The 2017 Cancer System Performance Report

June 2017

Technical Appendix

Cancer incidence

Definition:	Age-standardized incidence rates per 100,000 population diagnosed for the specified cancer sites
Rationale for measurement:	Data and metrics regarding age-standardized incidence rates and trends are needed to provide an accurate measure of the burden of disease across Canada.
Measurement timeframe:	Years 1992 to 2013
Denominator:	Canadian population estimates by year, sex and age group
Numerator:	Number of new invasive cases for the specified cancers diagnosed in the measure timeframe
Exclusion criteria:	1) Territories were excluded 2) For breast cancer, males were excluded
Data availability:	All provinces and territories, except QC from 2011 to 2013.
Stratification:	1) Cancer site: prostate, lung, breast (female), colorectal
Data source:	Statistics Canada, Canadian Cancer Registry (CANSIM table 103-0554)
Data retrieval date:	September 2016
Variables details:	The cancer sites/types were defined in ICD-O3 with behavior code 3 (invasive): • Prostate: C61.9 • Lung: C34 • Breast: C50 • Colorectal: C18, C19.9, C20.9, C26.0 Cancer cases with histology types 9590-9992 (leukemia, lymphoma and multiple myeloma), 9050-9055 (mesothelioma) and 9140 (Kaposi sarcoma) are excluded.
Notes from Jurisdictions:	Not applicable
Methodology notes:	1) Data presented were provinces combined for ages 0+. 2) The cancer incidence sites/types were classified by World Health Organization, International Classification of Diseases for Oncology, Third Edition (ICD- O-3). The International Agency for Research on Cancer (IARC) rules were used for determining multiple primaries sites. 3) Since QC data in 2011 onward were not available, QC incidence cases and population data in 2010 were copied forward to 2013. 4) Incidence rates were age standardized to the Canadian 2011 population using direct method.
Changes to definition compared to previous years:	Not applicable

Cancer deaths

Definition:	Age-standardized mortality rates per 100,000 population died from the specified cancer sites
Rationale for measurement:	Data and metrics regarding age-standardized mortality rates are needed to provide an accurate measure of the burden of disease across Canada.
Measurement timeframe:	Years 1992 to 2012
Denominator:	Canadian population estimates by year, sex and age group
Numerator:	Number of death in the measure timeframe from the specified cancers
Exclusion criteria:	For breast cancer, males were excluded
Data availability:	All provinces and territories
Stratification:	1) Cancer site: prostate, lung, breast (female), colorectal
Data source:	Statistics Canada, Vital Statistics Death Database
Data retrieval date:	September 2016
Variables details:	1) Up to the year 1999, the cause of deaths from invasive cancer sites/types were defined in ICD-9: 1) Prostate: 185 2) Lung: 162 3) Breast (female): 174 4) Colorectal: 153-154 2) After the year 1999, the cause of deaths from invasive cancer sites/types were defined in ICD-10: • Prostate: C61.9 • Lung: C34 • Breast: C50 • Colorectal: C18, C19.9, C20.9, C26.0
Notes from Jurisdictions:	Not applicable
Methodology notes:	1) Data presented were provinces combined for ages 0+. 2) The cause of death from cancer sites/types were classified by World Health Organization, International Classification of Diseases (ICD). Up to the year 1999, the Ninth Edition (ICD-9) was used. After the year 1999, the Tenth Edition (ICD-10) was used. 3) Mortality rates were age standardized to the Canadian 2011 population using direct method.
Changes to definition compared to previous years:	Not applicable

