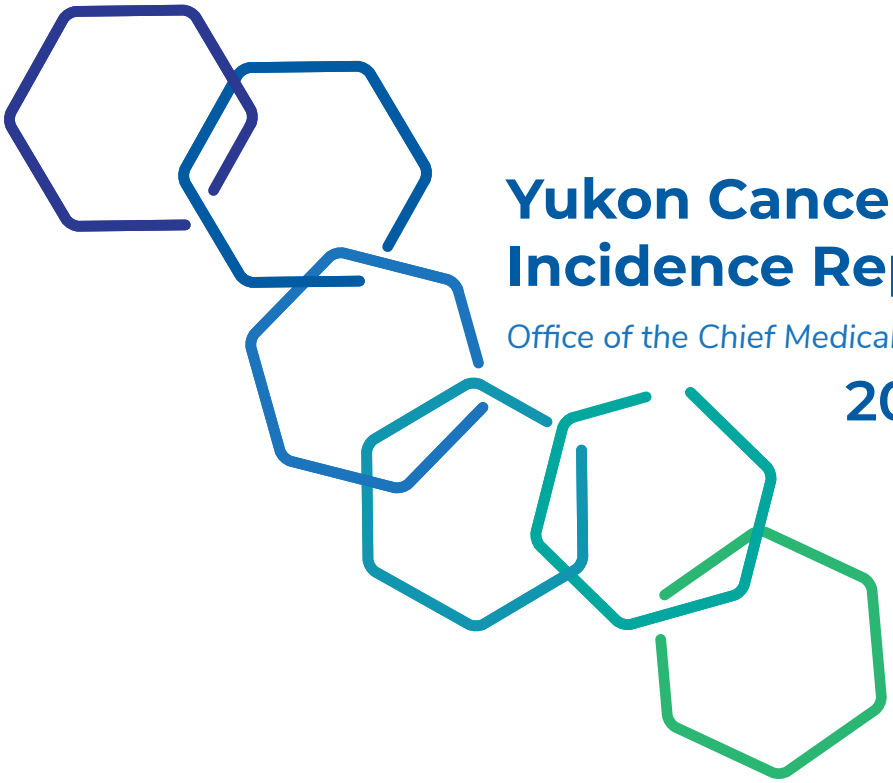

Yukon Cancer Incidence Report

Office of the Chief Medical Officer of Health

2009- 2016

About the Department of Health and Social Services

The Department of Health and Social Services, a department of the Government of Yukon, coordinates health and social services for the people of Yukon.

Our mission is to promote, protect, and enhance the well-being of Yukon people through a continuum of quality, accessible, and appropriate health and social services.

About the Office of the Chief Medical Officer of Health

The Office of the Yukon Chief Medical Officer of Health is responsible for the Department of Health and Social Services' legislated responsibility to protect and promote the public's health in a variety of areas.

Learn more about the Office of the Yukon Chief Medical Officer of Health at **www.yukoncmoh.ca**.

Project Team and Acknowledgements

This report represents the work of a collaborative initiative across several departments of the Government of Yukon and BC Cancer, which supports the Yukon Cancer Registry.

Brendan Hanley (Executive Lead)
Chief Medical Officer of Health
Office of the Chief Medical Officer of Health
Department of Health and Social Services
Government of Yukon

Marguerite Fenske
Acting Director
Insured Health and Hearing Services
Department of Health and Social Services
Government of Yukon

Ryan Woods
Scientific Director
BC Cancer Registry
Cancer Control Research, Population Oncology
BC Cancer

Jonathan Simkin
Cancer Epidemiologist
Insured Health and Hearing Services
Department of Health and Social Services
Government of Yukon

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This publication is available from the Office of the Yukon Chief Medical Officer of Health website at www.yukoncmoh.ca.

Contact Information

If you have any questions, feedback, or would like more information on this report, the Yukon Cancer Registry, or the Office of the Chief Medical Officer of Health, please feel free to contact hss@gov.yk.ca.

Citation

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EXECUTIVE SUMMARY

The Yukon Cancer Incidence Report, 2009-2016, provides detailed information on regional trends in cancer incidence, that is, *the rate of new cases of cancer*, for the most common cancer types. This report is the second of a series of Yukon cancer reports aiming to examine the Yukon cancer burden and help health professionals and policy-makers make decisions about cancer control and prevention in Yukon.

Summary of key findings

All cancer incidence

From 2009 to 2016, there were an average of 81 and 72 new cancer cases annually among Yukon males and females, respectively. After adjusting for population aging and growth, Yukon's all-cancer incidence rates have decreased overall since 2009. Relative to Canadian rates, the number of all new cancers in Yukon was no different than expected.

While Yukon's all cancer incidence rates declined overall, the number of individuals diagnosed with cancer is expected to increase as Yukon's population ages and grows. This observation has been reported nationally and will have important implications for health policy and resource planning.

Notable trends among the most common cancers

Of all cancers in Yukon, breast cancer was the most common followed by lung, colorectal and prostate cancers. These four common cancers are also the most common causes of cancer death in both Yukon and across Canada. In general, incidence rates for some of the more common cancers in Yukon are decreasing and are currently similar or lower to national levels. This includes female and male lung, female colorectal, and male prostate cancers.

This is the first report to examine stage of cancer at diagnosis in Yukon. Early detection of cancer leads to better outcomes and more treatment options for patients. As cancer treatment depends on cancer stage, clinicians and health planners may find the distributions of cancer stage in this report useful for resource planning.

Breast cancer

Yukon's female breast cancer rates are significantly elevated compared to the rest of Canada. In Yukon, almost three-quarters of female breast cancers are diagnosed at an early stage, with an early detection rate similar to, albeit somewhat lower, than Canada as a whole. Factors favouring early detection are organized breast cancer screening programs, public awareness of breast cancer symptoms, and prompt access to primary care for women with suspicious symptoms.

Colorectal cancer

Overall, early detection rates of colorectal cancer in Yukon were similar to national estimates. In Yukon, approximately half of cancers were diagnosed at an early stage. Given the availability of the ColonCheck screening program, increasing participation should help to shift diagnosis to early, and/or treatable, stages of disease.

Lung cancer

Lung cancer rates have declined for both males and females and are at similar levels to national rates. Smoking remains the most important risk factor for lung cancer. In Yukon, nearly a quarter of the population self-report as daily or occasional smokers, which is elevated compared to Canadian estimates (17.4%).

Across Canada, half of lung cancers are detected at Stage IV. This is reflected in a low survival rate relative to other major cancers. We report a similar finding in Yukon. There are no screening programs for lung cancer but pilot studies are underway to evaluate feasibility and improved outcomes. We are also exploring the feasibility for such a program.

Prostate cancer

Prostate cancer rates have steadily declined for both Yukon and the rest of Canada. In Yukon, prostate cancer rates were consistently lower than the rest of Canada. This is likely related to lower use of PSA testing in Yukon relative to Canadian counterparts. Despite recommendations against PSA test screening for prostate cancer, it is still widely used opportunistically across Canada and likely corresponds to regional variations of cancer incidence rates.

Yukon's prostate cancer rates were lower for stage I and stage II and elevated for stage IV compared to Canadian rates. While the low rates of stage I and II may be related to lower PSA testing in Yukon, it is unclear if they are related to elevated stage IV rates. Despite recommendations against population-based screening using the PSA test, early detection is very important. Factors that favour early detection are public awareness of prostate cancer symptoms and prompt access to primary care for men with suspicious symptoms.

Cancer incidence for screening cancers

Canadian screening recommendations are developed by the Canadian Task Force on Preventive Health Care (CTFPHC), which evaluate scientific evidence on population benefits of screening (i.e. reductions in cancer mortality and early detection), and potential harms (i.e. overdiagnosis and false positives). Most Yukon female breast, colorectal, and lung cancers fall within the recommended screening ages. A number of cancers still occur outside the recommended screening ages, however there is no evidence to support screening among these age groups for average risk individuals.

Cancer incidence by Yukon regional populations

After adjusting for size and age of the population, the incidence rate among the non-Whitehorse population appeared slightly greater than the Whitehorse population. The slightly elevated incidence rate among the non-Whitehorse population corresponds to findings from the Yukon Cancer Mortality report.

Mortality-to-incidence ratios, a crude measure of survival

Survival for female Yukoners was no different than Canadian females. For Yukon males, survival appears worse compared to Canadian males. This appeared so for all-cancers combined and prostate cancer. Cancer survival is influenced by a number of factors, including access to timely and appropriate care, and early detection of cancer.

It is not clear if lower survival among males for prostate cancer is related to differences in the risk of prostate cancer and treatment, or (1) a result of interprovincial variations in the use of PSA testing and therefore, prostate cancer incidence rates across Canada, and/or (2) under-capture of prostate cancer cases in the Yukon Cancer Registry. A closer look at prostate cancer in Yukon, including diagnosis, early detection, treatment and data quality, will help clarify these findings.

RECOMMENDATIONS
from the Chief Medical Officer of Health

Cancer's impact goes beyond the physical to draw upon emotional, social, economic and spiritual health. It affects individuals, care providers, family members and the community around them, and is a considerable challenge to the health system. In Canada, approximately 2 in 5 Canadians are diagnosed with cancer. In this report, while we found that the rate of new cancers among Yukoners is decreasing, we are also witnessing growth and aging of the Yukon population. Even with declining incidence rates, we can expect to see more people diagnosed with cancer, and thus an increasing demand on health and social services in the territory.

The following recommendations build upon recommendations from the Yukon Cancer Mortality Report, as well as work that is already underway at the Office of the Chief Medical Officer of Health and Department of Health and Social Services. In making these recommendations, we acknowledge that there are multiples factors that influence the risk of cancer, from biological to environmental factors, to the social circumstances we live in. Further, half of cancers can be prevented, and early detection of cancer is an effective and proven strategy to reduce cancer mortality and improve survival of individuals affected by cancer.

Briefly, our recommendations are:

1. Establish a Yukon Cancer Steering Committee to oversee a coordinated approach to cancer prevention and control involving the Government of Yukon and Yukon First Nations,

2. Partner with Yukon First Nations governments and communities for meaningful reporting of cancer data,

3. Report on key indicators of cancer care to inform and improve cancer care pathways in Yukon,

4. Build on existing initiatives that target modifiable risk factors, the social determinants of health and climate change to help prevent cancer,

5. Develop a centralized cancer screening hub to facilitate and evaluate organized cancer screening programs that improve early detection, reduce cancer mortality and improve survival.

1. Establish a Yukon Cancer Steering Committee to oversee a coordinated approach to cancer prevention and control.

As discussed in the Yukon Cancer Mortality report [1], there is a need to develop a coordinated approach involving the Government of Yukon and Yukon First Nations governments to address the burden of cancer in Yukon moving forward. Many Canadian jurisdictions rely on inclusive and inter-disciplinary steering committees to coordinate cancer prevention and control activities, as well as oversee and guide cancer surveillance for meaningful reporting on the cancer burden. Presently, there is no such committee in Yukon.

We recommend establishing a Yukon Cancer Steering Committee to coordinate the many efforts underway across government and health care settings, guide cancer surveillance activities, and prioritize new initiatives based on Yukon data and best practice. This committee would have a mandate to ensure that cancer control initiatives address Yukon's cancer priorities and that they are coordinated across governments. It would report to senior leadership in Health and Social Services and advise on existing and proposed cancer initiatives.

First Nations people have been calling for inclusion in cancer control planning and have offered a considerable body of work and recommendations as documented in numerous documents starting with Conversation on Cancer Part I (2007). A coordinated approach includes Yukon First Nations representation on the Committee and the First Nations voice in a meaningful way throughout the cancer control continuum.

2. Partner with Yukon First Nation governments and communities for meaningful reporting of cancer data.

Reporting of cancer among Yukon First Nations under the direction of Yukon First Nations.

Yukon First Nations governments have identified cancer as a health priority and a special project has already started that will lead to the creation of a Yukon First Nations Cancer Strategy. As part of this work, the development of a method to collect and analyze First Nations cancer data that is under the direction of Yukon First Nations is under consideration. This project is intended to reverse the cancer information-deficit and support future Yukon First Nations cancer prevention and control activities.

Yukon First Nations governments, Yukon government, Office of the Chief Medical Officer of Health and Yukon Hospital Corporation, are key partners on this project. As partners, we are committed to working together to improve the health and well being of First Nations peoples, enhance Yukon's cancer care system and build a forward-looking and inclusive system for all peoples in Yukon. Specifically, supporting a method to collect and analyze First Nations data, under the direction of Yukon First Nations governments, would help clarify gaps and inform Yukon First Nations cancer priorities.

Develop approaches for regional cancer surveillance and work together with communities to examine and address community cancer concerns.

In this report, we found that rates of cancer incidence may be higher in rural Yukon. These findings are consistent with the Yukon Cancer Mortality Report[1] that suggested cancer mortality rates appear higher in rural Yukon. This is likely related to multiple factors, such as a higher burden of risk factors and differential access to screening and treatment. Yukoners who are concerned about cancer within their community should be supported with readily available and reliable information. A meaningful approach to responding to community concerns, while establishing regional surveillance is required to appropriately respond to cancer concerns at the community or regional level.

We recommend that an approach for cancer investigation, community engagement and routine regional cancer surveillance be developed by the Office of the Chief Medical Officer of Health in partnership with relevant government areas, Yukon First Nations, and community care providers. This may be in the form of a committee, network of individuals or project team that is tasked with leading cancer investigations and communications with concerned individuals and communities, initiating public health action if necessary, and bringing cancer education and awareness.

3. Report on key indicators of cancer care to inform and improve cancer care pathways in Yukon.

Yukon's cancer control system includes prevention, screening, diagnostics, treatment and end-of-life care. Effective cancer care requires close collaboration between many care providers including community health nurses, physicians, hospitals and cancer centres outside Yukon. We recognize that at the time of publishing this report that a comprehensive review of Health and Social Services is underway. Notwithstanding the recommendations and improvements that may arise from that project, a more focused review of cancer care will likely still be necessary to identify opportunities for improving care. A systematic review of cancer care would help to better understand whether the relative higher mortality compared to incidence rates, differences in early detection, and lower survival are related to gaps in access to care or treatment, and if so which improvements in treatment and care are needed to improve cancer outcomes.

Such a review would include a description of cancer treatment pathways for priority cancers and stages, and could kickstart a process of regular reporting on key quality of care indicators based on evidence-based guidelines.

A cancer care review will require collaboration between the Department of Health and Social Services, Yukon Hospital Corporation, the clinicians who deliver cancer care and the agencies that deliver complex and advanced cancer care (i.e. BC Cancer). It will involve a review of current practice for priority cancers, identification of gaps between current and best practices and recommendations to improve care. To effect near-term improvements in care, suggested priority areas, as per the findings from this report, are as follows:

- Stage III and IV lung cancer
- Stage II and III colorectal cancer
- Stage I and II breast cancer
- Stage II and IV prostate cancer

4. Build on existing initiatives that target modifiable risk factors, the social determinants of health and climate change to help prevent cancer.

Half of cancers are preventable. For some cancers like lung cancer, more than half of cases can be prevented. Commercial tobacco smoking is responsible for nearly 85% of all new lung cancer cases in Canada[2]. Other modifiable factors that contribute to cancer are high alcohol consumption, poor diet, excess body weight, and physical inactivity. Importantly, our risk of cancer is also largely influenced by the social determinants of health, such as poverty, housing, education, and food security, as well as the built environment.

Another emerging factor contributing to cancer is climate change[3]. For example, air pollution, which is driven by human activity and perpetuated by climate change, is linked to lung cancer[4]. Climate change induced events, such as wildfire smoke emergencies, cause significant stress on mental and physical health and may also contribute to cancer risk.

Although these are not readily modifiable by the individual or any single organization, policy makers, decision makers, and community leaders are in a unique position to target cancer risk factors, reduce health inequities, and address climate change by championing healthy public policies and inclusive cancer prevention activities.

To effectively reduce the burden of cancer, we need to build upon existing evidence-based public policies and programs.

Evidence-based approaches for lung cancer prevention.

In Yukon, lung cancer incidence rates were historically elevated but are now at similar levels to national rates. However, Yukon has the third highest smoking rate in Canada[5] and is a region with elevated radon levels. Therefore, Yukon requires an aggressive strategy to address determinants of lung cancer.

Lung cancer is the most common preventable cause of premature death and cancer. Best practices to address lung cancer include effective tobacco control policy, evidence-based tobacco cessation programs, and distribution of residential radon testing kits. Even small gains in prevention can have a large impact in addressing lung cancer.

In Yukon, several efforts exist that are aligned with national practices. This includes the QuitPath tobacco cessation program, tobacco regulation policies and pricing, public awareness of radon and the distribution of radon testing kits. There is a need to build on existing strategies that can help prevent lung cancer. A variety of best practices are compiled by the Canadian Partnership Against Cancer (CPAC)[6] and their online prevention policy directory[7]. Moreover, there are relatively few tobacco cessation programs in Canada that are developed by, with and for First Nations[6]. The Yukon government and Yukon First Nations should work together to build on existing tobacco cessation programs that are culturally relevant for Yukon First Nations.

Evidence-based approaches for prevention of alcohol-related cancers

Alcohol consumption is another significant contributor to the cancer burden, among other diseases. Scientific evidence indicates a causal link between alcohol and seven types of cancer including colorectal and breast cancers, which are two of the most common cancers[8]. In Canada, Yukon ranks second highest in the proportion of adults drinking in excess of Canada's low-risk guidelines (11.7%)[9]. Yukon can benefit from an aggressive strategy that targets alcohol consumption. At the time of this report's release, Yukon's Liquor Act is under review, providing an ideal opportunity to improve upon Yukon's failing grade that it received in the recent national review of alcohol policy. This includes alcohol taxation and pricing, legislation that addresses sale, consumption, advertising and promotion restrictions, and raising public awareness of alcohol-related harms.

For Yukon First Nations governments, addressing alcohol use is a longstanding priority[10]. Alcohol use among Yukon First Nations is rooted in past and ongoing colonial policies that impact economic, political, cultural and social health, dislocation and marginalization, and intergenerational trauma from residential schools. Addressing alcohol among Yukon First Nations requires approaches that are developed with, by and for Yukon First Nations. The Council of Yukon First Nations and key partners have done considerable work in this area (e.g. Yukon First Nation Mental Wellness Workbook, 2010) and recommend a holistic approach that integrates current alcohol treatment with an on-the-land cultural healing component[10].

5. Develop a centralized cancer screening hub to facilitate and evaluate organized cancer screening programs that improve early detection, reduce cancer mortality and improve survival.

Organized screening of average-risk healthy individuals is one of many strategies to detect cancer early while minimizing avoidable and potentially harmful testing. Decreases in breast, cervical and colon cancer mortality are linked with the availability of organized cancer screening programs. In Yukon, breast, cervical, and colorectal cancer screening have typically occurred opportunistically. Opportunistic screening occurs in the primary care setting where individuals can receive screening tests at the recommendation of a health care professional during visits.

Organized screening programs have several benefits over opportunistic screening and are becoming more developed in Canada. They offer population-wide coverage by coordinating population-based identification, invitations and reminders. They support primary care providers by facilitating a seamless process through the screening pathway and enable monitoring and evaluation of program effectiveness through data collection.

In Yukon, there are currently three cancer screening activities: screening Papanicolauo (PAP) tests for cervical cancer occur opportunistically, mammography breast cancer is semi-organized (i.e. Yukon Mammography Program), and fecal immunochemical tests (FIT) for colorectal cancer occurs through an organized screening program (i.e. ColonCheck). Lung cancer screening for high-risk individuals is an active area in Canada and Yukon should follow developments closely. Although prostate cancer is a common cancer, as yet there is insufficient evidence of effectiveness for organized screening with PSA (Prostate Specific Antigen) due the risk of overdiagnosis[11].

Expand organized cancer screening in Yukon to incorporate cervical cancer screening.

