a percentage. The percentage increases linearly over time, as more prevalent cases accumulate each year. In 2017, for example, 2.15% (or approximately 1 in 45) of males aged 35 years and older on PEI had been diagnosed in the last 10 years and are living with a prostate cancer diagnosis. The high prevalence further demonstrates the effect of the high incidence of prostate cancer and excellent survival rates.

KEY MESSAGE:
The prognosis for prostate cancer is high resulting in a large number of males living with prostate cancer.

Prostate Cancer Prevalence by Stage and Risk Level
Figure 16 displays the prevalence for prostate cancer by stage, and includes males diagnosed within the ten years before January 1, 2018. For Stage I, Stage II, and Stage III prevalence, the majority of cases are made up of those diagnosed five to ten years before January 1, 2018. Stage IV, however, has a lower proportion of males five to ten years before January 1, 2018. Fewer males living to five to ten years after their cancer diagnosis is due to the lower survival rate for Stage IV. Most prevalent cases of prostate cancer were diagnosed at Stage II, followed by Stage I, which reflects incidence trends.

Figure 16 also presents the prevalence of prostate cancer by risk level over the ten years before January 1, 2018. Those with high risk level have a lower proportion of prevalent cases in the >5-10 years duration due to the lower relative survival rate in this risk group.

Figure 16: Prevalence of Prostate Cancer by Stage, Risk Level, and Duration, January 1, 2018, PEI



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 has the goal 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 prostate cancer, including:

- Establish a prostate cancer action group
- Provide information to guide males and clinicians in managing the risks and detection of prostate cancer
- Establish the best process to rapidly and accurately diagnose the four most frequent cancers in PEI (lung, breast, colorectal, and prostate)
- Support healthcare providers in using national guidelines to diagnose cancer, including Choosing Wisely Canada recommendations
- 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

Although the incidence of prostate cancer in PEI is high, the prognosis has been excellent. Prostate Specific Antigen (PSA) testing has been used for screening of prostate cancer since the 1990s. The use of a screening test can increase the incidence of prostate cancer by identifying prostate cancers that may not need treatment. In recent years, the incidence rate in PEI has been declining which may be associated with a decrease in PSA testing. Approximately 80% of prostate cancer cases diagnosed in the last five years were in males older than 60 years of age. Mortality is relatively low for this cancer and survival is relatively high as most prostate cancer are diagnosed in the early stages and at low and intermediate risk levels. The majority of deaths from prostate cancer occur in males over 80 years of age. Prognosis is best estimated using staging for advanced cases and risk levels for non-advanced cases. Currently there are over 900 men diagnosed in PEI in the last 10 years who are living with a diagnosis of prostate cancer. The high number of prevalent cases is associated with a high incidence and an excellent survival.

Health PEI will continue to reduce the impact of prostate cancer on Island men 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

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.[15] 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 prostate cancer cases from 1982 through 2017 and prostate cancer deaths from 1992 through 2017 from the Registry are presented. Staging and risk level stratification data is only available from 2005 through 2017.

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: National Death Clearance, which contains underlying COD, date of death, province of death, and death registration number, was sent to the Registry annually between 1992 and 2008. This information was used to verify Provincial Vital Statistics and to identify other cancer patient deaths 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 incidence and mortality rates.

Canadian Tables: The Canadian cancer incidence and mortality rates are provided by online tables through Statistics Canada and include data from the Canadian Cancer Registry and Canadian Vital Statistics.

Life Tables: Survival rates are calculated using the life tables prepared using the data from the Statistics Canada Table: 13-10-0140-01 Life expectancy and other elements of the life table, Prince Edward Island and the territories for which a Poisson model was used to interpolate to 1-year intervals from the PEI abridged (5-year) life table.

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.[26] 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.[27]

Counting Prostate Cancer Cases and Deaths: All newly diagnosed prostate cancer cases are counted as incident cases of cancer in the Registry; this may include a new cancer in the prostate in a person previously diagnosed with another type of cancer. Cases coded as prostate cancer deaths must have prostate cancer entered as the underlying cause of death. The 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. 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.[28] The SEER cancer groupings primarily based on anatomical site of origin and microscopic cellular structure were used to identify cases of prostate cancer (Appendix II).

Prostate 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 utilizes 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 treatment.

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, or over time. The incidence and mortality figures in this report include estimates for the most recent years, and the PEI rates are sometimes 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 more apparent.

• General Inclusion and Exclusion Rules
Cases of prostate cancer in PEI males 35 years of age and older were included in analyses, to maintain consistency with the range of ages reported in CPAC's prostate cancer report. Cases of rhabdomyosarcoma, which are very distinct from typical cases of prostate cancer, were excluded from all analyses. Metastatic cases of prostate cancer were included in analyses and non-invasive cases of cancer were excluded.

• Prostate Cancer Incidence and Mortality
Incidence rates are a measure of the risk of being diagnosed with cancer and can be specified by subgroups, such as the risk by age group. It is reported as the number of new cases of prostate cancer per 100,000 males aged 35+. It is calculated for each year by dividing the number of new cases by the number of males aged 35+ in PEI. Mortality rates are a measure of the risk of dying of prostate cancer and can also be specified by subgroups, such as the risk of prostate cancer death by stage at diagnosis. Similarly to incidence, it is reported as the number of prostate cancer deaths per 100,000 males. Prostate cancer mortality rates were calculated for each year by dividing the number of prostate cancer deaths by the number of males aged 35+ in PEI. For the number of prostate cancer deaths, the number of males who died in PEI from prostate cancer and who report PEI as their province of residence was counted.