Cancer incidence by stage at diagnosis

Definition:	Age-standardized incidence rates per 100,000 population by stage at diagnosis for the specified cancer sites
Rationale for measurement:	Availability of population-level cancer stage data at the provincial level allows for better interpretation of long-term outcome measures such as incidence, mortality and survival, and of treatment pattern indicators. Stage distribution is also used to assess the impact of screening programs on reducing late stage incidence of disease.
Measurement timeframe:	Years 2011 to 2013
Denominator:	Canadian population estimates by period, province, sex and age group
Numerator:	Number of new invasive cases for the specified cancers diagnosed in the measurement timeframe
Exclusion criteria:	1) For breast cancer, males were excluded 2) Incidence cases with age under 18 were excluded 3) Appendix (C18.1) was excluded from colorectal cancer
Data availability:	Except QC, NL and territories, all other provincial data were available
Stratification:	1) By province 2) Cancer site: prostate, lung, breast (female), colorectal 3) Cancer stage: stage I, II, III and IV
Data source:	Provincial cancer agencies and programs
Data retrieval date:	September 2015
Variables details:	The cancer sites were defined in ICD-O3 with behavior code 3 (invasive): • Prostate: C61.9 • Lung: C34.0 to C34.9 • Breast: C50.0 to C50.9 • Colorectal: C18.0, C18.2 to C18.9, C19.9, C20.9, C26.0 Cancer cases with histology types for lymphoma codes M-95 to M-98, sarcoma codes (see Appendix A) were excluded
Notes from Jurisdictions:	**AB**: Hematology, sarcoma and melanoma morphologies were removed from the site-specific cancers. All 2011-13 invasive primaries used collaborative staging and once coded there should be no cases with missing/not available stage values. AB used AB's 2012 population provided by Alberta Health Services (DIMR/Analytics) and the standardized 2011 Canadian population weights indicated on CPAC's data specification document. For this indicator, 8002, 8073 and 8803 are included as non-small cell lung cancer (NSCLC). **SK**: Saskatchewan covered population estimates were used as the denominator in all standardized rates.

	NS: Lung (NSCLC + small cell lung cancer) also contains cases that could not be classified as either.
Methodology notes:	1) Data presented include age 18+. 2) American Joint Committee on Cancer (AJCC) Cancer Staging Manual 7th edition was used to classify cancer stage groups. 3) Incidence rates were age standardized to the Canadian 2011 population using direct method.
Changes to definition compared to previous years:	Not applicable

Screening history in invasive cervical cancer cases

Definition:	Percentage of women with invasive cervical cancer diagnosed through screening, by time since previous Pap test.
Rationale for measurement:	Screening history in cases of invasive cervical cancer is a retrospective summary of screening prior to diagnosis. This indicator provides information on the proportion of women with invasive cervical cancer who were under-screened or never screened who could have benefited from appropriate screening
Measurement timeframe:	Years 2011 to 2013
Denominator:	Number of women diagnosed with invasive cervical cancers through screening during the specified timeframe
Numerator:	Number of women diagnosed with invasive cervical cancers through screening during the specified timeframe by history screening classification: • 0 to 0.5 years (0 days to 182 days) • 0.5 to 3 years (183 days to 1095 days) • >3 years to 5 years (1096 days to 1825 days) • > 5 years (1826 days plus) or never (no Pap test recorded)
Exclusion criteria:	Not available
Data availability:	BC, AB, SK, MB, NB, and NL.
Stratification:	1) Screening period: 0-<0.5, 0.5-<3, 3-<5 and over 5 years
Data source:	Provincial cancer agencies and programs
Data retrieval date:	February – April 2015
Variables details:	1) Cervical cancer was defined as C53 with behavior code 3 (invasive) in ICD-O3. 2) All cervical cancer cases included squamous cell carcinoma cases and non-squamous cell carcinoma cases. No other histology codes were specified. 3) For the list of squamous cell carcinoma, please refer to Appendix B.
Notes from Jurisdictions:	BC: Data included 2011 to 2012
Methodology notes:	1) BC includes data from 2011 and 2012. 2) Data presented include ages 21-69. 3) The cancer sites were classified by World Health Organization, International Classification of Diseases for Oncology, Third Edition (ICD- O-3).
Changes to definition compared to previous years:	Not applicable