Currently, Yukon does not have an organized cervical cancer screening program but screening is carried out opportunistically[12]. With some exceptions, screening requires women to have access to a primary care provider and relies on heath care providers to coordinate the screening process. Through the ColonCheck program, Yukon has the necessary program infrastructure that with appropriate expansion of supports, could incorporate cervical cancer screening, including screening invite, recall, and follow-up for eligible Yukoners.

A cervical cancer screening program would provide numerous benefits to the health status of women in Yukon by reducing cervical cancer mortality, detecting cancers early and treating pre-cancerous lesions. Remaining with the status quo means Yukon is unable to report on cervical cancer screening data. This is a significant barrier to tracking progress towards the elimination of cervical cancer, a goal that is being discussed nationally[13,14]. Incorporating cervical cancer screening into ColonCheck requires that benefits and costs be reviewed, and a pilot program initiated and evaluated.

Establish a centralized cancer screening hub that coordinates and evaluates all cancer screening programs in Yukon in relation to evidence-based guidelines.

Currently, the Yukon cancer screening system is fragmented and overseen by separate areas of government and health care. This can result in system inefficiencies, confusion for clients, and a barrier to consistent data collection, monitoring and evaluation of Yukon cancer screening programs. A centralized approach can address systems gaps and create an efficient and seamless screening pathway for clients. Centralized programs are a common approach to coordinating cancer screening across Canada[15,16].

Cancer screening was identified as a priority for Yukon First Nations[17,18]. A Yukon First Nation-led approach to providing safe colorectal, cervical and breast cancer screening is critical for improving outcomes among Yukon First Nations. Such an approach can be incorporated into the centralized cancer screening hub to support a Yukon First Nations vision.

Transitioning to a centralized program will take time and require collaboration between key partners to ensure screening services are not disrupted, including the Department of Health and Social Services, Yukon Hospital Corporation, and Yukon First Nations. Existing screening processes do not necessarily need to change as a result of an overarching cancer screening hub. While our first cancer screening recommendation takes place (i.e. organized cervical cancer screening), key partners should develop a business case and examine the costs and benefits of a centralized screening hub so that screening services are delivered and evaluated consistently in relation to evidence-based guidelines.

FOREWORD
from the Chief Medical Officer of Health

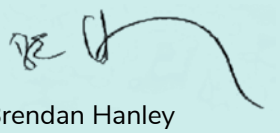
Cancer is the leading cause of death in Yukon, and is one of the top health concerns among Yukon First Nations. It makes sense, therefore, that we probe, ask questions and do our best to understand as much as we can about cancer in Yukon. Making sense of numbers in a small population is always challenging, but it doesn't mean we shouldn't try, or we can't make any conclusions. We just have to use special techniques, and be upfront about those areas where we don't have enough numbers to make conclusions.

In a jurisdiction with a small population there is another important aspect to gathering statistics. Even more than elsewhere, we are acutely aware that each statistic, each new case, represents someone that is *one of us*: someone that could be family, or from our neighborhood, a colleague or teammate or acquaintance. Between and among these numbers there are many stories of people facing the biggest challenges their lives might have thrown them, people who take on the cancer fight or journey; some who overcome, keep it at bay, or succumb.

As Yukoners no less than other Canadians, we need and deserve to know as much as we can make the numbers tell us. Who gets cancer, and why? Are there differences between regions; are there certain cancers we need to be more aware of? Can we be doing more in awareness, prevention, screening, access to treatment, and end of life care?

At the time we are publishing this report we are also embarking on a major project in developing a Yukon First Nations Cancer Strategy. Using information wisely to inform cancer prevention and care will be a major part of that project.

Cancer is a continued journey and conversation for all of us and I hope this report helps bring us a further, more mature, more informed, step along that journey.



Brendan Hanley

Yukon Chief Medical Officer of Health

"Cancer is a continued journey and conversation for all of us and I do hope that this report helps bring us a further, more mature, more informed, step along that journey"

ABOUT THIS REPORT

Purpose and intended audience

Yukon Cancer Incidence Report, 2009-2016 describes cancer incidence in the Yukon between 2009 and 2016. This report is the second of a series of territorial cancer reports aiming to examine the cancer burden in Yukon, to inform strategies for cancer prevention and control. The aim of this report is to provide detailed information regarding trends in cancer incidence, that is, the rate of new cases of cancer, for the most common types of cancer in Yukon. As cancer incidence is a determinant of cancer mortality, findings from this report will be discussed in relation to the previous territorial cancer report that focused on cancer mortality.

This report is designed to help health professionals, policy-makers, and researchers make decisions about regional cancer control and prevention. The media, educators, and members of the public with an interest in cancer may also find this publication valuable.

Yukon Cancer Registry

The Yukon Cancer Registry is a population-based registry of all cancers diagnosed in Yukon residents. The purpose of a population-based cancer registry is to collect information required to plan and evaluate cancer-control activities for the population. The Yukon Cancer Registry is overseen by the Department of Health and Social Services, which contracts BC Cancer (part of the BC Provincial Health Services Authority) to build and maintain a separate territorial registry within its infrastructure. The registry was built in 1987 and stage of disease information began to be entered for all Yukon cancer cases diagnosed from 2010 and onwards.

Today, the Yukon Cancer Registry receives notifications of cancer from many sources including diagnostic laboratories, health care providers, and vital statistics. The Yukon Cancer Registry contains personal and demographic information, information about the specific cancer diagnosis, as well as mortality information received from the Yukon Vital Statistics Registry.

Cancer registries across Canada are used to generate cancer statistics that describe trends and regional differences in cancer incidence and mortality, project future service needs, and evaluate patient outcomes and the effectiveness of cancer control programs. The data generated also support important research into the causes, prevention, screening, diagnosis and clinical management of cancer and the demand it places on the public health care system.

Cautions on interpretation

Many of the rates presented in this report have a large degree of uncertainty due to the small number of cancer cases. For example, as cancer cases are further categorized by sex, year and cancer type, the numbers in each sub-category drop substantially, resulting in increasingly imprecise rates for the smallest groups. To limit the uncertainty, data were often aggregated to multi-year periods. Although aggregating data may limit uncertainty, the aggregated estimates may not be truly reflective of current estimates. When examining rates, the reader is cautioned to consider the number of cases and the period upon which the estimate is based on.

Scope of report

This report conveys the most up to date information available for cancer statistics in Yukon. Since the annual number of cancer cases is relatively small in statistical terms, data were aggregated to multi-year groups based on year of diagnosis to produce more stable rates and enable meaningful statistical analysis. More stable rates provide a smaller range of error (or uncertainty) in the estimates, and improve our ability to draw comparisons with other regions and over time. Accurate reporting of cancers is especially important in Yukon, as cancer statistics in jurisdictions with small populations are sensitive to small changes in the number of cases. The methodology used in preparation and analysis of Yukon data reflects these considerations (Appendix I: Methodology). Data tables can be found at the end of this report in Appendix II: Data Tables.

In this report, we examined cancer incidence only among residents of Yukon. Therefore, former residents of Yukon who were residing elsewhere at the time of diagnosis were not included in these analyses. Information on cancer trends are based on data extracted from the Yukon Cancer Registry and Yukon Vital Statistics Registry. Trends were compared to national level data obtained from Statistics Canada's Canadian Socioeconomic Information Management (CANSIM) database[19].

Confidentiality

Data in this report are presented in such a way to prevent the identification of individuals with cancer. For this reason, cells less than five cases, which can occur for rare cancers and when stratifying (e.g. by age, sex and year), have been suppressed from presentation. When examining cancer incidence by Yukon regional population, cells less than 10 cases were suppressed from presentation.

Reporting by sex, gender and ethnicity

Cancer statistics are stratified by sex where possible given that the types of cancer and impacts of cancer affect men and women differently. In circumstances of low numbers, statistics were reported as both sexes combined to protect the privacy of those individuals represented by these statistics. The data used for this report were derived from the Yukon Cancer Registry. This allows us to report by sex but limits us on reporting by gender and ethnic categories as this level of data is not available. We are mindful that there are social and cultural issues related to cancer care and outcomes, and that these differ among men and women, gender, and ethnicity. These issues include access to cancer care and preventive services, the social determinants of cancer, differences in modifiable behavioural factors, and attitudes towards health.

Cancer among Yukon First Nation peoples

This report does not comment on cancer rates by First Nation identity. We acknowledge that this is an area of interest identified by Yukon First Nations governments and a special project is currently underway towards developing a Yukon First Nations Cancer Strategy. As part of this work, the development of a method to collect and analyze Yukon First Nations cancer data that is agreed to by, and under the direction of, Yukon First Nations is under consideration.

GLOSSARY

Age-standardized incidence rate

The number of new cancer cases per 100,000 people, standardized to the age structure of the 2011 Canadian population to account for changes in age distribution over time. Age-standardized rates are important statistics as they can be compared across populations and over time. Age-standardization is a statistical method applied to 'crude rates' to remove the impact different age-structures between comparators. For example, age-standardization of the incidence rate removes the impact of one population having a different age structure (e.g. an older population) compared another population. Therefore, comparing two age-standardized incidence rates allows us to compare between two populations, having accounted for the fact that the populations being compared may differ in age-structure.

Age-standardized mortality rate

The number of cancer deaths per 100,000 people, standardized to the age structure of the 2011 Canadian population to account for changes in age distribution over time.

Cancer incidence

The number of new cancer cases of a specific cancer type per person in the general population. It is useful for determining the type and amount of healthcare resources needed for cancer control and prevention activities.

Cancer incidence rate

The number of new cancers of a specific cancer type occurring in a specified population during a given period of time. The cancer rate is expressed as the number of new cancers per 100,000 persons. The cancer incidence rate (i.e. crude incidence rate) is often age-standardized to adjust for the impact of age and allow for meaningful comparisons with other populations and over time.

Cancer mortality

The number of deaths attributed to a specific cancer type for a given time period. It is useful for determining healthcare and support services needed, particularly for end of life care.

Cancer mortality rate

The number of cancer deaths of a specific cancer type occurring in a specified population during a given period of time. The cancer rate is expressed as the number of cancer deaths per 100,000 persons. The cancer mortality rate (i.e. crude mortality rate) is often age-standardized to adjust for the impact of age and allow for meaningful comparisons with other populations and over time.

Cancer stage

Cancer stage refers to the stage at which cancer is diagnosed. There are several ways to describe cancer stage. A widely used system is called the TNM staging system[20]. In this system, the tumour is examined by (i) size and extent, (ii) number of nearby lymph nodes that have cancer, and (iii) whether the cancer has metastasized[20]. These are then further categorized into early to late stages: Stage I (Early), Stage II, Stage III and Stage IV (Late).

Confidence intervals

Confidence intervals help quantify statistical uncertainty associated with estimates such as age-standardized incidence rates. Confidence intervals are often expressed as 95% lower and upper intervals. That is, we are 95% confident that the true value lies within the lower and upper confidence intervals. It's important to acknowledge that as cancer cases are further categorized by sex, year and cancer type, the numbers in each sub-category drops substantially, resulting in increasingly imprecise rates and wider confidence intervals.

Metastasis

Cancer cells from the original tumour (i.e. the primary tumour) can spread to other parts of the body[21]. For example, in metastatic breast cancer, breast cancer cells can be found at other sites of the body, such as the liver, but are in fact breast cancer cells that have spread. This would be referred to as metastatic breast cancer and not liver cancer.

Mortality-to-incidence rate ratio

The mortality-to-incidence rate ratio (MIR) is an indicator of survival that allows for comparison between populations. It is a cruder estimate of survival compared other measures such as relative survival. It is calculated by dividing the age-standardized mortality rate and age-standardized incidence rate.

It is interpreted as follows:

- An MIR less than 1 indicates that fewer people died from a particular cancer than were diagnosed with that cancer in a given period of time.
- An MIR of 1 indicates that the same number of people died from a particular cancer as were newly diagnosed with that cancer in a given period of time.
- An MIR greater than 1 indicates that more people died from a particular cancer than were diagnosed in a given period of time. MIRs greater than 1 are flagged as unreliable, as coding (i.e. determining cancer type) for mortality and incidence rates may vary significantly. Coding for mortality rates is derived from death certificates, and coding for incidence is derived from the cancer registry. The cancer registry is likely to be more specific to the cancer site[22].

Overdiagnosis

Overdiagnosis occurs when cancer is detected correctly but would not cause symptoms or death, and can lead to unnecessary treatment of cancer that would not have caused harm.

Standardized incidence ratio

A ratio comparing the number of observed new cancer cases to the expected number of new cancer cases, relative to Canadian age-specific cancer incidence rates for a given time period. It is reported as a percent, that is, 100% means the number of observed new cancer cases equaled the expected number. A percentage greater than 100% indicates that there were more observed new cancer cases than expected.

For example, if the standardized incidence ratio between population A and B was 110%, the observed number of new cancer cases in population A was 10% greater than expected relative to the age-specific incidence rates of population B. If the standardized incidence ratio was 90%, the observed number of new cancer cases in population A was 10% less than expected.

Standardized rate ratio

The ratio between two directly age-standardized rates (e.g. Yukon age-standardized incidence rate [ASIR] and Canadian ASIR). It represents the relative risk of disease in population 1 compared to population 2. When the rates (e.g. ASIRs) are the same, the ratio equates to 1.0 [23]. The MIR, a crude measure of survival presented in this report, is a type of standardized rate ratio, in which the mortality rate is divided by the incidence rate for a given period of time.

Abbreviations

ASIR – Age-standardized incidence rate

ASMR – Age-standardized mortality rate

BC – British Columbia

CA – Canada

CANSIM – Canadian Socioeconomic Information Management Database

CI – Confidence Intervals

MIR – Mortality-to-Incidence ratio

NHL – Non-Hodgkin's Lymphoma

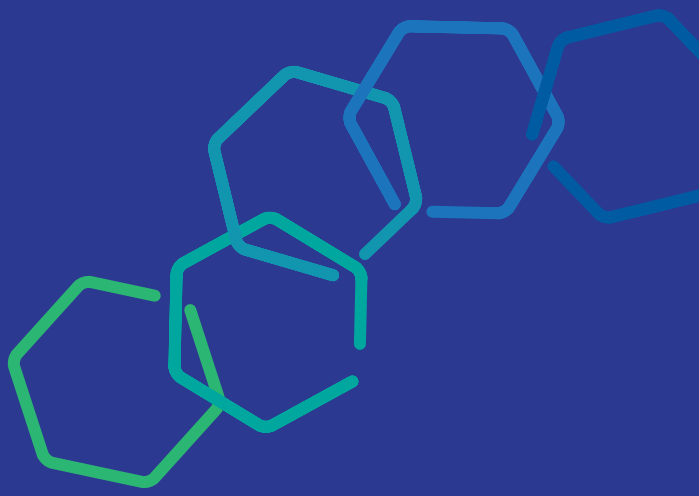
PAP – Papanicolauo test; also known as Pap test or Pap Smear

PSA – Prostate Specific Antigen

SIR – Standardized incidence ratio

SRR – Standardized rate ratio

YCR – Yukon Cancer Registry



All-cancer incidence

From 2009 to 2016, there were an average of 81 and 72 new cancer cases annually among Yukon male and female residents, respectively (Table 1). Among males, the annual number of new cancer cases ranged from 73 to 90, whereas among females, the annual number of new cancer cases ranged from 53 to 88. Of note, there was a low case count in 2014 which appears to be a random fluctuation. This illustrates that even when looking at all cancers combined, the number of cases are subject to significant variation due to Yukon's small population.

Table 1. Number of New Cancer Cases by Sex and Year, 2009-2016.

Year	Males	Females	Total
2009	73	72	145
2010	74	78	152
2011	89	63	152
2012	78	68	146
2013	74	70	144
2014	82	53	135
2015	90	85	175
2016	88	88	176
Total	648	577	1225

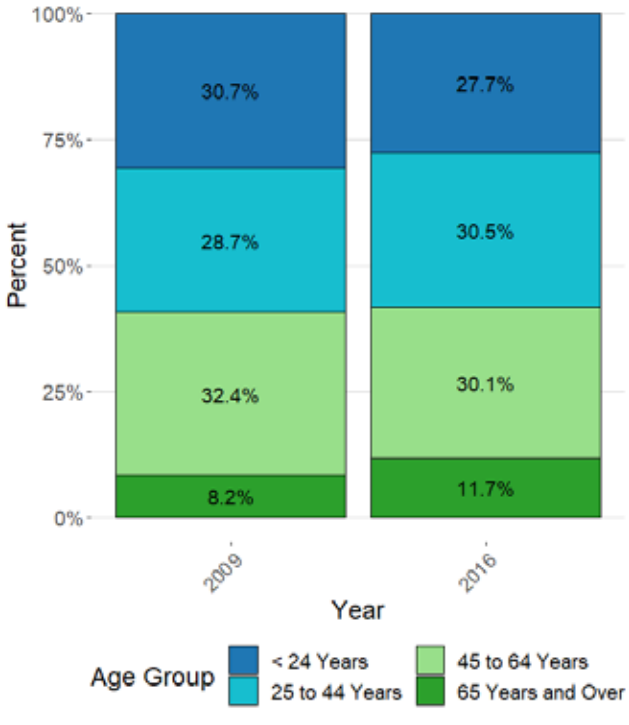
Population aging and growth in Yukon

According to the Yukon Bureau of Statistics, Yukon's population is experiencing population growth[24,25]. From 2009 to 2016, Yukon's total population increased nearly 13% and the population is expected to continue increasing. In the latest population projections report, the Yukon Bureau of Statistics projected the average population to increase by 1.6% over the next decade. By the year 2030, the population is projected to be 49,040[25].

Additionally, Yukon's population is aging, with the largest increases in ages 65 years and over (Figure 1). The proportion of Yukoners aged 65 years and over from the total population increased by 3.5% from 2009 to 2016. It is expected to increase by nearly 11% in 2025. At the same time, the proportion of Yukoners aged less than 24 years decreased by 3% from 2009 to 2016.

Population aging and growth have important health implications. That is, as the population ages we can expect a greater number of individuals developing diseases that are strongly linked with age, like cancer. Similarly, as the population grows, the actual number of cases and deaths are expected to increase[26].

Figure 1. Distribution of Yukon Population by Age, 2009-2016.