Both incidence rates and mortality rates are age-standardized to the standard population (2011 Canadian population). Annual rates are expressed as the number of cancer deaths per 100,000 people per year.

• Annual Percent Change (APC) in Prostate 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.[29] If a single APC does not characterize the trend, Joinpoint is capable of identifying changes in the trend and estimating APC for multiple time periods in the data.

Yearly age-standardized rates and standard errors from 1982 through 2017 for incidence and from 1992 through 2017 for mortality were used to calculate APC for prostate cancer. Significant APCs are those statistically different from a 0% yearly change at $P \leq 0.05$.

• Five-year Prostate Cancer Relative Survival Ratio
One method to measure cancer survival is a five-year relative survival ratio (RSR). This measure is often referred to as net survival and is the likelihood of a person with cancer being alive five years after diagnosis compared to a person from the general population who does not have prostate cancer. The period method was used to give the most recent relative survival information available.[30,31] The data from the five-year period of 2002-2006 was used as a comparison to demonstrate changes in survival over time, and this survival was calculated using the cohort method.[32] The actuarial method was used to develop the life table and the Ederer II method to calculate expected survival.[33]

Relative survivals were also calculated and age-standardized using a standard prostate cancer population.[34]

Prostate cancer survival can be quite high, and as a result can appear to be better at times than that of the general population. In these cases, when the five-year RSR was greater than 100%, it was simply reported as 100%. Additionally, if survival appeared to increase over time, the lowest survival estimate for the period was used. It should be noted that prostate cancer screening practices can artificially improve RSRs, especially for greater lengths of time, so they should be interpreted with caution.[11,14]

• Prevalence of Prostate Cancer
Prevalent cases are the number of PEI males 35 years and older alive with a diagnosis of prostate cancer and are a useful measure of the burden of prostate cancer for health care systems planning. Limited duration prevalence is presented for a 10 year period, which represents the proportion of PEI males that were diagnosed with a prostate cancer in the period from January 1, 2008 through December 31, 2017 who were still alive on January 1, 2018 even if they were considered cancer-free. No males with multiple prostate cancer tumors survived the period, so for this report prevalence of prostate tumors and person-based prevalence are the same.

The crude prevalence proportion is also presented, which is the total count of prevalence cases divided by the population at risk. The population at risk is calculated as the average of the population of PEI males 35 years of age in 2016 and 2017. This method is used by SEER. Additionally, prevalence is reported by prostate cancer stage and risk level. Only people from the Registry that were not identified by death certificate or autopsy only were included in prevalence analyses.

Prostate Cancer Risk Stratifications and Staging
Both risk category and stage are used to indicate the severity of prostate cancer cases. Risk categorization for prostate cancer is based on a combination of values for the clinical T-stage (using DRE, ultrasound testing or transrectal ultrasonography (TRUS) biopsy results, or incidental findings from a transurethral resection of the prostate (TURP)), prostate-specific antigen test, and Gleason score (see Table A1).[6] This information is available in the Registry from 2005 onwards. Using this data, risk stratifications were performed following CPAC's 2014 System Performance Data Specifications for Prostate Cancer Control in Canada-A System Performance Spotlight Report. These guidelines are based on the Genitourinary Radiation Oncologists of Canada (GUROC) consensus risk assessment in 2001.[6,22,23]

Staging information is also available in the Registry beginning in 2005, using the Collaborative Staging data collection methodology (which generates a combined clinical and pathological TNM stage group). TNM stage guidelines are supported by the Union for International Cancer Control (UICC).20 They are based on: the primary tumor (T-stage), regional lymph node involvement (N-stage), and distant metastases (M-stage).

In the first two levels of the T-stage, cancer is localized to the prostate, while T3 cancer is starting to spread outside and T4 cancer has started to affect additional organs[20]. Afterwards, a stage of I (early disease) to IV (advanced disease) is given to a case (see Table A1).

Beginning with cases diagnosed on January 1, 2010, the 7th edition of the AJCC cancer staging manual was used by the Registry instead of the 6th edition for staging guidelines. This resulted in a stage shift, where cases that would have previously been classified as Stage II at diagnosis became classified as Stage I.

Table A1. Stage and Risk Category Based on TNM, PSA Level, and Gleason Score[6,20,22,23]

Stage	Clinical T-Stage	N	M	PSA Level	Gleason Score	Risk Category
I	T1a-c	N0	M0	<10	≤6	**Low**
	T2a	N0	M0	<10	≤6	**Low**
	T1-2a	N0	M0	X*	X	**-**
IIA	T1a-c	N0	M0	<20	7	**Intermediate**
	T1a-c	N0	M0	≥ 10 <20	≤6	**Low/Intermediate**
	T2a	N0	M0	<20	≤7	**Intermediate**
	T2b	N0	M0	<20	≤7	**Intermediate**
	T2b	N0	M0	X	X	**-**
IIB	T2c	N0	M0	Any	Any	**Intermediate**
	T1-2	N0	M0	≥ 20	Any	**High**
	T1-2	N0	M0	Any	≥8	**High**
III	T3a-b	N0	M0	Any	Any	**High**
IV	T4	N0	M0	Any	Any	**High**
	Any T	N1	M0	Any	Any	**Low/Intermediate/High**
	Any T	Any N	M1	Any	Any	**Low/Intermediate/High**

*X=not assessed

Appendix II: Description of Prostate Cancer Codes

SITE:	DESCRIPTION:	ICD-O-3 CODES for site or histology (Incidence)	SEER Subsite	SEER Site	ICD-9 (Mortality)	ICD-10 (Mortality)
PROSTATE	Prostate gland	C61 (excluding histology 8900, 9050-9055, 9140, 9590-9992)	28010	14	185	C61

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Notes

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