Abnormal call in mammogram screening

Definition:	Percentage of mammograms that are identified as abnormal at program screen
Rationale for measurement:	Abnormal call rate is an important indicator of the quality of the mammography image and interpretation. A high abnormal call rate can increase the false positive rate and result in unnecessary (and potentially avoidable) tests. Programs should strive to balance the number of abnormal calls with the number of cancers detected. This can be monitored by comparing the number of abnormal screens per extra cancer detected. Programs with extremely low abnormal call rates should also be monitored as this may results in lower cancer detection and higher post-screen cancer rates.
Measurement timeframe:	Years 2003 to 2012
Denominator:	Number of mammogram screen during the timeframe
Numerator:	Number of mammogram identified as abnormal during the timeframe
Exclusion criteria:	1) Cases referred by clinical breast exam (CBE) alone were excluded 2) Males were excluded from the program screening
Data availability:	All provinces and northwest territories
Stratification:	1) By year 2) Screening sequence: first screens (women who had a screening mammogram for the first time), subsequent screening
Data source:	Canadian Breast Cancer Screening Database (CBCSD)
Data retrieval date:	February 2016
Variables details:	Not available
Notes from Jurisdictions:	**AB**: Excluded from data prior to 2007 as AB Breast Cancer Screening Program (ABCSP) launched in 2007 **QC**: Complete diagnostic/cancer information were available to September 30, 2012 **PE**: Data from 2007-08 were not available
Methodology notes:	1) Data presented included ages 50-69, provinces combined. 2) Analysis was conducted by Public Health Agency of Canada (PHAC).
Changes to definition compared to previous years:	Not applicable

Breast cancer detection in mammography screening

Definition:	Rate of invasive breast cancers in women detected per 1,000 screens
Rationale for measurement:	The cancer detection rate is to evaluate how successful the program is at finding invasive cancers. It is also meaning when considered in relation to the abnormal call rate.
Measurement timeframe:	Years 2008 to 2012
Denominator:	Number of mammography screens
Numerator:	Number of mammography screens detected with invasive breast cancers (stages I to IV)
Exclusion criteria:	1) Breast cancers detected by clinical breast exam alone were excluded 2) Cancers diagnosed more than 6 months following an abnormal screen were excluded 3) Once diagnosed with breast cancer, women are no longer eligible for screening in most programs and were excluded 4) In the case of bilateral breast cancers, only the highest stage tumor were counted in the numerator 5) Results for 2007-08 exclude PE, as data was unavailable
Data availability:	All provinces and northwest territories
Stratification:	1) By year 2) Screening sequence: subsequent screens
Data source:	Canadian Breast Cancer Screening Database (CBCSD)
Data retrieval date:	February 2016
Variables details:	1) Micro-invasion was included
Notes from Jurisdictions:	**AB**: Excluded from data prior to 2007 as AB Breast Cancer Screening Program (ABCSP) launched in 2007 **QC**: Complete diagnostic/cancer information were available to September 30, 2012 **PE**: Data from 2007-08 were not available
Methodology notes:	1) Data presented included ages 50-69, provinces combined. 2) Analysis was conducted by Public Health Agency of Canada (PHAC). 3) Women could be counted twice in the denominator when calculating over two year period.
Changes to definition compared to previous years:	Not applicable

Removal and examination of 12 or more lymph nodes in colon resections

Definition:	The percentage of colon resections with 12 or more lymph nodes removed and examined within 12 months of diagnosis
Rationale for measurement:	The removal and examination of 12 or more lymph nodes is important for proper staging and subsequent treatment planning and has been associated with improved survival. Most clinical guidelines recommend that a minimum of 12 lymph nodes be removed and examined by a pathologist to more definitively establish a cancer's nodal status.
Measurement timeframe:	Years 2009 to 2012
Denominator:	All invasive colon cancer cases resected within 12 months of diagnosis in the timeframe
Numerator:	Invasive colon cancer cases that were resected with 12 or more lymph nodes removed and examined within one year of diagnosis in the timeframe
Exclusion criteria:	Cases with unknown number of lymph nodes removed and examined were excluded
Data availability:	AB, SK, MB, ON, NB, NS, PE, NL
Stratification:	1) By year 2) By province
Data source:	Provincial cancer agencies and programs
Data retrieval date:	September 2015
Variables details:	Cancer definition: 1) Colon cancer was defined C18 in ICD-O3 with behavior code 3 (invasive) For the cancer, cases with lymphoma Codes M-95 to M-98, sarcoma codes (see Appendix A), neuroendocrine carcinoma, and squamous cell carcinoma were excluded. Resection identification: 2) Colon resections were identified using CCI codes: 1NM87 or 1NM89 or 1NM91 or list of descriptors (see Appendix A) 3) All resections were included regardless of margin status. Treatment criteria: 4) All colon resections were within 12 months of diagnosis. If there were multiple resections, counted the last resection: last resection date (if multiple) – diagnosis date ≤ 365 days
Notes from Jurisdictions:	**AB:** For 2009/2010/2011/2012/, treatment information is based on initially planned treatment to primary site (Alberta Cancer Registry (ACR) data). The Canadian Classification of Health Interventions (CCI) codes are not used by the ACR; as such, all coded surgeries were included for complete colon resection. If more than one surgical procedure is performed