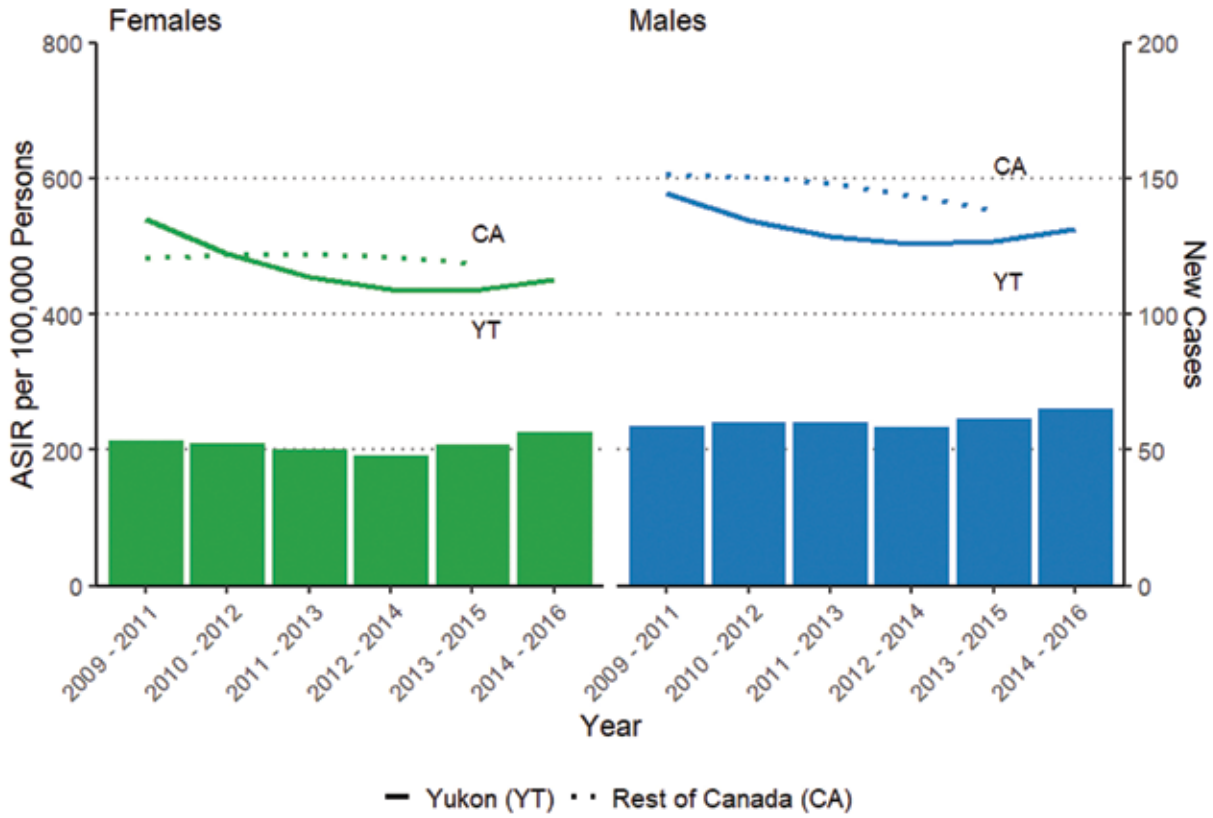


All-cancer incidence rates

Figure 2 shows three-year rolling age-standardized incidence rates (ASIRs) and counts of new cases from 2009 to 2016 for all cancers combined. ASIRs were smoothed and are displayed as lines while counts are represented by bars.

Among males and females, incidence rates decreased overall since the 2009-2011 period. It appears that the declining trend plateaued in the 2012-2014 period and increased slightly in the most recent period of analysis (2014-2016). While rates have declined overall, the number of cases appear to have increased overall.

Figure 2. Yukon All-Cancer Age-Standardized Incidence Rates by Sex, 2009-2016



How do Yukon and the rest of Canada compare?

Another way of looking at cancer incidence is to compare the observed number of cases in Yukon compared to what we would expect relative to Canadian cancer incidence rates. This is summarized by the standardized incidence ratio (SIR) statistic and presented in Figure 3 and Table 4 at the end of this report. It is presented as a ratio calculated by dividing the number of observed cases of cancer by the number expected cases relative to Canadian rates.

For Yukon females and males, all cancer incidence was slightly lower than expected relative to Canadian rates but did not reach statistical significance. That is, we do not have evidence to believe the observed number of new cases among males and females during 2009-2015 was different from that expected relative to Canadian rates.

What do these statistics mean?

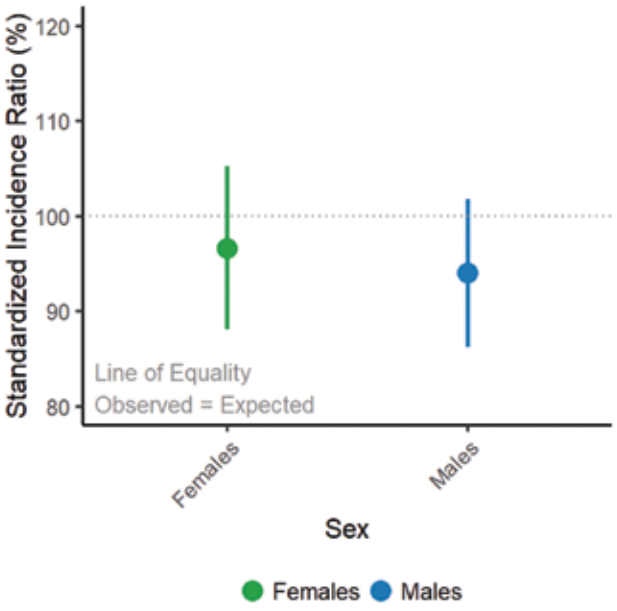
After adjusting for population aging and growth, Yukon's all-cancer incidence rates have decreased overall since 2009 for both males and females. The decline in incidence will contribute to declines in Yukon's cancer mortality rates over time as incidence is a main determinant of mortality[1].

Although incidence has declined overall among Yukoners, the trend appears to have plateaued for both males and females in the most recent years of analysis. There was a slight increase in the most recent period of analysis (2014-2016), however more data years are required to determine if this was due to random variations in rate estimates, or indicative of a true change in the trend. Importantly, the all-cancer incidence rate is reflective of a collective of trends among different cancer types, such as breast, prostate, colorectal and lung cancers, among others. While it is positive to see that Yukon's cancer incidence has declined overall, cancer-specific trends allow us to understand which cancers have declined and which have not. We will examine the most common types of cancers in Yukon in the next few sections.

Similar to what we see in Yukon, all-cancer incidence rates among Canadian males have decreased overall over the same period of analysis (2009-2016). Among Canadian females, all-cancer incidence rates have slightly increased[26]. The increasing all-cancer incidence rate among Canadian females reflects a steady rise in incidence rates for melanoma, thyroid and endometrial cancer[26]. When examining the observed number of all new cancers in Yukon compared to what we would expect relative to Canadian rates, we found no difference among females or males. That is, the observed incidence in Yukon was not different to what we would expect relative to Canadian rates. While the observed and expected numbers of all new cancers were similar for Yukon relative to Canadian rates, this likely differs for certain types of cancers as we shall explore further in this report.

While Yukon's all cancer incidence rates declined overall, the number of individuals diagnosed with cancer is expected to increase as Yukon's population ages and grows[24]. This observation has also been reported nationally[26]. As early detection, treatment and outcomes improve over time in Canada, it is also expected that more individuals will be living with or will have survived a cancer diagnosis[26]. This increased prevalence of people living with or surviving cancer will have important implications for health policy and resource planning.

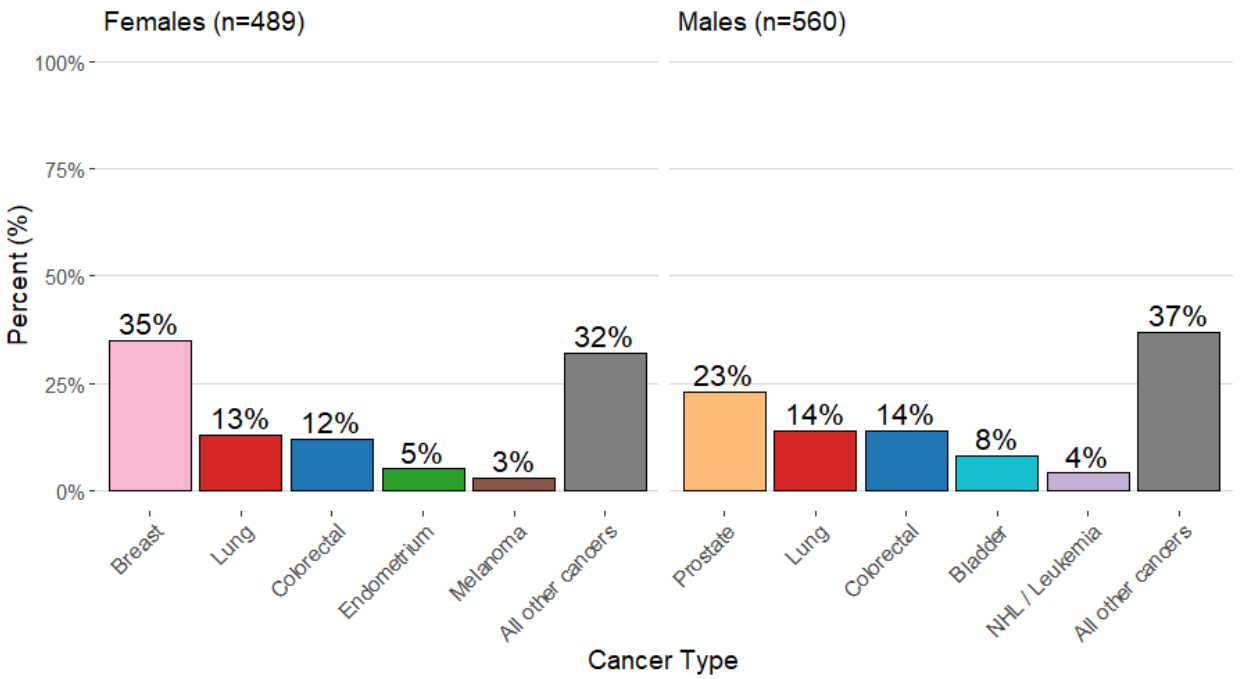
Figure 3. Standardized Incidence Ratios for All Cancers Combined by Sex Relative to Canadian All-Cancer rates.



Most common cancers in Yukon

From 2009-2015, there were 1049 new cases of cancer in Yukon. Female breast, lung, colorectal and prostate cancers were the most common. During this period, the most common cancers accounted for 55% of all cancers diagnosed.

Figure 4.1. New Cases of Cancer in Yukon by Cancer Type by Sex, 2009-2015[i].



NHL = Non-Hodgkin's Lymphoma; In Yukon, NHL and Leukemia had an equal number of cases.

Figure 4.1, and Tables 5.1-2, show the number of new cases in Yukon for the most common cancers by sex. The most common cancers among females were breast, lung, colorectal, endometrial, and melanoma cancers. Together, these accounted for 68% of all 489 female cancers diagnosed in Yukon during this time. Among males, the most common cancers were prostate, lung, colorectal, bladder, and Non-Hodgkin's Lymphoma (NHL) and leukemia cancers. Together these accounted for 63% of all 560 male cancers diagnosed in Yukon during this time. Approximately 37% of cancer diagnoses in males and 32% in females were 'other' cancers, a category that summarizes several cancer types that are less common.

i In this section, we analyzed data from 2009-2015 because 2015 was the most recent period in which data was available for Canada.

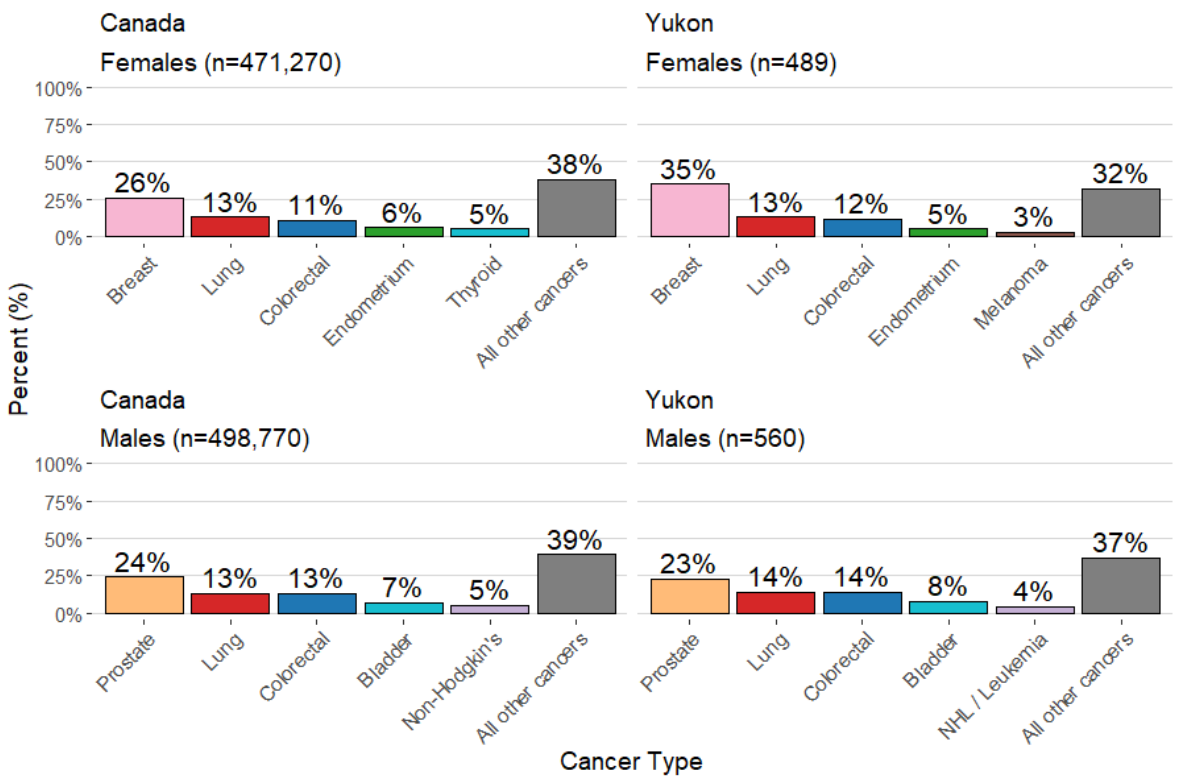
Key details about the most common cancers in Yukon:

- Female breast cancer was the most commonly diagnosed cancer in Yukon. Among females, breast cancer accounted for 35% of all female cancers.
- Among males, prostate cancer was the most commonly diagnosed, accounting for 23% of all male cancers.
- Lung and colorectal cancers were the second and third most common cancers diagnosed for both males and females, respectively.
- Among males, bladder was the fourth most common cancer, followed by NHL and leukemia (equal number of cases). Among females, endometrial cancer and melanoma were the fourth and fifth most common cancers, respectively.
- Of note, bladder and thyroid cancer were the sixth and seventh most common cancers among Yukon females. Pharynx and liver cancer were the sixth and seventh most common cancers among males.
- Stomach cancer, a common cancer causing death in Yukon [1], was the 14th most common cancer diagnosed among males and females combined.

How do Yukon and Canada compare?

Figure 4.2 and Tables 5.1-2 compare the number and proportion of the most common cancers diagnosed in Yukon and Canada for males and females.

Figure 4.2. Most Common Cancers Diagnosed in Yukon and Canada by Sex, 2009-2015.



NHL = Non-Hodgkin's Lymphoma; In Yukon, NHL and Leukemia had an equal number of cases.

Key details for females (Figure 4.2):

- The most common cancers for Yukon and Canada were similar: Breast, lung, colorectal, and endometrial cancers. Notably, breast cancer appears to account for a greater proportion of all new female cancers in Yukon (35%) than it does nationally (26%). Although the proportion is different, it does not tell us if there is a true difference between the observed rate of female breast cancer in Yukon compared to the rest of Canada. A closer look at the rate of female breast cancer in Yukon will be discussed in the next section.
- Thyroid was the 5th most common cancer among Canadian females (5% of all female cases) and the 7th most common cancer among Yukon females (2-3% of all female cases).
- Melanoma represents a similar proportion of all females cancers in Yukon (3-4%) and Canada (4%).
- Cervical cancer represents nearly 2% of all female cancers in both Yukon and Canada.

Key details for males (Figure 4.2):

- The most common cancers were similar between Yukon and Canada: prostate, lung, colorectal, bladder, and Non-Hodgkin's lymphoma cancers.
- Leukemia was the fifth most common cancer among Yukon males and tenth among Canadian males. Despite a difference in rank, leukemia represents nearly 4% of all male cancers in both Yukon and Canada.

What do these statistics mean?

Of all cancers in Yukon, breast cancer is the most common followed by lung, colorectal and prostate cancers. These four common cancers are also the most common causes of cancer death in both Yukon and across Canada[1,26].

A similar cancer incidence profile is seen in Canada as a whole[27], however, certain cancers stand out. Among Yukon females, breast cancer accounts for a greater proportion of all cancers than it does nationally. Further, thyroid cancer is commonly diagnosed across Canada but it accounts for a slightly lower proportion of all cancers in Yukon than it does across Canada. While proportions allow us to identify the common cancers for further investigation, it does not tell us if the number of observed cases are greater than we would expect relative to national rates. We will address this matter in the next section, *Trends by cancer type and stage at detection.*

In our previous report, stomach cancer was determined to be a common cancer causing death in Yukon, and mortality was elevated compared to the rest of Canada. In terms of incidence (new cancers), stomach cancer is not one of the most common cancers diagnosed in Yukon. This observation is not out of the ordinary, as cancers that have high mortality and low incidence are commonly those that have poor survival, and such is the case with stomach cancer[26]. Across Canada, only 21% of individuals with stomach cancer survive after five years from diagnosis[26]. Pancreatic cancer is similar with high mortality, low incidence and poor survival[26]. Therefore, we would not expect stomach cancer to be one of the most common cancers despite it being a common cancer causing death in Yukon.

Overall, identifying the major cancers in Yukon and comparing these to national statistics helps us identify cancers warranting further investigation, and informs decision-makers and health professionals on strategies to support cancer prevention and control in Yukon.

Trends by cancer type and stage at detection

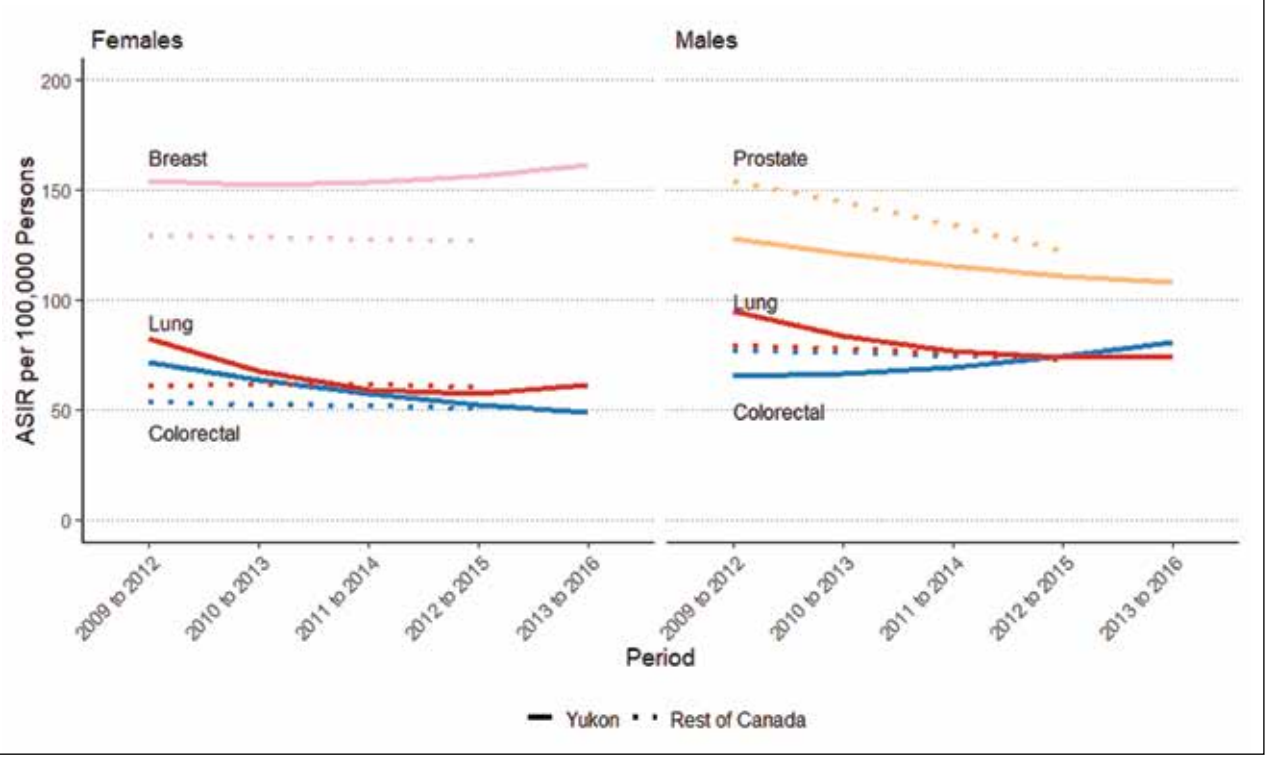
Figure 5 shows ASIRs for the most common cancers diagnosed in Yukon relative to the rest of Canada, respectively. The SIR statistic is presented for common cancers in Tables 9.1-2 at the end of this report. Additionally, Figures 6.1-4 and Tables 6.1-4 provide detailed information on cancer stage. Cancer stage refers to the stage at which cancer is diagnosed. There are several ways to describe cancer stage. A widely used system is the TNM staging system[20]. In this system, the tumour is examined by (a) size and extent, (b) number of nearby lymph nodes that have cancer, and (c) whether the cancer has metastasized. These are then further categorized into early to late stages: Stage I (Early), Stage II, Stage III and Stage IV (Late)[20].