	as a part of the initial treatment, the most definitive procedure is documented. The definition of definitive is the surgical procedure with the intent to cure. Through quality assurance, there were a number of the cases coded as surgery on the ACR but that had CCI codes or billing codes other than the ones listed. The majority of these cases appear to be cases in which the DAD had resection of the rectum even though the patient only had C18.7 sigmoid colon. For 2010/2011/2012, cases for C18.1 Appendix were excluded. However, there were also some cases in which the ACR codes surgery for polypectomy and hence these had also been included in 2011. There are also some cases in which the ACR codes surgery for colon but no records were found in the Inpatient database or billing data. This may be out of province resection in 2012. Data did not limit to complete resection (colectomy) in 2009. **ON:** Data were generated by the CSQI methodology. 2010 data were for colon cancer cases with 12 or more lymph nodes examined in 2010 rather than colon cancer cases that were diagnosed in 2010. Cases for Appendix C18.1 were excluded in 2011. **NS:** For 2011, collaborative stage variables were used to identify those having a resection. Resections dates manually reviewed from chart review. **PE:** For 2009, the CS Extension Evaluation code (=3) was used to meet AJCC pathological criteria for staging. For 2011, cases for Appendix C18.1 were excluded. **NL:** For 2009/2010, data did not limit to complete sections (colectomy).
Methodology notes:	1) Data presented include ages 18+. 2) The Canadian Classification of Health Interventions (CCI) codes were used to identify surgery types, except AB. 3) Subsite of cancer Appendix C18.1 was excluded in some provinces and in some years.
Changes to definition compared to previous years:	Not applicable

Pre-operative radiation therapy for patients with stage II or III rectal cancer

Definition:	The percentage of stage II or III rectal cancer cases receiving pre-operative radiation therapy up to 120 days before resections within one year of diagnosis
Rationale for measurement:	The delivery of radiation therapy (along with chemotherapy) prior to surgical resection for Stage II and III rectal cancer has been shown to improve local disease control compared with surgery alone or post-operative radiation therapy. Also, it has been associated with a reduction in treatment-related toxicity compared with post-operative radiation therapy. Clinical practice guidelines therefore recommend pre-operative radiation therapy (combined with chemotherapy) for patients with Stage II and III rectal cancer.
Measurement timeframe:	Years 2009 to 2012
Denominator:	Stage II and III rectal cancer cases diagnosed during the timeframe and receiving rectal resection within one year of diagnosis
Numerator:	Stage II and III rectal cancer cases diagnosed during the timeframe and receiving pre-operative radiation therapy up to 120 days before resection within one year of diagnosis
Exclusion criteria:	Cases with age under 18 were excluded
Data availability:	AB, MB, ON, NB, NS, PE, NL
Stratification:	1) By year 2) By province
Data source:	Provincial cancer agencies and programs
Data retrieval date:	September 2015
Variables details:	Cancer definition: 1) Rectal cancer was defined C19.9 and C20.9 in ICD-O3 with behavior code 3 (invasive) 2) Cancer cases with lymphoma Codes M-95 to M-98, sarcoma codes (see Appendix A) 3) Rectal cancer cases were restricted to stage II and stage III in American Joint Committee on Cancer (AJCC). Resection identification: 4) Rectal resections were identified in CCI codes as 1NQ87 or 1NQ89 (see list of descriptors in Appendix A) 5) Only resections with negative margin were included. Treatment criteria: 6) All rectal resections were within 1 year of diagnosis. If there were multiple resections, the first resection was counted: First resection date (if multiple) – diagnosis date ≤ 365 days For 2009, the last resection date were counted 7) All pre-operative radiation therapies were up to 120 days before resections: First resection date – Radiation therapy date ≤120 days
Notes from Jurisdictions:	**AB:** For 2009, resections were not necessarily limited to the specified types (complete rectum). For 2010/2011/2012, treatment information is

	based on initially planned treatment to primary site (ACR data). The CCI codes are not identified in the ACR, as such all coded surgeries were included for complete rectum resection. If more than one surgical procedure is performed, the ACR codes the most definitive procedures is documented. The definition of definitive is the surgical procedure with the intent to cure. There are some procedures could not identify the margins are negative. For 2011/2012, through quality assurance, there are a number of cases coded as surgery on the ACR had CCI codes or Billing codes other than the ones listed. The majority of these cases appear to be cases in which the DAD had resection of the rectum even though the patient only had C18.7 sigmoid colon. There are also some cases in which the ACR codes surgery for colon but no records were found in the Inpatient database or Billing data. This may be out of province resection. Cases with radiation therapy after surgery were excluded. **SK:** For 2009, the adjuvant treatment and the site radiation therapy was applied to could not be identified. For 2012, data were not limited to complete resections where margins are negative. **MB**: For 2009, radiation therapy was not limited to primary tumor site. For 2010/2011/2012, data were not limited to complete resections where margins are negative. **ON**: For 2009, radiation therapy was not limited to primary tumor site**. NB:** For 2010, the surgery information was captured in Cancer Registry instead of Discharge Abstract Database. For 2012**,** all surgeries were included where margins are positive or negative. **NS:** For 2009, cases from Cumberland Health Authority were included. For 2010, collaborative stage variables were used to identify those having resections. Individual charts were reviewed to obtain resection date. Extension codes were used to identify true resections (i.e. polypectomies were not considered resections). For 2010/2011/2012, data were not limited to complete resections where margin is negative. **PE:** For 2009/2010, treatment intent filter was used to identify neo-adjuvant therapy. For 2010/2011, data were not limited to complete resection where margins are negative. **NL:** For 2009/2010, treatment intent filter was used to identify neo-adjuvant therapy. For 2010, margin status was not recorded. Ineligible surgeries were excluded. For 2011/2012, data were limited to complete resections where margin is negative.
Methodology notes:	1) Data presented include stage II and III combined 2) American Joint Committee on Cancer (AJCC) Cancer Staging Manual 7th edition was used to classify cancer stage groups. 3) The Canadian Classification of Health Interventions (CCI) codes were used to identify surgery types, except AB. 4) Resection with negative margin was specified but some provinces could not apply this restriction (see Notes from Jurisdictions). Nevertheless, interpret with caution owing to the criterion and the actual data. 5) Tumours of the recto-sigmoid junction were included (C 19.9). Guidelines recommend pre-operative radiation therapy for tumours

	of the rectum only. Future reporting of this indicator will exclude tumours of the rectosigmoid junction.
Changes to definition compared to previous years:	1) To calculate the duration from the diagnosis to resection, for 2009, the last resection date were used. For 2010 onward, the first resection date were used.