In this section, two statistics are presented to examine cancer stage: the percent distribution at diagnosis, and stage-specific ASIRs. Each provides complementary information. The percent distribution describes the percent of cancers diagnosed at each stage from the total number diagnosed. It helps understand how cancers are diagnosed across all stages but it is limited for comparing to other populations. The stage-specific ASIR is preferred for comparing to other populations as it accounts for different age-structures between populations.

Why does reporting cancer stage matter?

Stage of diagnosis reflects how early cancers are detected. It provides valuable prognostic information for patients and clinicians to make informed decisions for treatment. Generally, when cancers are detected early, patients have more treatment options and better prognosis. Therefore, it is important for us to monitor how early cancers are detected and how best to focus our efforts on improving early detection of cancers.

Figure 5. Rolling Smoothed Age-Standardized Incidence Rates by Sex for Common Cancer Types, 2009-2016 (Four-Year Aggregated Periods).[ii]



ii Canadian statistics were available up until 2015 and therefore, Canadian trends lines plotted in Figure 5 are reported until the 2013-2015 period.

Lung cancer

From 2009 to 2016, there were 76 and 92 new cases among females and males, respectively (Table 10.1). Annually, there were an average of 10 new cases of lung cancer among females and 12 new cases among males.

Trends in ASIRs

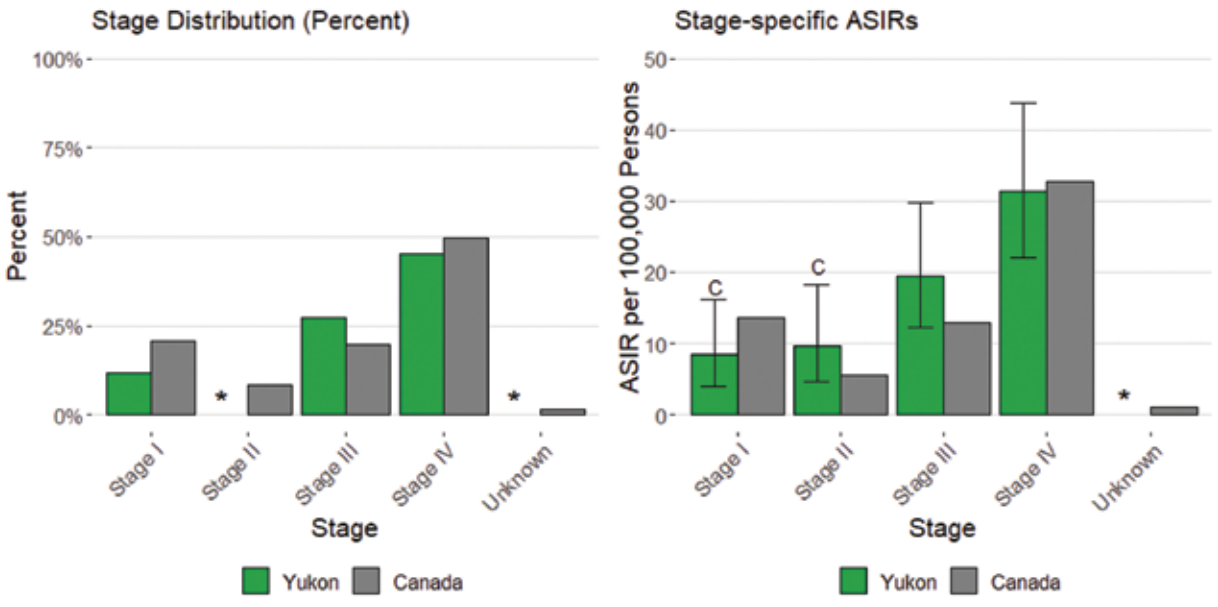
Among Yukon females, lung cancer incidence rates have decreased overall since the 2009-2012 period (Figure 5). Among females, Yukon rates were historically higher than Canadian rates until 2010-2013, where rates declined to match national levels. A similar trend was observed among Yukon males. Yukon male rates were elevated compared to national rates in the 2009-2012 period but have decreased to similar levels as Canadian rates. Overall, Yukon's lung cancer incidence was not statistically different compared to Canadian rates for males or females. [iii]

Trends in cancer stage, 2011-2015

Figure 6.1 and Tables 6.1 and 7, show the percent distribution of lung cancer stage and stage-specific ASIRs for Yukon and Canada. In Yukon, nearly 23% of cases were detected at an early stage (stage I and II) and 71% were detected at a late stage (stage III and IV). In Canada, lung cancer was also commonly diagnosed at a late stage (69.3%). In Yukon, a lower proportion of individuals are diagnosed as stage I (11.9% vs. 20.7%) and a greater proportion are diagnosed as stage III (27.4% vs. 19.7%).

When adjusting for age (i.e. stage-specific ASIRs), a similar trend was noted. Rates for stage I appear slightly lower and rates for stage II and III appear slightly elevated. However, no statistically significant differences were detected between Yukon and Canadian rates and we cannot conclude with confidence that they are different.

Figure 6.1. Lung Cancer Percent Stage Distribution and Stage-Specific Age-Standardized Incidence Rates in Yukon and Canada, Ages 18 to 79 Years and Both Sexes Combined, 2011-2015.



* Category suppressed due to small numbers.

C Caution when interpreting this rate because it was calculated with less than 16 counts.

iii As cases are further categorized by sex, year and cancer type, the numbers in each sub-category drops substantially, resulting in increasingly imprecise rates for the smallest groups. Due to small numbers, statistical significance is often not reached and confidence intervals widen.

Colorectal cancer

Trends in ASIRs

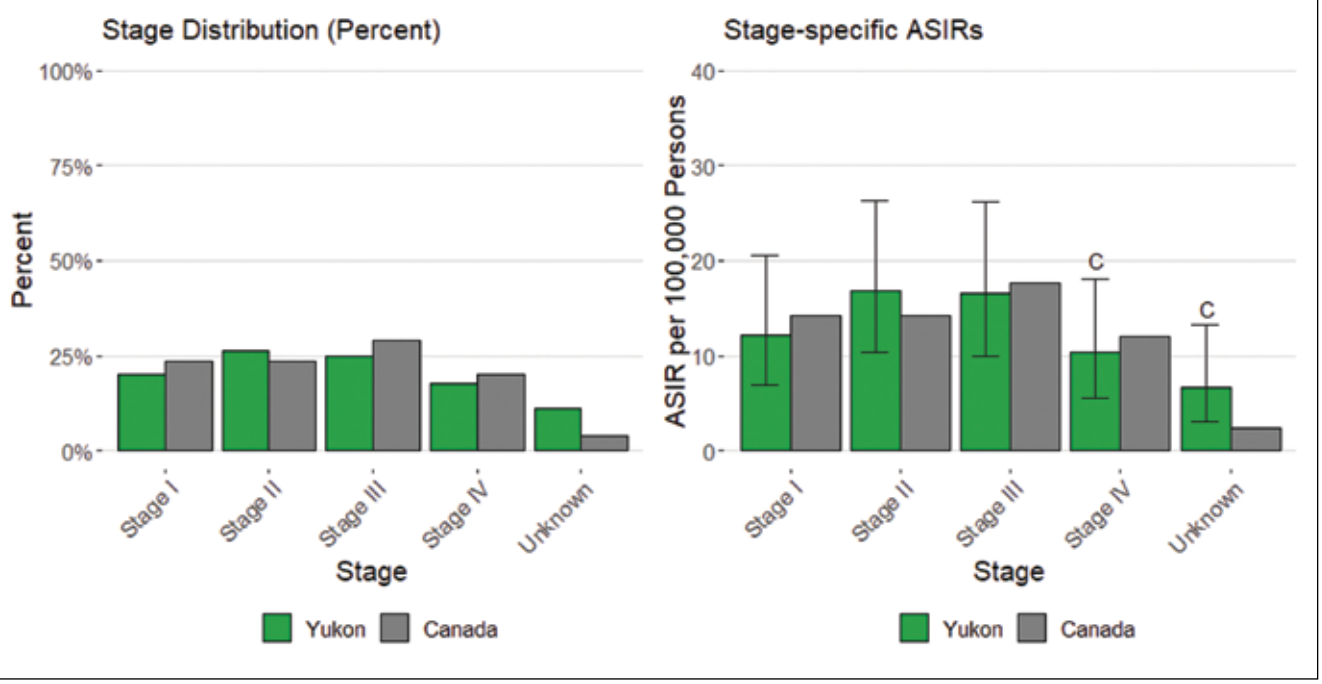
From 2009 to 2016, there were an average of eight new cases of colorectal cancer per year among females and 11 new cases among males (Table 10.2). Overall, there were 65 and 88 new cases among females and males, respectively.

Among Yukon females, colorectal cancer incidence rates have steadily declined since the 2009-2012 period (Figure 5). Rates were higher compared to Canadian rates in the 2009-2012 period and decreased to match national levels in 2012-2015. In contrast, the rate among Yukon males has steadily increased since 2009-2012. While rates were historically lower compared to national rates, they reached national levels in 2012-2015 (Figure 5). We also examined the SIR statistic to compare observed colorectal cancer incidence to what we would expect relative to Canadian rates. Overall, Yukon's colorectal cancer incidence was not statistically different compared to Canadian rates (Table 9.1). [iv]

Trends in cancer stage, 2011-2015

Figure 6.2 and Tables 6.2 and 7, shows the percent distribution of colorectal cancer stage and stage-specific ASIRs for Yukon and Canada. From a total of 80 cases, 46.2% were diagnosed at an early stage (stage I and II) and 42.5% were diagnosed at a late stage (stage III and IV). Almost 10% were considered to be stage unknown, which is greater than the rest of Canada. Overall, Yukon and Canada, stage-specific ASIRs were similar and no significant differences were detected by stage.

Figure 6.2. Colorectal Cancer Percent Stage Distribution and Stage-Specific Age-Standardized Incidence Rates in Yukon and Canada, Ages 18 to 79 Years and Both Sexes Combined, 2011-2015.



C Caution when interpreting this rate because it was calculated with less than 16 counts.

iv As cancer cases are further categorized by sex, year and cancer type, the numbers in each sub-category drops substantially, resulting in increasingly imprecise rates for the smallest groups. Due to small numbers, statistical significance is often not reached and confidence intervals widen.

Female breast cancer

Trends in ASIRs

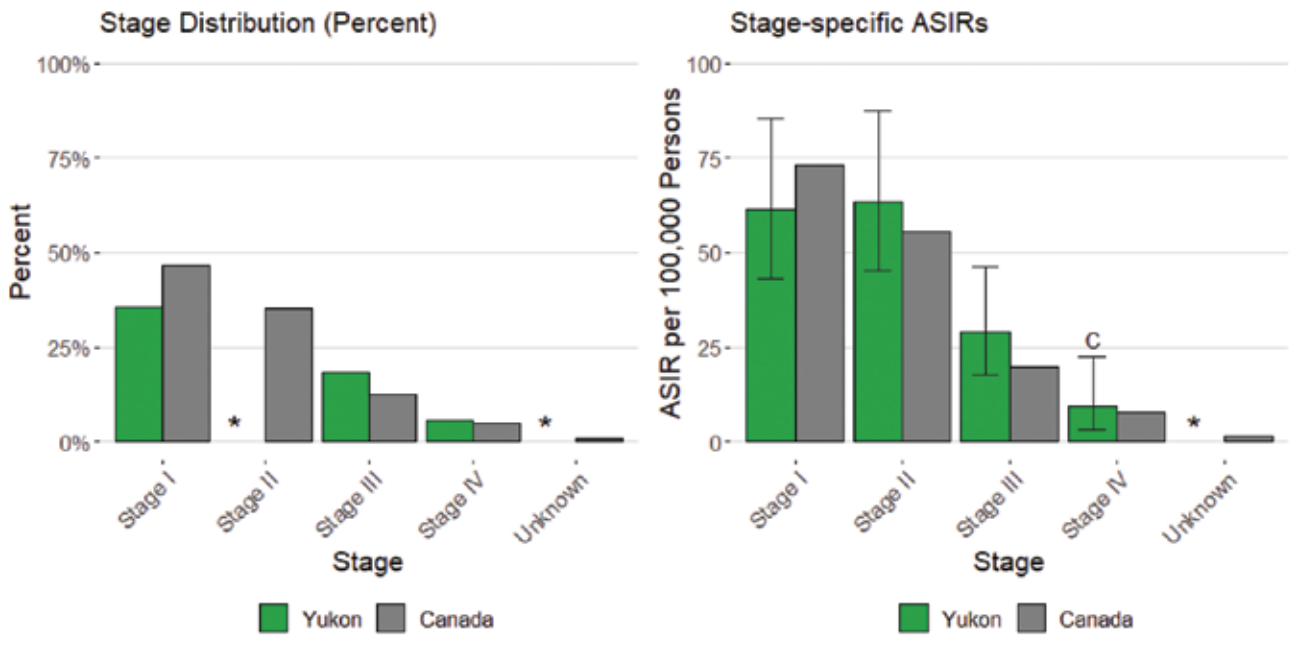
From 2009-2016, there were an average of 25 new cases of female breast cancer per year, and a total of 201 new cases (Table 10.3). Among Yukon females, breast cancer incidence rates appear to have increased slightly overall since the 2009-2012 period. In contrast, national rates appear to have remained stable. Yukon rates appear elevated relative to national rates for the entire period of analysis (Figure 5). The SIR statistics revealed, from 2009-2015, Yukon's observed female breast cancer incidence was 18.6% higher compared to what we would expect relative to Canadian female rates (Table 9.1). This finding was statistically significant. That is, we have sufficient evidence to believe female breast cancer incidence was elevated in Yukon relative to Canadian females during this period.

Trends in cancer stage, 2011-2015

Figure 6.3 and Tables 6.3 and 7, shows the percent distribution of female breast cancer stage and stage-specific ASIRs for Yukon and Canada. From a total of 110 cases, nearly 73% were detected at an early stage (stage I and II) and 23% were detected at a late stage (stage III and IV). Compared to Canada, a greater proportion of female breast cancers were detected at a late stage in Yukon (23% vs. 17%). When looking at individual stages, there were notable differences between Yukon and Canada in the proportion of women diagnosed at stage I and stage III. In Yukon, the proportion of stage I cancers (35.5%) was lower than in Canada as whole (46.6%). Conversely, there was a slightly greater proportion of stage III cancers in Yukon (18.2%) than Canada as a whole (12.4%).

When adjusting for age (i.e. Stage-specific ASIRs), stage III rates appeared slightly elevated. However, no statistically significant differences were detected between Yukon and Canadian rates and we cannot conclude with confidence they are different [v].

Figure 6.3. Female Breast Cancer Percent Stage Distribution and Stage-Specific Age-Standardized Incidence Rates in Yukon and Canada, Ages 18 to 79 Years, 2011-2015.



* Category suppressed due to small numbers.

C Caution when interpreting this rate because it was calculated with less than 16 counts.

v As cancer cases are categorized by sex, year and cancer type, the numbers in each sub-category drops substantially, resulting in increasingly imprecise rates for the smallest groups. Due to small numbers, statistical significance is often not reached and confidence intervals widen.

Prostate cancer

Trends in ASIRs

From 2009-2016, there were an average of 18 new cases of prostate cancer annually, and a total of 144 new cases (Table 10.4). Yukon prostate cancer incidence rates were lower than national rates for the entire analysis period (Figure 5), and incidence rates decreased over the time of analysis. The SIR statistics revealed, from 2009-2015, Yukon's prostate cancer incidence was slightly lower compared to what we would expect relative to Canadian rates (Table 9.1) but this was not a statistically significant finding. [vi] This means we do not have sufficient evidence to conclude prostate cancer incidence was lower in Yukon relative to Canadian rates.

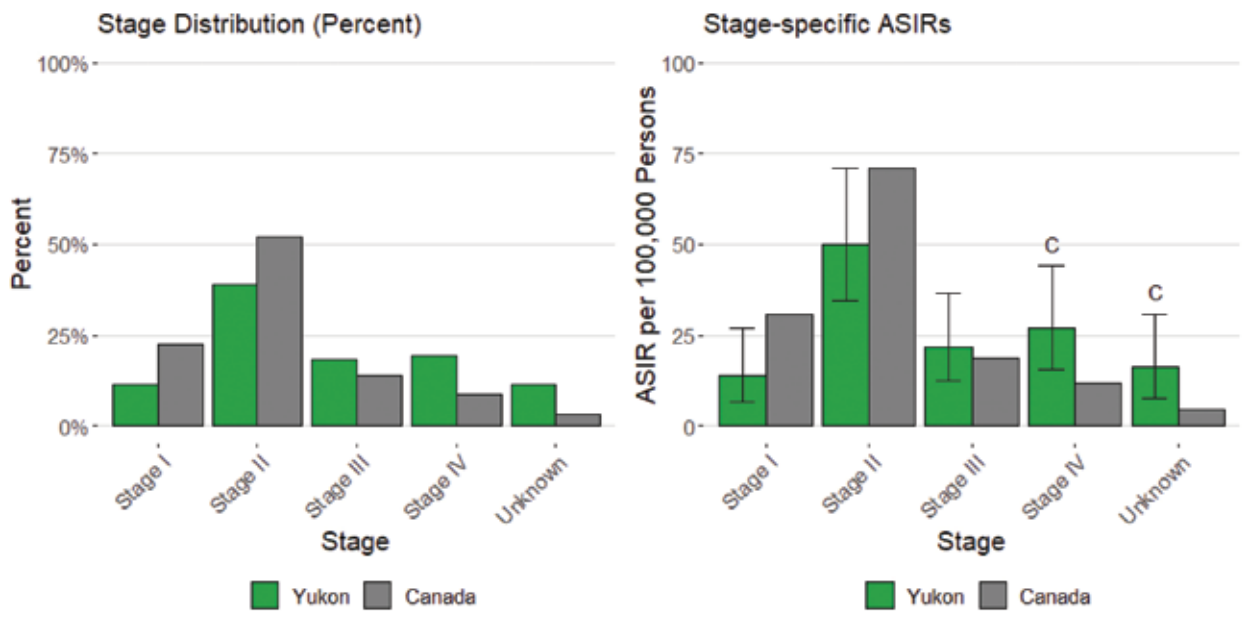
Trends in cancer stage, 2011-2015

Although current evidence does not support population based screening for prostate cancer [11], early diagnosis through prompt investigation of suspicious symptoms is important. Figure 6.4 and Tables 6.4 and 7, show the percent distribution of prostate cancer stage and stage-specific ASIRs for Yukon and Canada.

From a total of 87 cases, 50.6% were detected at an early stage (stage I and II) and 37.9% were detected at a late stage (stage III and IV). Relative to Canada, the proportion of late stage prostate cancers was higher in Yukon (37.9% vs. 22.4%).

When looking by individual stages, notable differences are seen with Canada, particularly in stage I, II, and IV. When adjusting for age, Yukon rates for stage I and stage II were statistically lower than Canadian rates. Yukon stage IV rates were statistically greater than Canadian rates.

Figure 6.4. Prostate Cancer Percent Stage Distribution and Stage-Specific Age-Standardized Incidence Rates in Yukon and Canada, Ages 18 to 79 Years, 2011-2015.



C Caution when interpreting this rate because it was calculated with less than 16 counts.

vi As cancer cases are further categorized by sex, year and cancer type, the numbers in each sub-category drops substantially, resulting in increasingly imprecise rates for the smallest groups. Due to small numbers, statistical significance is often not reached and confidence intervals widen.

SIRs for other common cancers: Bladder, Cervical, Endometrial, Melanoma, Non-Hodgkin's Lymphoma, Leukemia, and Stomach cancers

Other commonly diagnosed cancers in Yukon are bladder, cervical, endometrial, melanoma, Non-Hodgkin's lymphoma (among males), leukemia and stomach cancers. The SIRs for these cancers are reported in Table 9.2. Although they are common, the observed number of cases are relatively low. This results in increasingly imprecise estimates and statistical significance is often not reached as confidence intervals widen. We caution the reader when interpreting these statistics based on small numbers and recommend taking into account the observed and expected number of cases presented in Table 9.2. Stage is not routinely collected for cancers others than breast, colorectal, lung and prostate cancer and therefore, we do not report on cancer stage for other cancers.

DISCUSSION
Notable trends by cancer type

In general, incidence rates for some of the more common cancers in Yukon are decreasing and are currently similar or lower to national levels (Figure 6). The more notable cancers that have declined in rates over time are both female and male lung cancer, female colorectal cancer, and male prostate cancer. On the other hand, female breast cancer rates have slightly increased over time and are elevated compared to national rates. Male colorectal cancer rates have shown a steady increase over time.

While incidence rates indicate how many individuals are diagnosed with cancer over time, it does not provide information on how early cancers are detected. Early detection of cancer leads to better outcomes and more treatment options for patients. This report is the first to examine stage of cancer at diagnosis in Yukon.

Breast cancer

Among the rest of Canada, female breast cancer rates slightly decreased during this period but have generally remained stable. The Canadian Cancer Statistics Publication reports that female breast cancer rates have remained relatively stable since 2004 with a series of small fluctuations[26]. The slight increasing trend in Yukon is out of synch compared to national statistics but is a low enough trend that this may represent simple rate fluctuation. What we can say with more confidence, however, is Yukon's female breast cancer rates are significantly elevated compared to the rest of Canada as a whole, based on total numbers of breast cancers diagnosed in the eight-year period leading up to 2016.

Reasons for fluctuations in female breast cancer rates have been unclear. Factors that are thought to influence breast cancer incidence rates are participation in mammography screening, long-term changes in hormonal factors (e.g. early age at menarche, breastfeeding, late age at menopause, oral contraceptive use and late age at full-term pregnancy), and diabetes[26].

In the Yukon Cancer mortality report, we examined female breast cancer mortality over the 2003-2012 period[1]. We found that female breast cancer death rates were no different than what we would expect relative to the rest of Canada[1]. Given that incidence rates in Canada and Yukon were generally stable (only a slight increase in Yukon) it is likely that mortality trends will remain similar in Yukon.

An important piece to consider is stage of diagnosis. In Yukon, almost three-quarters of female breast cancers are diagnosed at an early stage, with an early detection rate similar to, albeit somewhat lower, than Canada as a whole. High rates of early detection are a positive finding as early detection leads to better treatment options and outcomes[28]. Similar to the national average, approximately 5% of cases are detected at Stage IV (the latest stage). Factors favouring early detection of breast cancer are organized breast cancer screening programs, public awareness of breast cancer symptoms, and prompt access to primary care for women with suspicious symptoms. Controversies within the literature still exist as to the relative value of mammographic screening versus measures facilitating early diagnosis, but a population based screening program would ideally address all aspects from awareness through screening and early detection[29].

Lung cancer

Lung cancer rates have declined for both males and females and are at similar levels to national rates. Nationally, male lung cancer incidence rates have declined since the mid-1980's[26]. Canadian female lung cancer rates have historically been increasing but peaked in 2006 and stabilized thereafter. Smoking remains the most important risk factor for lung cancer and patterns in the lung cancer incidence rate reflect the prevalence of daily smokers over time[30]. In Yukon, nearly a quarter of the population self-report as daily or occasional smokers in 2015/16. This is lower than estimates in previous years[1]. That being said, smoking prevalence was still elevated compared to the Canadian estimate of 17.4% in 2015/16[31].

In Yukon, male lung cancer mortality was slightly elevated for males from 2008-2012, but not significantly different than expected relative to Canadian rates. Further, lung cancer mortality rates declined since 1999. Among Yukon females, lung cancer mortality was significantly elevated compared to Canadian rates. An increasing trend was observed since 1999 however, the trend peaked in the period of 2009-2013. Given that incidence rates have shown a declining trend, we expect that both male and female lung cancer mortality rates will see declines in the future. Lung cancer has a long latency period (i.e. time between a particular exposure and the development of cancer), and therefore, the incidence trends in lung cancer reported here, beginning in 2009, will not be seen in mortality rates for several years to come.

Across Canada, half of Canada's lung cancers are detected at Stage IV[28]. This is reflected in a low survival rate relative to other major cancer types[28]. We report a similar finding in Yukon. That is, lung cancer was most commonly diagnosed at Stage IV, in which cancer has already spread beyond the lungs.

There are no screening programs in Canada for lung cancer. However, the Canadian Task Force on Preventive Health Care (CTFPHC), a Canadian committee that evaluates scientific evidence and develops screening recommendations, recently released new recommendations to screen for high-risk individuals with low-dose computed tomography (32). Pilot studies are underway in Canada to evaluate the feasibility of such programs and the impact on detecting lung cancer at an earlier stage and therefore, the possibility for improved outcomes among patients[28,32]. We are also actively exploring the feasibility for such a program in Yukon as well.

Colorectal cancer

Trends for colorectal cancer incidence in Yukon were different for males and females. Rates have steadily declined for females and are at similar levels to national rates. A declining trend has also been observed nationally, more prominently among females[26]. The declining trend for Yukon females is likely to decrease female colorectal cancer mortality rates. For Yukon males on the other hand, colorectal cancer incidence rates have steadily increased and are elevated compared to national rates[1]. Nationally, colorectal cancer incidence has been trending downwards for males[26]. Small increases have been noted and are attributed to increased use of colorectal cancer screening[26].

Overall, Yukon shared a similar distribution of stage at diagnosis for colorectal cancer compared to national estimates. In Yukon, approximately half of cancers were diagnosed at an early stage[28]. Given the availability of colorectal cancer screening programs, this finding suggests that increasing participation in screening programs should help to shift diagnosis to early, and/or treatable, stages of disease[28].

It will be important to assess the impact of the introduction of ColonCheck, Yukon's new colorectal cancer screening program, on incidence, stage of diagnosis and mortality. Overall, like other screening programs, the Yukon ColonCheck program is expected over time to decrease colorectal cancer mortality rates. In the process there may be fluctuations in cancer incidence rates as previously undetected asymptomatic cancers may be found therefore increasing the proportion of early stage colorectal cancers.

Stomach cancer

In the previous report in this series, stomach cancer was determined to be a common cancer causing death in Yukon and mortality was elevated compared to the rest of Canada[1]. In terms of incidence, stomach cancer is not one of the most common cancers diagnosed in Yukon (see section entitled: Most common cancers in Yukon). Further, Yukon stomach cancer incidence was not significantly different than what we would expect relative to Canadian rates.

What we appear to be witnessing therefore is an average stomach cancer incidence with a higher mortality, suggesting that stomach cancer may be presenting relatively late in Yukon compared to the rest of Canada, or that the type of stomach cancer here is more aggressive in nature.

Other cancers

Several other common cancers were examined as well. Most of these cancers were found to occur at either lower than, or similar to, national rates. These include endometrial, melanoma, cervical, and Non-Hodgkin lymphoma. Bladder cancer incidence may warrant further attention as incidence appears slightly elevated compared to national rates.

Also warranting further analysis and follow-up are cancers where there is an apparent mismatch between incidence and mortality rates. In other words, there are certain cancers where, given what we observe about the incidence, the mortality rate as described in the Yukon mortality report appears to be higher than expected. We have described this for stomach cancer.

Prostate cancer

Prostate cancer rates have steadily declined for both Yukon and the rest of Canada. Prostate cancer incidence trends are linked to the intensity of opportunistic screening in the population with the prostate-specific antigen (PSA) test[26,28]. The CTFPHC recommends against screening males who are at average risk for prostate cancer with the PSA test[11]. The recommendation is supported by evidence from large-scale randomized clinical trials (RCT) and observational studies that conclude the benefits of screening, such as early detection and potential reductions in mortality, do not outweigh the harms and costs, such as overdiagnosis and false positives[11]. Overdiagnosis occurs when cancer is detected correctly but would not cause symptoms or death, and can lead to unnecessary treatment of cancer that would not have caused harm[11,29]. False positives can have significant psychological impacts and can lead to adverse effects from further testing[11,29]. From one RCT (the European Randomized Study of Screening for Prostate Cancer), overdiagnosis ranged from 40% to 56% of men who received a diagnosis of prostate cancer as a result of PSA screening[33–35]. This was aligned with other overdiagnosis estimates reported from other trials, such as the Prostate, Lung, Colorectal and Ovarian Cancer trial[34–36].

Despite recommendations against PSA test screening for prostate cancer, it is still widely used opportunistically across Canada. The intensity of its use varies considerably by province/territory[26,37]. Variations in PSA testing likely correspond to regional variations of overall cancer incidence rates and early stage incidence rates[28]. In Yukon, prostate cancer rates were consistently lower than the rest of Canada. This likely related to lower use of PSA testing in Yukon relative to other regions in Canada[37]. According to the Canadian Community Health Survey, from 2010 to 2013 the proportion of men aged 35 years or older that report at least one PSA test in the past two years was lower in Yukon (26.7%) compared to provincial counterparts (41%-53%)[28,37].

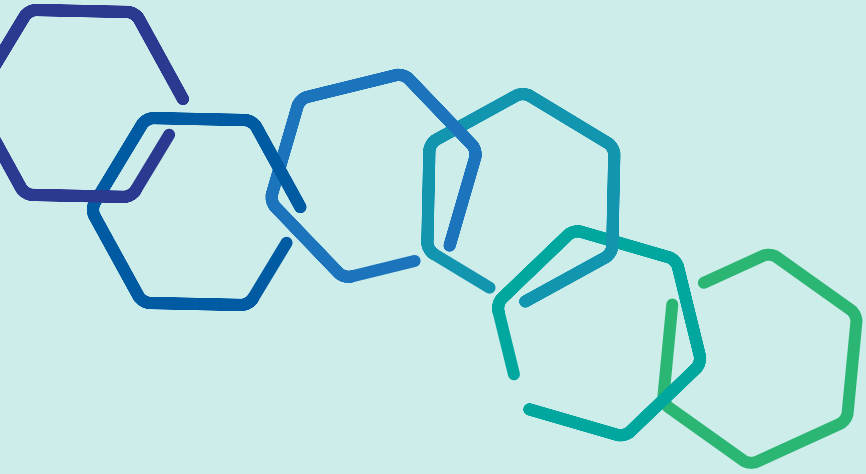
When we examined cancer incidence by stage, Yukon's prostate cancer rates were lower for stage I and stage II, and elevated for stage IV compared to Canadian rates. While the low rates of stage I and II may be related to lower PSA testing in Yukon, it is unclear if they are related to elevated stage IV rates. Our findings are in synch with the 2018 Canadian Cancer Statistics Publication, that reported elevated rates of stage IV prostate cancer in the territories, Manitoba, and Saskatchewan, relative to other Canadian provinces[28]. Higher incidence of stage IV prostate cancer indicates that we can do more in terms of helping providers and men understand the need for assessment of symptoms and signs of prostate cancer.

In the Yukon Cancer Mortality report we examined prostate cancer mortality over the 2003-2012 period[1]. We found that prostate cancer death rates were not significantly different than what we would expect relative to the rest of Canada, although they appeared slightly elevated[1]. This in synch with elevated rates of stage IV prostate cancer in Yukon.

Despite recommendations against population-based screening using the PSA test[11], early detection is very important. Factors that favour early detection are public awareness of prostate cancer symptoms and prompt access to primary care for men with suspicious symptoms. Prostate cancer is more common in older men (greater than 50), men with African ancestry, men with a family history of prostate cancer, and those with particular genetic conditions such as Lynch syndrome[38]. Men who are interested in understanding more about the potential benefits and risks of PSA screening should discuss with their health care provider.

Summary

In summary, incidence rates are an important tool for planning and evaluating efforts in cancer prevention, like cancer screening and health promotion, health care services, survivorship, and end of life care. To better understand the underlying incidence trends, it is important to take into account regional determinants of cancer and access to preventive, diagnostic and care services. Regional determinants of cancer are described in detail in the Yukon Cancer mortality report[1]. For cancers where population-based screening programs are in place, such as colorectal and breast cancers, monitoring incidence and stage at diagnosis allows us to assess the impact of these programs on incidence and early detection moving forward. Moreover, incidence and early detection rates are necessary to know in order to understand regional mortality and survival rates, and to be able to determine where improvements in awareness, prevention, screening, or cancer care need to take place.



All-cancer incidence by sex and age groups

Incidence by sex

Cancer incidence rates vary between different age groups and by sex. Examining cancer incidence by sex and age provides a sense of who is developing cancer and therefore, informs planning for targeted cancer prevention, early detection and control services.

From 2009-2016, 52.9% of all cancer diagnoses were among males and 47.1% were among females (Table 11). The distribution of all cancer incidence in Yukon males and females is similar to that of Canada for the same time period[39]. Although the distribution of all cancers is nearly equal by sex, the distribution changes slightly depending on cancer type.

Table 11. Number and Percent Distribution of Cancer Incidence Among Males and Females for Select Cancer Types 2009-2016.

Cancer	Sex	Count	Percent
All Cancer	Males	648	52.9%
	Females	577	47.1%
Lung	Males	92	54.8%
	Females	76	45.2%
Colorectal	Males	88	57.5%
	Females	65	42.5%

Incidence by age

Cancer primarily affects Canadians aged 50 years and over. During 2009 to 2015, approximately 87% of all new cases in Yukon occurred in people aged 50 years and older, with a median[vii] age at diagnosis of 63. Table 12 shows the distribution of cancers by age and by sex in Yukon.

The distribution of cancers by age group gives us a clear picture of what age groups are diagnosed with cancer, but they do not tell us if the incidence rates by age group are different from Canadian rates. To draw meaningful comparisons between Yukon and Canada, we calculated the SIR statistic by age group (Figure 7 and Table 13).

Among females, all cancer incidence was similar across most age groups to what we would expect relative to Canadian female incidence rates. Notably, all cancer incidence among females aged 0 to 49 years was 35.7% lower than expected relative to Canadian female rates. This was a statistically significant finding.

All cancer incidence among all age groups was similar to what we would expect relative to Canadian male incidence rates.

vii The midpoint of a distribution of observed values.

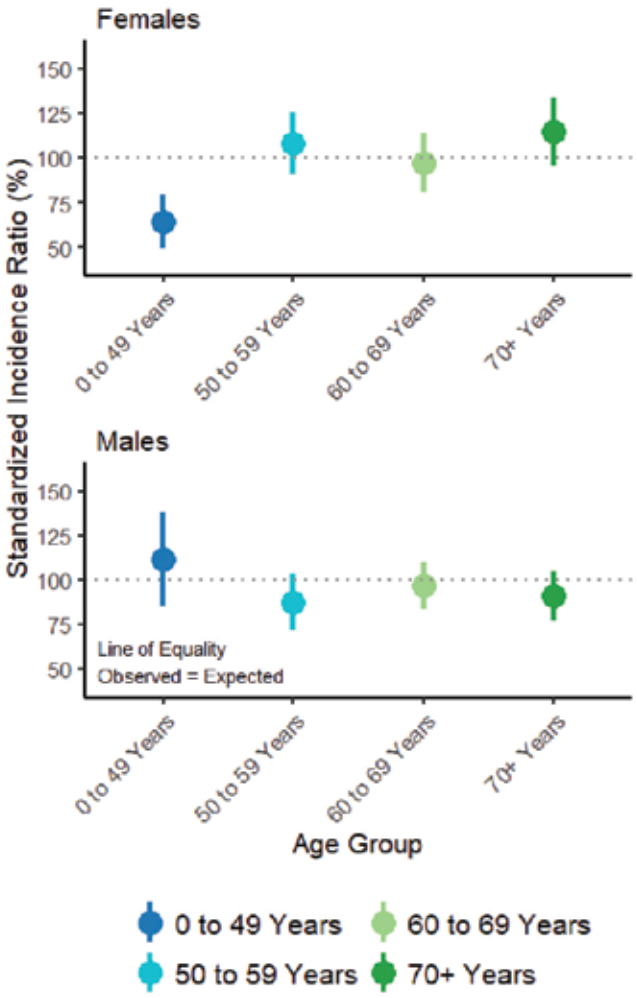
What do these statistics mean?

Overall, the number of new cancers in Yukon is slightly higher among Yukon males (53%) than females (47%), a similar pattern to what we observed with cancer mortality in the previous report. Across Canada, the number of new cancers are roughly equal among males and females[26].

Cancer primarily affects individuals after 50 years of age. Approximately 87% of all new cancers in Yukon occurred in people aged 50 years and older with a median[viii] age of 63 years. This is similar to national estimates[26,40].

After adjusting for different age structures, cancer incidence rates for most age groups in Yukon did not differ relative to national rates. Among Yukon women aged 0-49 years, incidence was lower than expected relative to national rates. This appears to be due to lower incidence among less common cancers collectively. That is, all cancers collectively excluding breast, colorectal and lung cancers.

Figure 7. Yukon Standardized Incidence Ratio for All Cancers Combined Relative to Canadian Cancer Incidence Rates by Age, 2009-2015.



viii The midpoint of a distribution of observed values.

Cancer incidence by age for screening cancers

We examined cancer incidence in Yukon by specific age groups for cancers with cancer screening guidelines (Tables 14.1-3). This includes female breast, colorectal, and lung cancer. Cervical cancer screening is also recommended in Canada, however numbers were too small for meaningful analysis. Examining cancer incidence by age for these cancers helps us understand the proportion of cancers diagnosed within the recommended screening age groups. This information can help guide and evaluate our cancer screening programs moving forward.

Female breast cancer

Screening guidelines

Female breast cancer is the leading incident cancer and second leading cause of cancer death among Yukon and Canadian women[1,26]. In Canada, the incidence rate has remained relatively stable since 2004 [26] but the mortality rate has declined. This is related to the role of breast cancer screening in women and advances in breast cancer treatment [26]. Breast cancer screening, or mammography screening, has been shown to reduce breast cancer mortality [29]. Screening recommendations published by the CTFPHC [29] recommend the following for women who are not at an increased risk of breast cancer [ix]:

- For women aged 40–49, routine screening with mammography is not recommended, however, the decision to undergo screening depends on the value a woman places on potential benefits and harms of screening. In Yukon, women 40-49 years can be referred by a healthcare provider for screening and depends on the woman's relative value of benefits and harms of screening.
- For women aged 50–74, routine screening is recommended with mammography every 2 to 3 years.

The Yukon Mammography Program is a semi-organized breast cancer screening program aimed at early detection of breast cancer among average risk women and follows the CTFPHC recommendation as listed above. The Program is carried out at Whitehorse General Hospital by specially trained health professionals.