Post-operative chemotherapy for patients with stage II or IIIA non-small cell lung cancer

Definition:	The percentage of patients diagnosed with stage II or IIIA non-small cell lung cancer (NSCLC) who received post-operative chemotherapy within 120 days of resections
Rationale for measurement:	The delivery of chemotherapy following resection has been shown to improve outcomes (i.e., disease-free and overall survival) and prevent recurrences in patients with Stage II and IIIA NSCLC, compared with surgery alone. Clinical practice guidelines therefore recommend post-operative chemotherapy for patients with Stage II and IIIA NSCLC.
Measurement timeframe:	Year 2012
Denominator:	Stage II and IIIA non-small cell lung cancer cases diagnosed during the timeframe and having a lung resection within one year of diagnosis
Numerator:	Stage II and IIIA non-small cell lung cancer cases having post-operative chemotherapy within 120 days of resections, which were diagnosed during the timeframe and receiving resections within one year of diagnosis
Exclusion criteria:	Cases with age under 18 were excluded
Data availability:	AB, SK, MB,PE
Stratification:	1) Age group: age 18-59, 60-60, 70-79, and 80+
Data source:	Provincial cancer agencies and programs
Data retrieval date:	September 2015
Variables details:	Cancer definition: 1) Non-small cell lung cancer was defined C34 in ICD-O3 with behavior code 3 (invasive). Cases included squamous cell carcinoma, but cases with lymphoma Codes M-95 to M-98, sarcoma codes (see Appendix A), neuroendocrine carcinoma were excluded. Histology codes 8002, 8041, 8043, 8044, 8045, 8073 and 8803 were excluded. 2) Non-small lung cancer cases were restricted to stage II and stage IIIA in AJCC. Resection identification: 3) Lung resections were identified in CCI codes as 1GR87, 1GR89, 1GR91, 1GT59, 1GT87, 1GT89 or 1GT9 (see list of descriptors in Appendix A). 4) All resections regardless of margin status were included. Treatment criteria: 5) Chemotherapy included oral (as available in data) and IV chemotherapy.

	6) All lung resections were within 1 year of diagnosis. If there were multiple resections, the last resection was counted: Last resection date (if multiple) – diagnosis date ≤ 365 days 7) All post-operative chemotherapy were within 120 days after resections: Chemo start date – Last resection date (if multiple) ≤120 days
Notes from Jurisdictions:	**AB:** For 2009, resections not necessarily limited to the specified types (lobectomy, pneumonectomy or segmentectomy). Treatment information is based on initially planned treatment to the primary site (ACR data). The CCI codes are not identified in the ACR, as such all coded surgeries were included for complete lung resection. If more than one surgical procedure is performed, the most definitive procedure is documented. The definition of definitive is the surgical procedure with the intent to care. This indicator excludes case with stage="III". Chemotherapy before surgery were excluded. There are some other procedures in which the margins could not be identified as negative. **SK:** all surgeries are included where margins could not be identified as negative, and oral and IV chemotherapy were not included. **MB:** all surgeries are included where margins could not be identified as negative. **ON:** most oral chemotherapy were excluded since those data were not reliably reported to Cancer Care Ontario. 2012 data are for 2012/2013.
Methodology notes:	1) Data presented include stage II and IIIA combined 2) American Joint Committee on Cancer (AJCC) Cancer Staging Manual 7th edition was used to classify cancer stage groups. 3) The Canadian Classification of Health Interventions (CCI) codes were used to identify surgery types, except AB.
Changes to definition compared to previous years:	1) For 2010/2011, squamous cell carcinomas was also excluded, but included in 2012. 2) Histology codes 8002, 8041, 8043, 8044, 8045, 8073 and 8803 were excluded in 2010/2011/2012 data

Chart review – referral and treatment status for radiation therapy preceding or following resection for stage II and III rectal cancer