Incidence by age groups

From 2009 to 2015, there were 170 cases of breast cancers diagnosed in Yukon (Table 14.1). The majority of cases were among women recommended for routine screening (aged 50 to 74 years; 68.2%). Although collectively, 31.8% of breast cancer cases occurred in women outside the recommended routine screening age groups, there is no evidence to support the value of population routine screening among this group[29]. That is, the CTFPHC concluded from reviewing numerous studies that the potential benefits of organized screening among these age groups (e.g. reductions in cancer mortality and early detection of cancer) do not outweigh the harms and costs (e.g. overdiagnosis and false positives). Overdiagnosis occurs when cancer is detected correctly but would not cause symptoms or death, and leads to unnecessary treatment of cancer that would not have caused harm[11,29]. False positives can have significant psychological impacts and can lead to adverse effects from further testing[11,29].

Table 14.1. Number and proportion of female breast cancer cases by age, 2009-2015.

Age (years)	Count	Proportion (%)
20-39	7	4.1%
40-49	25	14.7%
50-74	116	68.2%
75+	22	12.9%
Total	170	100.0%

ix As stated by the CTFPHC, an increased risk for breast cancer includes women with a personal or family history of breast cancer, women who are carriers of gene mutations such as BRCA1 or BRCA2 or have a first-degree relative with these gene mutations, and women who had chest radiation therapy before 30 years of age or within the past eight years[62].

Colorectal cancer

Screening guidelines

Colorectal cancer is the second and third most common cancer and cause of cancer death among Yukon and Canadian men and women, respectively[1,26]. In Canada, incidence has generally declined over the past few decades, particularly among adults 50 years and older. This is partly attributed to colorectal cancer screening that can identify precancerous lesions, which are treatable, thereby preventing cancer and reducing cancer incidence. Mortality rates have seen a more profound decline for the past few decades[26]. The decrease in mortality is related to the decrease in incidence and improvements in diagnosis and treatment[26].

Colorectal cancer screening can reduce colorectal cancer mortality and is the newest organized screening program to be implemented around Canada[41]. The CTFPHC recommends[41] the following for average risk adults aged 50 years or older who are not at high risk for colorectal cancer[x]:

- Recommend screening adults aged 50 to 74 for CRC with a Fecal Occult Blood Test (FOBT) every two years or flexible sigmoidoscopy every 10 years.
- Recommend not screening adults aged 75 years and over for CRC.
- Recommend not using colonoscopy as a screening test for CRC.

ColonCheck Yukon is an organized colorectal cancer screening program aimed at early detection of colorectal and pre-cancerous lesions among average risk men and women in Yukon. Screening is delivered through a Fecal Immunochemical Test (FIT; a type of FOBT), a take-home test that can detect early warning signs of colon cancer[42].

Incidence by age groups

From 2009 to 2015, there were 72 male and 57 female colorectal cancers diagnosed overall in Yukon. Table 14.2 shows the number and proportion of colorectal cancer cases by age; we could not separate by sex due to small numbers. The majority of cases were among ages recommended for routine screening (50 to 74 years). Although, nearly 36% of cases occur in ages outside those recommended for screening, there is no evidence to support the value of routine screening in these age groups[41]. That is, the CTFPHC concluded from reviewing numerous studies that the potential benefits of organized screening among these age groups (e.g. reductions in cancer mortality and early detection) do not outweigh the harms and costs (e.g. overdiagnosis [xi] and false positives).

Table 14.2. Number and proportion of colorectal cancer cases by age, 2009-2015.

Age (years)	Count	Proportion
18-49	14	10.9%
50-74	82	63.6%
75+	33	25.6%
Total	129	100.0%

x As stated by the CTFPHC, the recommendations do not apply to those who are not at average risk: Individuals with previous colorectal cancer or polyps, inflammatory bowel disease, signs or symptoms of colorectal cancers, history of colorectal cancer, in one or more first degree relatives, or adults with hereditary syndromes predisposing to colorectal cancer (e.g. familial adenomatous polyposis, Lynch Syndrome[63].

xi Overdiagnosis occurs when cancer is detected correctly but would not cause symptoms or death, and can lead to unnecessary treatment of cancer that would not have caused harm[11,29].

Lung cancer

Organized lung cancer screening is not formally implemented among Canadian provinces and territories. However, the case is being examined closely and the CTFPHC released recommendations in 2016[32] with a commitment to monitor scientific developments and update the guidelines in 2021. The recommendations focus on a targeted approach towards screening, meaning that it will focus on individuals who are at high-risk and not those at average risk for lung cancer[32]. High-risk individuals are defined as those with a smoking history of 30 pack-years[xii] who currently smoke or quit less than 15 years ago. According to the CTFPHC,

- For high-risk adults aged 55-74 years, screening is recommended annually with low dose computed tomography (LDCT) (i.e. a screening tool) up to three consecutive times[32].
- For all other adults, regardless of age, smoking history or other risk factors, screening is not recommended for lung cancer with LDCT[32].

From 2009 to 2015, there were 81 male and 64 female lung cancers diagnosed in Yukon. Table 14.3 shows the number and proportion of lung cancer cases by age and sex. The majority of cases were among those aged 55 to 74 years for both males and females. Although nearly a third of cancers occur at ages 40-54 years and 75+ years for both males and females, there is no evidence to support the value of routine screening in these age groups[32]. That is, the CTFPHC concluded from reviewing numerous studies that the potential benefits of organized screening among these age groups (e.g. reductions in cancer mortality and early detection) do not outweigh the harms and costs (e.g. overdiagnosis [xiii] and false positives).

Table 14.3. Number and proportion of lung cancer cases by age and sex.

Age (years)	Males		Females	
	Count	Proportion	Count	Proportion
40-54	7	8.6%	5	7.8%
55-74	55	67.9%	41	64.1%
75+	19	23.5%	18	28.1%
Total	81	100.0%	64	100.0%

xii Pack-years are calculated by multiplying the average number of cigarette packs smoked daily and years smoking[32].

xiii Overdiagnosis occurs when cancer is detected correctly but would not cause symptoms or death, and can lead to unnecessary treatment of cancer that would not have caused harm[11,29].

What do these statistics mean?

In Yukon, the majority of female breast, colorectal, and lung cancers fall within the recommended screening ages. Even though a number of cancers still occur outside the recommended screening ages, there is no evidence to support screening among these age groups for average risk individuals. Canadian screening recommendations are developed by the CTFPHC, which evaluates scientific evidence on the cancer screening and reductions in cancer mortality, as well as the potential harms of screening. The decision to undergo screening also depends on an individual's relative value of the potential benefits and harms and should be discussed with their health care providers.

For those outside the recommended screening age groups, attention to prevention, awareness of symptoms, and awareness of baseline risk are important. An individuals' baseline risk for developing a particular type of cancer is related to several factors, such as family history of cancer, ethnicity, health conditions, and modifiable behaviours (e.g. smoking history and alcohol consumption) and should be discussed with their health care providers.

Cancer incidence by Yukon regional populations

As of 2018 mid-year, Yukon is home to just over 40,000 residents. Roughly three-quarters of the population live in and around Whitehorse and surrounding areas [xiv], the territory's capital and urban centre[43]. Apart from Whitehorse and surrounding areas, the two largest communities are Dawson and Watson Lake, and the rest of the population live in communities around the territory[43]. In this section, we examined cancer by different populations in Yukon based on place of residence. That is, we looked at cancer among residents of Whitehorse and surrounding areas, and the rest of Yukon (i.e. non-Whitehorse residents).

From 2009 to 2016, there were 1225 new cases of cancer in Yukon. Of those 1225 cases, 1214 had information regarding location of residence at diagnosis. From those 1214 cases, there were 864 and 350 new cases of cancer among Whitehorse and non-Whitehorse residents, respectively (Table 15). On average, there were 108 and 44 new cases of cancer per year among residents of Whitehorse and non-Whitehorse residents, respectively.

Table 15. Number and Proportion of New Cases of Cancer by Yukon Regional Population, 2009-2016.

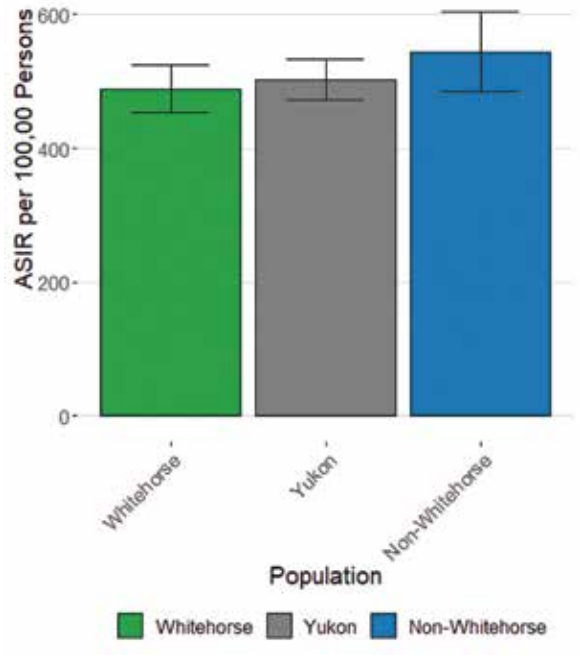
Year	Counts			Percent		
	Whitehorse	Rest of Yukon	Total	Whitehorse	Rest of Yukon	Total
2009-2012	411	179	590	69.7%	30.3%	100.0%
2013-2016	453	171	624	72.6%	27.4%	100.0%
Total	864	350	1214	71.2%	28.8%	100.0%

All-cancer incidence rates

Figure 8 shows the cumulative ASIR for all cancers combined and by Yukon regional populations (i.e. Whitehorse and non-Whitehorse residents).

From 2009-2016, the ASIR corresponding to the non-Whitehorse population was 1.1 times greater than the ASIR corresponding to the Whitehorse population (Figure 8 and Table 18). This was not a statistically significant result, and we cannot conclude that they are different.

Figure 8. All-Cancer Age-Standardized Incidence Rates by Yukon Regional Population, 2009-2016.



xiv Whitehorse and surrounding areas includes: Marsh Lake, Ibex Valley, Lake Laberge and Mt. Lorne. This reflects national and territorial definitions of Whitehorse and surrounding areas.

Major cancers by Yukon regional population, 2009-2016.

Breast, lung, colorectal, and prostate cancers were the most common cancers among Yukon regional populations (Figure 9 and Table 17.1-2). The distribution of cancer types was relatively similar by Yukon region. For females, over a third of cancer cases among females were due to breast cancer in both the Whitehorse and non-Whitehorse population. Lung cancer as a proportion of all cancers was higher among non-Whitehorse residents versus Whitehorse residents for both males and females. The proportion of prostate cancers was higher among Whitehorse males than non-Whitehorse males. The proportion of colorectal cancers was higher among Whitehorse females and non-Whitehorse males, relative to their respective counterparts.

Figure 9. Proportion of New Cancer Cases by Cancer Type, Yukon Regional Populations, 2009-2016.

What do these statistics mean?

Most new cases of cancer occur in residents of Whitehorse and surrounding areas, which also represent the majority of Yukon's population. A similar observation was noted concerning cancer death[1].

After adjusting for size and age of the population, the incidence rate among the non-Whitehorse population appeared slightly greater than the Whitehorse population. However, we caution the reader that we cannot conclude with confidence that they are different. As we further categorize cancer incidence by community category, the number of cancer cases in each category drops. This results in increasingly imprecise rates, which is reflected by wider confidence intervals around the estimated rates. This means we are less certain of the estimates. The slightly elevated incidence rate among the non-Whitehorse population is in sync with findings from the Yukon Cancer Mortality report[1]. We reported slightly elevated mortality rates among the non-Whitehorse population versus the Whitehorse population[1].

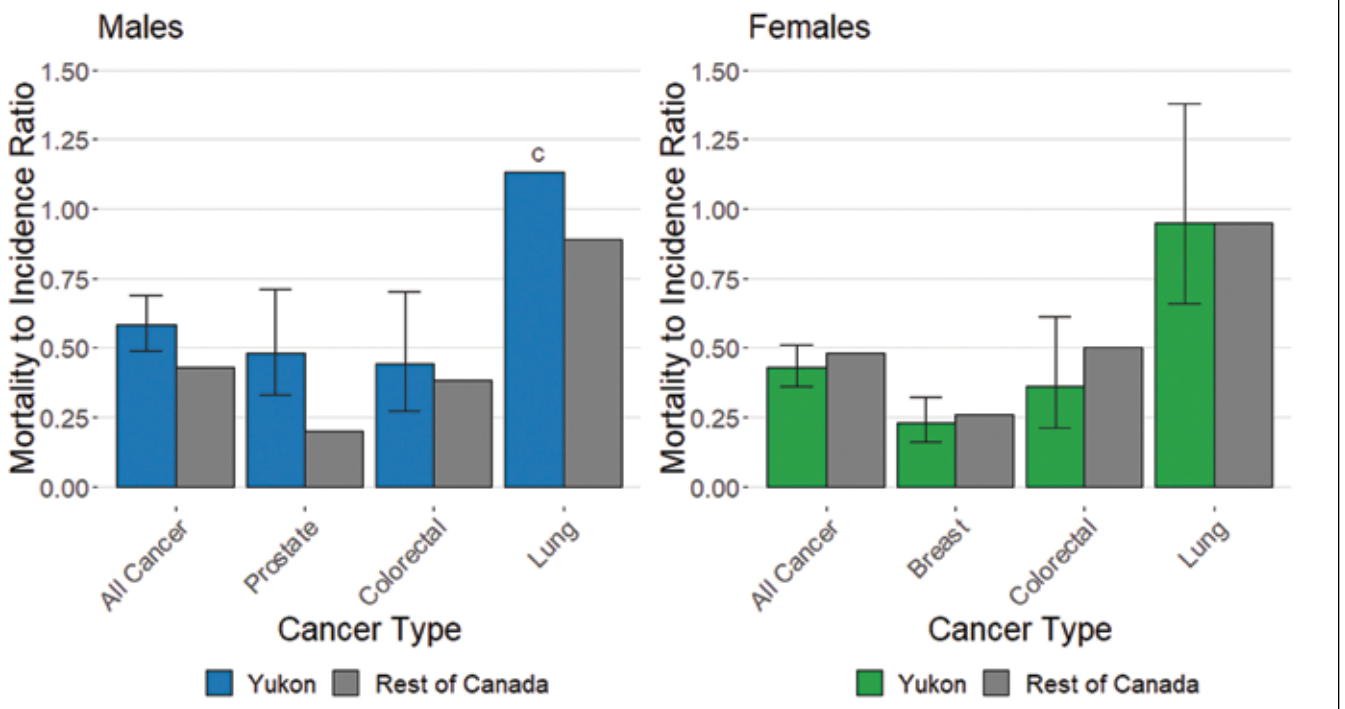
The most common cancers by Yukon region were similar: Breast, lung, colorectal and prostate cancers. The proportion of lung cancers was relatively higher among the non-Whitehorse population. The proportion of prostate cancers was relatively lower among non-Whitehorse males. While there may be differences in the proportions of cancer type by region, it does not tell us whether incidence rates differ. Differences between regions may related to differences in sex and age structures, as well as the prevalence of risk factors (e.g. smoking rates and alcohol consumption), screening rates, and the social determinants of health[44,45].

Differences in cancer incidence, between urban, rural, and remote populations, as well as northern and southern populations, are not anomalous to Yukon and have been reported across Canada[45–51]. A Pan-Canadian report found that cancer incidence rates for lung and colorectal cancers were higher for rural and remote Canadians compared to urban counterparts[52]. In the Northwest Territories, the proportions of common cancers were different between Yellowknife, Regional Centres and Small Communities[47]. Similar to Yukon, the proportion of lung cancer was larger and prostate cancer lower in smaller communities compared to Yellowknife[47]. In British Columbia (BC), lung cancer incidence rates were elevated among Northern residents compared to the rest of the province[48]. Further, rural breast cancer patients in BC were less likely to be screened than their urban counterparts[46]. Differences in the social determinants of health, prevalence of risk factors (e.g. smoking rates and alcohol consumption), and screening may play a role in varying incidence patterns by geography[1,44,45,53].

Cancer mortality-to-incidence rate ratios

Cancer incidence and mortality rates are important measures of the Yukon cancer burden. Information from both measures can be used to calculate the mortality-to-incidence rate ratio (MIR), a crude population-based indicator of survival. Low MIR values indicate better survival relative to higher MIR values[xvi]. Figure 10 and Tables 19 and 20 compare Yukon MIRs to the rest of Canada for all cancers combined and the most common cancers.

Figure 10. Mortality-to-Incidence Rate Ratios for Yukon compared with the Rest of Canada by All Cancers and Select Cancer Sites, 2009-2015. [xv xvi]



C There is variation in coding for death certificates and cancer incidence records. Cancer incidence records are likely to be more specific to cancer site which may give a false impression of an elevated rate ratio. Ratio values greater than 1 are flagged as "Unreliable".

For Canada, survival as indicated by the MIR statistic was lowest for lung, followed by colorectal, female breast and prostate cancers. Among Yukon females, MIRs were similar, albeit slightly lower, to Canadian MIRs and no differences were detected. Among Males, MIRs were elevated for all cancers combined and prostate cancer. The all-cancer MIR in Yukon was 1.4 times greater compared to Canada's. For prostate cancer, the MIR in Yukon was 2.4 times greater. These findings were statistically significant findings. That is, we are confident that survival among Yukon males, as measured by the MIR statistic, is poorer for all cancers combined and prostate cancer compared to Canadian males. The Yukon MIR for colorectal cancer was similar to the Rest of Canada. Yukon's lung cancer MIR was flagged as unreliable and a comparison with Canada cannot be determined.

xv Canadian incidence rates exclude Quebec and Yukon populations. Given limitations in availability of national data, Canadian mortality rates only exclude the Yukon population but include the Quebec population.

xvi There is variation in coding for death certificates and cancer incidence records. Cancer incidence records are likely to be more specific to cancer site which may give a false impression of an elevated rate ratio. Ratio values greater than 1 are flagged as "Unreliable". As such, no error bars were presented for male lung cancer.

What do these statistics mean?

Survival for female Yukoners was no different than Canadian females. For males, survival appears worse in Yukon compared to Canadian males. This was particularly true for all-cancers combined and prostate cancer. While stage was reported in this report, it was not reported by sex due to low numbers. However, poorer survival among males may indicate lower early detection compared to females in Yukon.

It is important to acknowledge that cancer survival is influenced by a number of factors, including access to timely and appropriate care, and early detection of cancer. While early detection was examined in this report, our findings could be further informed through an examination of cancer care service utilization in and out of the territory.

Yukon's prostate cancer MIR was elevated compared to Canadian estimates. While this indicates that survival for male prostate cancers is worse in Yukon compared to the rest of Canada, it is not clear if this is related to differences of risk of prostate cancer and treatment, or (1) an artifact of interprovincial variations in the use of PSA testing and therefore, prostate cancer incidence across Canada, and/or (2) under-capture of prostate cancer cases in the Yukon Cancer Registry.

PSA testing has been reported to be lower in Yukon relative to Canadian counterparts[37]. PSA testing is closely linked with prostate cancer incidence as it has been shown to lead to overdiagnosis [xvii,11,26]. Therefore, low PSA testing in Yukon may be related to low incidence rates versus national counterparts. With that in mind, lower prostate cancer incidence rates in Yukon may inflate the MIR statistic while higher incidence rates among Canadian counterparts may lower the MIR statistic. Therefore, it is not clear whether the elevated MIR statistic in Yukon versus Canada is a result of significant inter-provincial variations in PSA screening and prostate cancer incidence rates.

Further, it is possible that the Yukon MIR statistic is influenced by current processes to register cancers in the Yukon Cancer Registry. The MIR statistic is calculated with knowledge of the cancer mortality rate and the cancer incidence rate. The cancer mortality rate is calculated with information from the Yukon Vital Statistics Registry, which has complete capture of deaths and their related causes among Yukon residents. The cancer incidence rate is calculated with information from the Yukon Cancer Registry, which contains information on all cancers among Yukon residents. However, there are challenges to current Registry operations as the cases to be captured by the Registry occur in Yukon while the data collection takes place in British Columbia, in partnership with BC Cancer. Therefore, there is a chance that the elevated MIR statistics is a result of low capture of prostate cancer cases in Yukon. This possibility should be followed up with closer examination of referral, diagnostic and cancer registration processes.

While routine PSA screening for prostate cancer among average risk men is not recommended, public awareness of signs and symptoms, and access to primary care for suspicious symptoms, is important.

It is important to note that MIRs are a crude measure of survival. It is relatively simple to calculate but not as robust compared to other survival methods (e.g. relative and net survival). Future work should focus on survival estimates using more robust measures.

xvii Overdiagnosis occurs when cancer is detected correctly but would not cause symptoms or death, and can lead to unnecessary treatment of cancer that would not have caused harm.

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APPENDIX I: Methodology

Data sources

Incidence data

Cancer incidence data used in this report were derived from the Yukon Cancer Registry and cover the period of 2009 to 2016. The Yukon Cancer Registry is a person-oriented database that includes clinical and demographic information on Yukon residents diagnosed with new cases of cancer. The Yukon Cancer Registry is overseen by the Department of Health and Social Services, which contracts BC Cancer (an agency of the Provincial Health Services Authority) to build and maintain a separate territorial registry within its infrastructure. The registry was built in 1987 and stage of disease information began to be entered for all Yukon cancer cases diagnosed from 2010 and onwards.

The period of 2009 to 2016 was chosen to provide the most up to date data for the Yukon. Further, this period reflects the most reliable cancer incidence records in Yukon Cancer Registry as significant efforts have been made to find missing cases of cancer for this period and appropriately record them in the cancer registry. Missing cases were identified through multiple population-based data linkages involving the Yukon Cancer Registry, Yukon Vital Statistics Registry, and the Yukon Discharge Abstract Database. Medical charts of potential missed cancer cases were reviewed and, when appropriate, missing tumours were registered in the Yukon Cancer Registry. Of note, it is possible that incidence estimates published in this report differ from those reported through the Statistics Canada CANSIM database as Statistics Canada may not have updated their data tables to include the recently registered missed Yukon cases.

National age-specific counts of cancer (excluding Quebec) were obtained from Statistics Canada[54]. Data for Quebec were not available for the period of analysis. National incidence data covered the period 2009 to 2015 because 2015 is the most recent data year that is available through the Statistics Canada CANSIM database. National incidence data in this report excluded Quebec and Yukon incidence data and therefore, is often referred to as the "Rest of Canada".

Cancer definitions

Cancer incidence data used for this publication were defined according to International Statistical Classification of Diseases for Oncology, Third Edition (ICD-O-3)[55]. Only malignant cancer cases were included with the exception of bladder cancer, in which in situ carcinomas were included as well. Bladder in situ carcinomas are considered invasive for the purpose of incidence reporting in all provinces and territories[28].

Cancers were staged according to the seventh edition of the American Joint Committee on Cancer (AJCC) Staging Manual[56]. This report focused on stage data for the four most commonly diagnosed invasive cancers (lung, colorectal, breast and prostate cancers). This is because stage data is routinely collected for these four cancers and therefore, we can draw comparisons with national estimates. Stage information for other cancers varies across Canada[28].

Population data

Population data used to calculate incidence rates were taken at mid-year (July 1) and obtained from Statistics Canada's CANSIM database[57]. In this report, national rates (also referred to as the "Rest of Canada") excluded the populations of Quebec and Yukon. All population estimates include non-permanent residents and are adjusted for net census undercoverage and Canadians returning from abroad. Quebec population counts were excluded because cancer incidence data was not available for Quebec for the period of analysis in this report. Yukon population counts were excluded from Canadian estimates to draw meaningful comparisons between Yukon and the "Rest of Canada". Yukon regional population data were provided by the Yukon Bureau of Statistics.

Analysis

Age-standardized incidence rates (ASIRs)

Records of cancer from the Yukon were extracted from the Yukon Cancer Registry and classified by year of diagnosis, cancer type, sex, and ten-year age groupings (0-10 years, 10-20 years, ... 90+ years). Ten-year age groups were chosen over the standard five-year age group classifications to limit the number of zero's in age strata and increase stability in rate estimates. Since the annual number of cancer cases is relatively small in statistical terms, multi-year periods were used to produce more stable rates and allow for meaningful statistical analysis.

The direct method was used to calculate ASIRs relative to the age structure of the 2011 Canadian population and are calculated per 100,000 persons[23]. This involves weighting the age-specific rates for each ten-year group according to the age distribution of the 2011 Canadian population. Age-standardized rates computed for the ten-year age categories used in this reports used adjusted weights of the 2011 Canadian population.

Standard errors used to compute 95% confidence intervals for ASIRs were derived using the Poisson approximation[23]. Rates were plotted and smoothed using the 'ggplot2' R package and specifically, the loess method of the geom_smooth function[58]. Rate smoothing was done to assess the general trends while removing some of the uncertainty resulting from Yukon's small population from the trend plots.

Age-Standardized Incidence Ratios (SIRs)

The indirect method was used to calculate standardized mortality ratios (SIRs) with confidence intervals. Standard errors used to compute 95% confidence intervals for SIRs were derived using the Poisson approximation[23]. Yukon data was age-standardized to ten age-groups as described before. The CANSIM database was accessed to obtain Canadian age-specific counts of cancer for the cancers included in this report and all cancers combined (excluding Quebec) that were necessary to calculate SIRs[54]. Yukon age-specific counts, derived from the Yukon Cancer Registry, were subtracted from Canadian age-specific counts so that Canadian comparator data is considered the "Rest of Canada" (i.e. Yukon was excluded from the comparator).

Stage distribution and Stage-specific ASIRs

Records of cancer were extracted from the Yukon Cancer Registry and then classified by year of diagnosis, cancer type and stage group determined by the seventh edition of the AJCC Cancer Staging Manual. In this report, Stage I-IV and stage unknown were examined. Unstageable cancers were considered as "stage unknown". Stage unknown is assigned to records where information is insufficient to determine a stage. This might happen when an individual did not undergo all diagnostic workups required to determine stage or the diagnostic records were not available.

For stage-specific ASIRs, only individuals aged 18 to 79 years were included to match methods published in the Canadian Cancer Statistics report[28]. This age range under analysis was chosen because the percentage of unknown stage cases are generally higher in older age groups indicating differences in diagnostic workups for older and younger individuals[28]. For stage-specific ASIRs, the calculation included both sexes except for sex-specific cancers (female breast and prostate cancers). Stage-specific ASIRs were calculated for a five-year period of analysis (2011-2015) using the direct method. To calculate rates and 95% confidence intervals, the age.adjust function was used from the 'epitools' R package[59]. This method calculates exact confidence intervals based on the gamma distribution and the intervals are considered conservative estimates relative to intervals derived from other methods[60].

The following age groupings were used: 18-59 years, 60-69 years, 70-79 years. Again, this was done to match methodologies used to calculate national estimates. The Canadian 2011 standard population were recalculated to correspond to the stage-specific age groupings as presented in the Canadian Cancer Statistics 2018 report[28].

Mortality data

Cancer mortality data used in this report were derived from the Yukon Vital Statistics Registry and cover the period of 2009 to 2015. The Yukon Vital Statistics Registry is a person-oriented database that includes cause of death and demographic information on deceased Yukon residents. The Yukon Vital Statistics Registry is overseen by the Department of Health and Social Services, Government of Yukon. For Yukon cancer deaths, cancer deaths were considered as deaths in which cancer was the primary or secondary cause of death.

Canadian age-specific counts of cancer death were obtained from Statistics Canada[61]. Cancer deaths were considered as deaths in which cancer was the underlying cause of death. Data for Quebec were included in Canadian age-specific counts of cancer death as counts were national and not available by province/territory. Yukon counts of cancer death were subtracted from national counts of cancer death to calculate mortality-to-incidence ratios (MIRs). National incidence data was described above and covered the period 2009 to 2015.

Of note, data to calculate national incidence rates and national mortality rates differ based on the population definitions. For national incidence rates, Quebec and Yukon counts were excluded from incidence and population counts. For national mortality rates, only Yukon was excluded from mortality and population counts. This is because mortality data were only available for Canada as a whole, and not by province/territory.

Age-standardized mortality rates (ASMRs)

Records of cancer mortality from the Yukon were extracted from the Yukon Vital Statistics Registry and classified by cancer type that caused death, sex, and ten-year age groupings (0-10 years, 10-20 years, … 90+ years). Cancer deaths included deaths in which cancer was described as any cause of death. The direct method was used to calculate ASMRs relative to the age structure of the 2011 Canadian population and are calculated per 100,000 persons[23]. Age-standardized rates computed for the ten-year age categories used in this report used adjusted weights of the 2011 Canadian population.

Mortality-to-Incidence Rate Ratios (MIRs)

ASMRs and ASIRs were used to calculate the mortality-to-incidence rate ratio (a type of a standardized rate ratio) for Yukon from 2009-2015 and the rest of Canada for comparison. ASMRs were derived from the Yukon Vital Statistics Registry. ASIRs were derived from the Yukon Cancer Registry. To calculate the MIR, the ASMR was divided by the ASIR. Standard errors used to compute 95% confidence intervals for ASIRs and ASMRs were derived using the Poisson approximation[23]. An approximation of the exact 95% confidence interval were obtained by Smith's method[23].

It is interpreted as follows:

- An MIR less than 1 indicates that fewer people died from a particular cancer than were diagnosed with that cancer in a given period of time.
- An MIR of 1 indicates that the same number of people died from a particular cancer as were newly diagnosed with that cancer in a given period of time.
- An MIR greater than 1 indicates that more people died from a particular cancer than were diagnosed in a given period of time. MIRs greater than 1 are flagged as 'unreliable' because cause of death coding (i.e. determining the cancer type that caused death) varies significantly from coding the cancer at diagnosis. That is, coding for mortality rates is derived from death certificates and coding for incidence is derived from the cancer registry. The cancer registry is likely to be more specific to the cancer site[22].

Limitations

Due to the small Yukon population size, drawing comparisons against other jurisdictions is challenging. Small numbers reduced statistical power to detect statistically significant differences. In particular, high year-to-year variation creates unstable rates and wide confidence intervals. To limit this instability, multiple years were aggregated, rates were smoothed when plotted, and age-standardization age strata were collapsed to ten-year age groups. In some cases, when cases were low, the entire period of analysis was aggregated. It is important to note that aggregating data over several years may not be truly reflective of the annual rates.

After aggregating Yukon data multi-year periods, we reported common cancer types and select cancers of interest. This included the most common cancers, such as breast, prostate, lung, and colorectal cancers, as well less common cancers, such as bladder, endometrial, melanoma, Non-Hodgkin's lymphoma, cervical, stomach, and leukemia. Age standardized incidence rates, where many of the age strata have values of zero, can cause an underestimation in the true variance. To eliminate the risk of falsely suggesting a significant difference when in fact there truly is no statistically significant difference, age-standardized incidence rates (ASIRs) were limited to the most common cancer types and age strata were collapsed to ten-year age groups. For less common cancers, standardized incidence ratios (SIRs) were used relative to Canadian age-specific cancer incidence rates.

APPENDIX II: Data Tables

Data tables – All Cancer Incidence

Table 1. Number of New Cancer Cases by Sex and Year, 2009-2016.

Year	Males	Females	Total
2009	73	72	145
2010	74	78	152
2011	89	63	152
2012	78	68	146
2013	74	70	144
2014	82	53	135
2015	90	85	175
2016	88	88	176
Total	648	577	1225

Table 2. Number of New Cancer Cases by Sex and Four-Year Aggregates, 2009-2016.

Period	Males	Females	Total
2009-2012	314	281	595
2013-2016	334	296	630
Total	648	577	1225

Table 3. Yukon Three-Year All-Cancer Age Standardized Incidence Rates by Sex, 2009-2016.

Year	Males			Females		
	ASIR	95% CI	Observed	ASIR	95% CI	Observed
2009 – 2011	547.6	492.8-656.3	236	530.6	454.7-606.5	213
2010 – 2012	543.2	468.9-617.5	241	504.4	431.4-577.4	209
2011 – 2013	521.0	449.3-592.8	241	460.0	392.4-527.6	201
2012 – 2014	491.8	422.8-560.7	234	417.7	355.2-480.3	191
2013 – 2015	508.4	438.0-578.8	246	442.1	379.0-505.2	208
2014 – 2016	525.9	454.8-596.9	260	451.5	390.1-512.8	226

ASIR = Age standardized incidence rate per 100,000 persons; CI = Confidence intervals

Table 4. Yukon All-Cancer Standardized Incidence Ratios by Sex Relative to Canadian All-Cancer Incidence Rates, 2009-2015.

Period	Sex	Observed	Expected	SIR	95% CI
2009-2015	Males	560	596	94.0	86.2-101.8
	Females	489	506	96.6	88.1-105.2
	Total	1049	1090	96.2	90.4-102.0

SIR = Standardized incidence ratio, CI = Confidence intervals

Data tables – Most common cancers in Yukon

Table 5.1. Number and Proportion of All Male Cancer Diagnoses by Cancer Type, 2009-2015, Yukon and Canada.

Males					
Yukon (n=560)			Canada (n=498,770)		
Cancer	Cases	Percent	Cancer	Cases	Percent
Prostate	129	23%	Prostate	119,500	24%
Lung	81	14%	Lung	64,040	13%
Colorectal	77	14%	Colorectal	64,015	13%
Bladder	43	8%	Bladder	34,490	7%
NHL / Leukemia*	21	4%	NHL	23,680	5%
Other cancers	209	37%	Other Cancers	193,045	39%

* Non-Hodgkin's Lymphoma (NHL) and Leukemia individually ranked the same as they had an equal number of cases.

Table 5.2. Number and Proportion of All Female Cancer Diagnoses by Cancer Type, 2009-2015, Yukon and Canada.

Females					
Yukon (n=489)			Canada (n=471,270)		
Cancer	Cases	Percent	Cancer	Cases	Percent
Breast	170	35%	Breast	123,985	26%
Lung	64	13%	Lung	60,235	13%
Colorectal	57	12%	Colorectal	52,255	11%
Endometrial	25	5%	Endometrial	30,395	6%
Melanoma	17	3%	Thyroid	23,690	5%
Other Cancers	156	32%	Other Cancers	180,710	38%

Data tables – Trends by cancer type and stage at detection

Table 6.1. Lung Cancer Stage at Diagnosis in Yukon and Canada, Ages 18 to 79 years, 2011-2015.

Stage	Yukon (N=84) (%)	Canada (%)	Stage Aggregated [a]	Yukon [a] (%)	Canada (%)
Stage I	11.9	20.7	Early	23.5	29.1
Stage II [supp]	-	8.4			
Stage III	27.4	19.7	Late	70.6	69.3
Stage IV	45.2	49.6			
Unknown [supp]	-	1.6	Unknown	5.9	1.6
Total	100.0	100.0	Total	100.0	100.0

[a] Counts were randomly rounded to the nearest 0/5/10 because of small numbers. Therefore, note that these are not true proportions or counts as they have been rounded to the nearest 0/5/10.

[supp] Categories suppressed due to small numbers in at least one category.

Canadian data from *Canadian Cancer Statistics 2018 Report* [28].

Table 6.2. Colorectal Cancer Stage at Diagnosis in Yukon and Canada, Ages 18 to 79 years, 2011-2015.

Stage	Yukon (N=80) (%)	Canada (%)	Stage Aggregated	Yukon (N=80) (%)	Canada (%)
Stage I	20.0	23.5	Early	46.2	47.1
Stage II	26.2	23.6			
Stage III	25.0	29.1	Late	42.5	49.0
Stage IV	17.5	19.9			
Unknown	11.2	3.8	Unknown	11.2	3.8
Total	100.0	100.0	Total	100.0	100.0

Canadian data from *Canadian Cancer Statistics 2018 Report* [28].

Table 6.3. Female Breast Cancer Stage at Diagnosis in Yukon and Canada, Ages 18 to 79 years, 2011-2015.

Stage	Yukon (N=110) (%)	Canada (%)	Stage Aggregated [a]	Yukon [a] (%)	Canada (%)
Stage I	35.5	46.6	Early	72.7	81.7
Stage II	-	35.1			
Stage III	18.2	12.4	Late	22.7	17.3
Stage IV	5.5	4.9			
Unknown	-	0.9	Unknown	4.5	0.9
Total	100.0	100.0	Total	100.0	100.0

[a] Counts were randomly rounded to the nearest 0/5/10 because of small numbers. Therefore, note that these are not true proportions or counts as they have been rounded to the nearest 0/5/10.

Canadian data from *Canadian Cancer Statistics 2018 Report* [28].

Table 6.4. Prostate Cancer Stage at Diagnosis in Yukon and Canada, Ages 18 to 79 years, 2011-2015.

Stage	Yukon (N=87) (%)	Canada (%)	Stage Aggregated [a]	Yukon (N=87) (%)	Canada (%)
Stage I	11.5	22.5	Early	50.6	74.4
Stage II	39.1	51.9			
Stage III	18.4	13.8	Late	37.9	22.4
Stage IV	19.5	8.6			
Unknown	11.5	3.2	Unknown	11.5	3.2
Total	100.0	100.0	Total	100.0	100.0

[a] Rounded to the nearest 0/5/10.

Canadian data from *Canadian Cancer Statistics 2018 Report* [28].

Table 7. Yukon and Canadian Stage-Specific Age Standardized Incidence Rates for Common Cancers, Ages 18 to 79 Years, 2011-2015.

Cancer	Stage	Yukon		Canada
		ASIR per 100,000	95% CI	ASIR
Female Breast (N=110)	Stage I	61.2	43.1-85.3	73.0
	Stage II	63.4	45.1-87.6	55.5
	Stage III	28.9	17.6-46.3	19.7
	Stage IV [C]	9.4	3.3-22.3	7.7
	Unknown [supp]	-	-	1.4
Colorectal (N=80)	Stage I	12.2	6.9-20.5	14.2
	Stage II	16.8	10.3-26.3	14.2
	Stage III	16.5	10.0-26.2	17.6
	Stage IV [C]	10.4	5.6-18.1	12.0
	Unknown [C]	6.6	3.0-13.2	2.3
Lung (N=84)	Stage I [C]	8.5	4.0-16.2	13.7
	Stage II [C]	9.7	4.6-18.2	5.6
	Stage III	19.5	12.2-29.8	13.0
	Stage IV	31.4	22.0-43.8	32.8
	Unknown [supp]	-	-	1.0
Prostate (N=87)	Stage I [C]	13.9	6.6-26.9	30.7
	Stage II *	50.0	34.4-71.1	71.1
	Stage III	21.9	12.4-36.7	18.7
	Stage IV *	26.8	15.4-44.0	11.8
	Unknown [C]	16.1	7.6-30.6	4.4

* 95% Confidence intervals (CI) do not overlap and ASIRs are considered statistically significantly different.

[C] Caution is warranted because the proportion was calculated with less than 16 counts.

[supp] Data were suppressed due to small numbers (less than 5 cases).

ASIR = Age-standardized incidence rate per 100,000 persons; CI = Confidence intervals

Table 8. Yukon and Canadian Age-Standardized Incidence Rates and 95% Confidence Intervals by Sex, Cancer Type and Population, Four-Year Aggregates for Selected Cancers, 2009-2016.

Cancer	Period	Males		Females	
		Yukon	Canada	Yukon	Canada
Breast	2009-2012	-	-	155.2 (121.7-188.6)	129.3 (128.3-130.3)
	2010-2013	-	-	150.8 (118.1-183.6)	128 (127.1-129)
	2011-2014	-	-	151.8 (118.6-185)	128.2 (127.2-129.1)
	2012-2015	-	-	160.2 (127.2-193.2)	126.7 (125.7-127.6)
	2013-2016	-	-	159.8 (128.4-191.1)	-
Lung	2009-2012	95.0 (67.3-122.7)	79 (78.2-79.9)	82.3 (55.1-109.4)	61.1 (60.4-61.7)
	2010-2013	85.5 (58.8-112.2)	77.9 (77.1-78.7)	67.8 (44-91.7)	61.5 (60.8-62.1)
	2011-2014	72.0 (48.5-95.4)	75.7 (75-76.5)	59.7 (37.7-81.6)	61.4 (60.7-62)
	2012-2015	78.7 (54.1-103.3)	72.8 (72-73.5)	56.7 (35.5-77.9)	60.3 (59.7-60.9)
	2013-2016	73.2 (48.3-98.1)	-	62 (41.1-82.8)	-
Prostate	2009-2012	125.5 (93.4-157.5)	153.9 (152.8-155)	-	-
	2010-2013	128.1 (96.1-160.1)	144.4 (143.4-145.5)	-	-
	2011-2014	111.8 (83.9-139.8)	134.1 (133.1-135.1)	-	-
	2012-2015	108.8 (81.9-135.7)	122.5 (121.5-123.5)	-	-
	2013-2016	109.9 (82.7-137.1)	-	-	-
Colorectal	2009-2012	66.1 (41.9-90.3)	76.9 (76.1-77.7)	72.4 (47.2-97.5)	53.4 (52.8-54)
	2010-2013	63.9 (42.0-85.8)	76.1 (75.4-76.9)	64 (41.5-86.6)	52.4 (51.8-53)
	2011-2014	73.7 (49.8-97.6)	74.9 (74.2-75.7)	54.7 (33.9-75.6)	52.1 (51.6-52.7)
	2012-2015	71.7 (48.6-94.8)	73.2 (72.4-73.9)	56.9 (36.3-77.5)	50.8 (50.2-51.4)
	2013-2016	81.4 (57.5-105.3)	-	47.3 (29.1-65.5)	-

Table 9.1. Yukon Standardized Incidence Ratios Relative to Canadian Cancer Incidence Rates by Sex and Cancer Type (Common Cancers), 2009-2015.

Cancer	Sex	Observed	Expected	SIR	95% CI
Lung	Males	81	72	112.6	88.1-137.1
	Females	64	58	110.3	83.3-137.4
	Total	145	129	112.5	94.2-130.8
Colorectal	Males	72	75	96.0	73.8-118.2
	Females	57	50	114.4	84.7-144.1
	Total	129	123	104.9	86.8-123
Breast	Females	170	144	118.3	100.5-136.1
Prostate	Males	129	148	87.2	72.1-102.2

SIR = Standardized incidence ratio, CI = Confidence intervals

Table 9.2. Yukon Standardized Incidence Ratios Relative to Canadian Cancer Incidence Rates by Sex and Cancer Type (Other Cancers), 2009-2015.

Cancer	Sex	Observed	Expected	SIR	95% CI
Endometrium	Females	25	36	69.9	42.5-97.4
Melanoma	Males	15	24	61.1	30.2-92
	Females	19	20	95.8	52.8-139.1
	Total	34	44	77.6	51.5-103.7
Bladder	Males	43	37	115.1	80.7-149.5
	Females	15	10	149.5	73.8-225.1
	Total	58	45	128.4	95.4-161.4
Cervix	Females	10	10	97.7	37.2-158.3
NHL	Males	19	29	66.3	36.5-96
	Females	-	-	-	-
Stomach	Total	16	18	88.1	44.9-131.3
Leukemia	Males	17	21	82.5	43.3-121.8
	Females	10	12	82.4	31.3-133.5
	Total	27	32	84.0	52.3-115.7

SIR = Standardized incidence ratio, CI = Confidence intervals

Table 10.1. Number of New Yukon Lung Cancer Cases by Year and Sex, 2009-2016.

Year	2009	2010	2011	2012	2013	2014	2015	2016	Total
Females	15	11	8	5	12	6	7	12	76
Males	13	10	12	17	7	6	16	11	92
Total	28	21	20	22	19	12	23	23	168

Table 10.2. Number of New Yukon Colorectal Cancer Cases by Year and Sex, 2009-2016.

Year	2009	2010	2011	2012	2013	2014	2015	2016	Total
Females	7	11	6	12	7	5	9	8	65
Males	7	10	10	8	10	16	11	16	88
Total	14	21	16	20	17	21	20	24	153

Table 10.3. Number of New Yukon Female Breast Cancer Cases by Year, 2009-2016.

Year	2009	2010	2011	2012	2013	2014	2015	2016	Total
Females	20	25	24	24	25	18	34	31	201

Table 10.4. Number of New Yukon Prostate Cancer Cases by Year, 2009-2016.

Year	2009	2010	2011	2012	2013	2014	2015	2016	Total
Males	18	20	17	14	22	19	19	15	144

Data tables – All-cancer incidence by sex and age groups

Table 11. Number and Percent Distribution of Cancer Incidence Among Males and Females for Select Cancer Types, 2009-2016.

Cancer	Sex	Count	Percent
All Cancer	Males	648	52.9%
	Females	577	47.1%
Lung	Males	92	54.8%
	Females	76	45.2%
Colorectal	Males	88	57.5%
	Females	65	42.5%

Table 12. Number and Percent Distribution of Cancer Incidence by Age Group and Sex, 2009-2015.

Sex	Characteristic	0-49 Years	50-59 Years	60-69 Years	70+ Years
Males (n=560)	Count	70	120	204	166
	Percent	12.5	21.4	36.4	29.6
Females (n=489)	Count	71	144	135	139
	Percent	14.5	29.4	27.6	28.4
Total (n=1049)	Count	141	264	339	305
	Percent	13.4	25.2	32.3	29.1

Table 13. Yukon Standardized Incidence Ratio for All Cancers Combined Relative to Canadian Cancer Incidence Rates by Age, 2009-2015.

Sex	Age Group	Observed	Expected	SIR	95% CI
Males	0 to 49 Years	70	63	111.7	85.5-137.8
	50 to 59 Years	120	137	87.6	71.9-103.3
	60 to 69 Years	204	211	96.7	83.4-109.9
	70+ Years	166	182	91.2	77.4-105.1
Females	0 to 49 Years	71	110	64.3	49.4-79.3
	50 to 59 Years	144	134	107.8	90.2-125.4
	60 to 69 Years	135	139	97.2	80.8-113.6
	70+ Years	139	121	114.8	95.7-133.9
Both Sexes	0 to 49 Years	141	172	82.0	68.5-95.5
	50 to 59 Years	264	271	97.4	85.7-109.2
	60 to 69 Years	339	345	98.2	87.7-108.6
	70+ Years	305	297	102.8	91.3-114.4

SIR = Standardized incidence ratio; CI = Confidence interval

Data tables – Cancer incidence by age for screening cancers

Table 14.1. Number and Proportion of Female Breast Cancer Cases by Age, 2009-2015.

Age (Years)	Count	Proportion (%)
20-39	7	4.1%
40-49	25	14.7%
50-74	116	68.2%
75+	22	12.9%
Total	170	100.0%

Table 14.2. Number and Proportion of Colorectal Cancer Cases by Age, 2009-2015.

Age (Years)	Count	Proportion (%)
18-49	14	10.9%
50-74	82	63.6%
75+	33	25.6%
Total	129	100.0%

Table 14.3. Number and Proportion of Lung Cancer Cases by Age and Sex, 2009-2015.

Age (Years)	Males		Females	
	Count	Proportion (%)	Count	Proportion (%)
40-54	7	8.6%	5	7.8%
55-74	55	67.9%	41	64.1%
75+	19	23.5%	18	28.1%
Total	81	100.0%	64	100.0%

Data Tables – Cancer incidence by Whitehorse and non-Whitehorse populations

Table 15. Number and Proportion of New Cases of Cancer by Yukon Regional Population, 2009-2016.

Year	Counts			Percent		
	Whitehorse	Rest of Yukon	Total	Whitehorse	Rest of Yukon	Total
2009-2012	411	179	590	69.7%	30.3%	100.0%
2013-2016	453	171	624	72.6%	27.4%	100.0%
Total	864	350	1214	71.2%	28.8%	100.0%

Table 16. Population Structure by Yukon Population, 2009-2016.

Age Group	Whitehorse		Non-Whitehorse	
	Count	Change since 2009	Count	Change since 2009
0-9 Years	24769	+17.0%	7041	+3.3%
10-19 Years	25400	-9.0%	6907	-19.2%
20-29 Years	33680	+11.0%	8857	+5.5%
30-39 Years	34426	+28.3%	9164	+16.0%
40-49 Years	34043	-6.8%	10082	-18.8%
50-59 Years	36875	+4.3%	12376	+10.9%
60-69 Years	22652	+45.1%	8185	+41.9%
70-79 Years	8120	+48.5%	3211	+49.1%
80-89 Years	2758	+48.2%	1086	+28.1%
90+ Years	437	+114.7%	143	-14.3%
Total	223160	+12.2%	67052	+6.4%

Table 17.1. Number and Proportion of All Male Cancer Diagnoses by Cancer Type, 2009-2016, Populations of Whitehorse and Non-Whitehorse Communities.

Males					
Whitehorse (n=446)			Non-Whitehorse (n=199)		
Cancer	Cases	Percent	Cancer	Cases	Percent
Prostate	107	24%	Prostate	37	19%
Lung	61	14%	Lung	34	17%
Colorectal	61	14%	Colorectal	32	16%
All other cancers	217	49%	All other cancers	96	48%

Table 17.2. Number and Proportion of All Female Cancer Diagnoses by Cancer Type, 2009-2016, Population of Whitehorse and Non-Whitehorse Communities.

Females					
Whitehorse (n=418)			Non-Whitehorse (n=151)		
Cancer	Cases	Percent	Cancer	Cases	Percent
Breast	142	34%	Breast	54	36%
Lung	51	12%	Lung	25	17%
Colorectal	50	12%	Colorectal	14	9%
All other cancers	175	42%	All other cancers	58	38%

Table 18. All Cancer Age-Standardized Incidence Rates by Yukon Population, 2009-2016, and Standardized Rate Ratio.

Year	Non-Whitehorse		Whitehorse		SRR	95% CI
	ASIR (95% CIs)	Counts	ASIR (95% CIs)	Counts		
2009 – 2016	544.3 (484.0-604.6)	350	488.6 (453.2-523.9)	864	1.11	0.97-1.28

ASIR = Age-standardized incidence rate per 100,000 persons;
CI = Confidence interval; SRR = Standardized rate ratio

Data tables - Yukon cancer mortality-to-incidence ratios

Table 19. Mortality-to-Incidence Rate Ratios for Yukon Compared with the Rest of Canada by All Cancers and Select Cancer Sites, 2009-2015.

Sex	Cancer	Yukon MIR	95% CIs	Canada MIR	95% CIs	Yukon-Canada Ratio [a]	95% CIs
Both Sexes	All Cancer	0.49	0.44-0.55	0.46	0.46-0.46	1.07	0.96-1.20
	Lung [xviii]	1.03	0.8-1.32	0.93	0.92-0.94	1.11	0.87-1.40
	Colorectal	0.39	0.27-0.55	0.43	0.43-0.44	0.91	0.63-1.25
Females	All Cancer	0.43	0.36-0.51	0.48	0.48-0.48	0.90	0.75-1.06
	Lung	0.95	0.66-1.38	0.95	0.94-0.96	1.00	0.70-1.44
	Colorectal	0.36	0.21-0.61	0.50	0.49-0.51	0.72	0.43-1.20
	Breast	0.23	0.16-0.32	0.26	0.26-0.26	0.88	0.62-1.23
Males	All Cancer*	0.58	0.49-0.69	0.43	0.43-0.44	1.35	1.14-1.57
	Lung [xviii]	1.13	0.8-1.62	0.89	0.88-0.9	1.27	0.91-1.80
	Colorectal	0.44	0.27-0.7	0.38	0.37-0.38	1.16	0.73-1.84
	Prostate*	0.48	0.33-0.71	0.20	0.2-0.2	2.40	1.65-3.55

[a] The Yukon-Canada Ratio describes the magnitude of difference between the Yukon and Canadian MIR. It is calculated by dividing the Yukon mortality-to-incidence ratio (MIR) and 95% confidence intervals with the Canada MIR and the 95% confidence intervals. A value of one indicates no differences in MIRs. Values higher than one indicates the Yukon MIR was elevated and a value lower than one indicates the Yukon MIR was lower compared with the rest of Canada.
* 95% Confidence intervals do not overlap and Yukon-Canada Ratio are considered statistically significantly different.
MIR = Mortality to incidence Ratio; CI = Confidence intervals

Table 20.1. Counts, Age-Standardized Rates for Incidence and Mortality, and Mortality-to-Incidence Rate Ratios for Yukon compared with the Rest of Canada, Both Sexes, 2009-2015.

Region	Cancer Type	ASMR	Mortality Count	ASIR	Incidence Count	MIR	95% CI
Yukon	All Cancer	249.0	408	504.8	1049	0.49	0.44-0.55
	Lung[xviii]	79.8	128	77.7	145	1.03	0.8-1.32
	Colorectal	25.5	41	65.9	129	0.39	0.27-0.55
Canada [xix]	All Cancer	241.4	518921	521.2	968961	0.46	0.46-0.46
	Lung	62.1	137318	66.7	124060	0.93	0.92-0.94
	Colorectal	27.0	56652	62.4	116136	0.43	0.43-0.44

ASMR = Age-standardized mortality rate per 100,000 persons; ASIR = Age-standardized incidence rate per 100,000; MIR = Mortality to incidence ratio; CI = Confidence Interval

xviii There is variation in coding for death certificates and cancer incidence records. Cancer incidence records are likely to be more specific to cancer site which may give a false impression of an elevated rate ratio. Ratio values greater than 1 are flagged as “Unreliable”.

xix Canadian incidence rates exclude Quebec and Yukon populations. Given limitations in availability of national data, Canadian mortality rates only exclude the Yukon population but include the Quebec population

Table 20.2 Counts, Age-Standardized Rates for Incidence and Mortality, and Mortality-to-Incidence Rate Ratios for Yukon compared with the Rest of Canada, Females, 2009-2015.

Region	Cancer Type	ASMR	Mortality Count	ASIR	Incidence Count	MIR	95% CI
Yukon	All Cancer	205.9	177	478.8	489	0.43	0.36-0.51
	Lung	67.3	55	70.9	64	0.95	0.66-1.38
	Colorectal	22.1	19	60.7	57	0.36	0.21-0.61
	Breast	35.9	31	157.4	170	0.23	0.16-0.32
Canada [xx]	All Cancer	231.7	246421	479.2	470761	0.48	0.48-0.48
	Lung	57.2	63033	60.4	60106	0.95	0.94-0.96
	Colorectal	25.7	26143	51.9	52208	0.50	0.49-0.51
	Breast	32.8	35106	128.1	123810	0.26	0.26-0.26

ASMR = Age-standardized mortality rate per 100,000 persons; ASIR = Age-standardized incidence rate per 100,000; MIR = Mortality to incidence ratio; CI = Confidence Interval

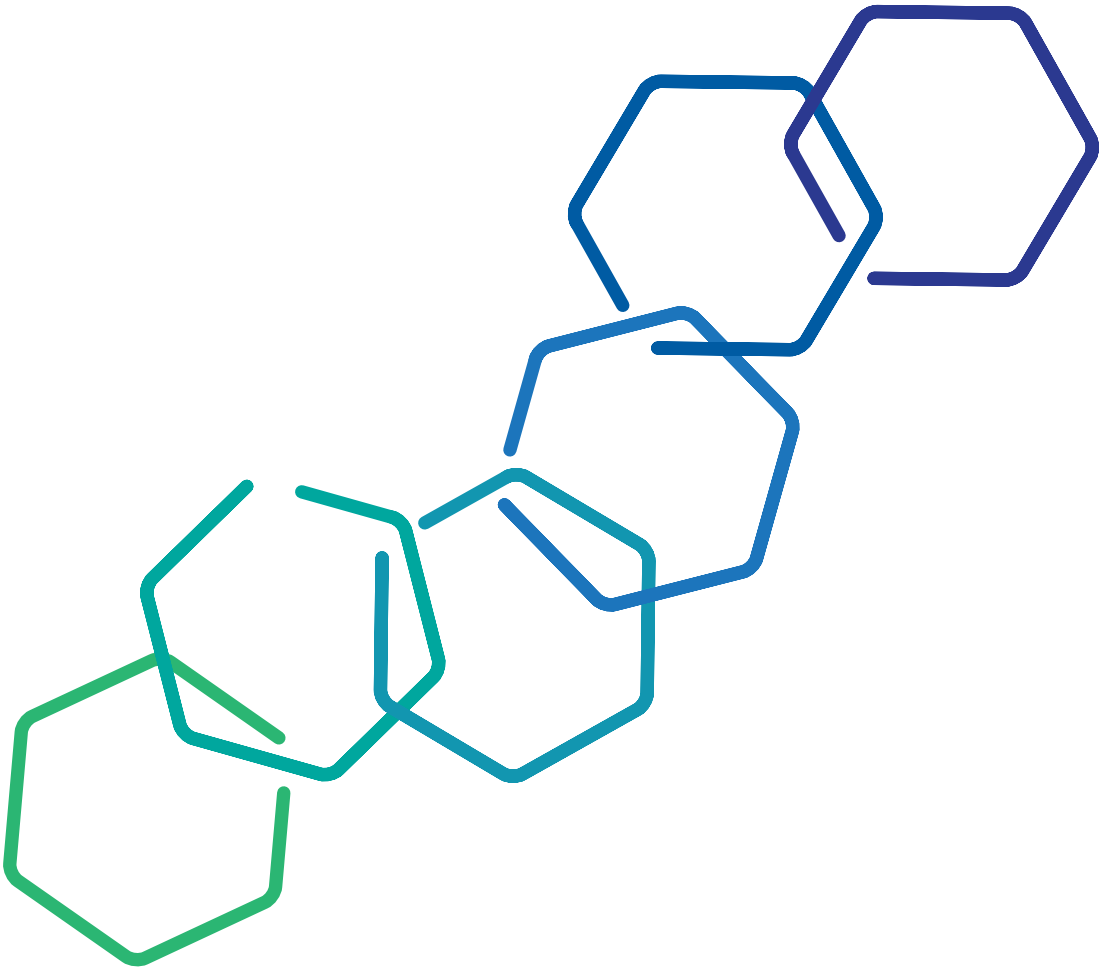
Table 20.3 Counts, Age-Standardized Rates for Incidence and Mortality, and Mortality-to-Incidence Rate Ratios for Yukon compared with the Rest of Canada, Males, 2009-2015.

Region	Cancer Type	ASMR	Mortality Count	ASIR	Incidence Count	MIR	95% CI
Yukon	All Cancer	307.9	231	529.8	560	0.58	0.49-0.69
	Lung [xxi]	94.9	73	83.7	81	1.13	0.8-1.62
	Colorectal	30.6	22	70.3	72	0.44	0.27-0.7
	Prostate	58.2	33	120.2	129	0.48	0.33-0.71
Canada [xx]	All Cancer	251.1	272500	579.0	498200	0.43	0.43-0.44
	Lung	67.0	74285	75.3	63954	0.89	0.88-0.9
	Colorectal	28.2	30509	74.8	63928	0.38	0.37-0.38
	Prostate	27.3	27067	137.1	119361	0.2	0.2-0.2

ASMR = Age-standardized mortality rate per 100,000 persons; ASIR = Age-standardized incidence rate per 100,000; MIR = Mortality to incidence ratio; CI = Confidence Interval

xx Canadian incidence rates exclude Quebec and Yukon populations. Given limitations in availability of national data, Canadian mortality rates only exclude the Yukon population but include the Quebec population.

xxi There is variation in coding for death certificates and cancer incidence records. Cancer incidence records are likely to be more specific to cancer site which may give a false impression of an elevated rate ratio. Ratio values greater than 1 are flagged as "Unreliable".



Yukon

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