Definition:	Distribution of referral and treatment status for radiation therapy preceding or following resection for patients diagnosed with rectal cancer
Rationale for measurement:	Distribution and referral of treatment status helps to identify patient-specific and practice-specific sources of inter-provincial variation. Understanding these factors would help clarify the extent to which non-concordance can be explained by clearly documented rationales for non-referral and/or non-treatment including comorbidities, performance status and other contraindications that preclude treatment.
Measurement timeframe:	Year 2008
Denominator:	All sampled patients diagnosed with stage II or III rectal cancer
Numerator:	Referral and treatment status: • Referred and treated with post-operative RT • Referred and treated with pre-operative RT • Referred, but not treated with RT • Not referred, and not treated with RT
Exclusion criteria:	1) Patients younger than 18 were excluded 2) Patients without resections were excluded 3) Patients diagnosed with cancers rather than stage II or III rectal cancer
Data availability:	AB, SK, MB, PE and NL
Stratification:	1) Referral and treatment status
Data source:	Chart review study, provincial cancer agencies and programs
Data retrieval date:	May to August 2012
Variables details:	Cancer definition: 1) The cancer sites/types were defined in ICD-O3 with behavior code 3 (invasive): • Rectal: C19.9, C20.9 Cases with histology codes of M-95 to M-98 (lymphoma) were excluded; besides these codes, for lung cancer, cases with histology codes of 8002, 8041, 8043, 8044, 8045, 8803 and 9073 were excluded. Resection time: 2) Resections were within one year of diagnosis
Notes from Jurisdictions:	Not available
Methodology notes:	1) Data presented included age 18+, stage II/III. 2) This was a study launched in 2011 by CPAC in collaboration with the provincial partners to look at the factors that may contribute to explaining the difference between the calculated concordance rate and the "expected" rate.

	3) A random sample of patient charts were retrieved by two trained registrars in each participating province. *See the details on the study and the methodologies in the Technical Appendix on pages 193-194, in "The 2012 Cancer System Performance Report"*
Changes to definition compared to previous years:	Not applicable

Chart review – Referral and treatment status for chemotherapy following resection for stage II and IIIA lung cancer

Definition:	Distribution of referral and treatment status for chemotherapy following resection for stage II or IIIA lung cancer
Rationale for measurement:	Distribution and referral of treatment status helps to identify patient-specific and practice-specific sources of inter-provincial variation. Understanding these factors would help clarify the extent to which non-concordance can be explained by clearly documented rationales for non-referral and/or non-treatment including comorbidities, performance status and other contraindications that preclude treatment.
Measurement timeframe:	Year 2008
Denominator:	All sampled patients diagnosed with stage II or IIIA lung cancer
Numerator:	Referral and treatment status: • Referred and treated • Referred, but not treated • Not referred, and not treated
Exclusion criteria:	1) Patients younger than 18 were excluded 2) Patients without resections were excluded 3) Patients diagnosed with cancers rather than stage II or IIIA lung cancer were excluded
Data availability:	AB, SK, MB and PE
Stratification:	1) Referral and treatment status
Data source:	Chart review study, provincial cancer agencies and programs
Data retrieval date:	May to August 2012
Variables details:	Cancer definition: 1) The cancer sites/types were defined in ICD-O3 with behavior code 3 (invasive): • Lung: C34 Cases with histology codes of M-95 to M-98 (lymphoma) were excluded; besides these codes, for lung cancer, cases with histology codes of 8002, 8041, 8043, 8044, 8045, 8803 and 9073 were excluded. Resection time:

	2) Resections were within one year of diagnosis
Notes from Jurisdictions:	Not available
Methodology notes:	1) Data presented included age 18+, stage II/III. 2) This was a study launched in 2011 by CPAC in collaboration with the provincial partners to look at the factors that may contribute to explaining the difference between the calculated concordance rate and the "expected" rate. 3) A random sample of patient charts were retrieved by two trained registrars in each participating province. *See the details on the study and the methodologies in the Technical Appendix on pages 193-194, in "The 2012 Cancer System Performance Report"*
Changes to definition compared to previous years:	Not applicable

Adult clinical trial participation for cancer-related therapeutic trials or clinical research studies

Definition:	The ratio of the total number of all patients aged 19 years or older newly enrolled in cancer-related therapeutic trials or clinical research studies to the projected number of new incident cancer cases
Rationale for measurement:	Patients who are treated in cancer centres with active clinical trial programs tend to have better health outcomes than those treated in centres that do not participate in clinical trials. This finding is likely due to better processes and delivery of care, including treatment guideline concordance. Although the number of cancer clinical trials opened per year remained the same or grew from 2000 to 2010, patient enrolment per year has plateaued or decreased. Comparing clinical trial participation across the country can identify opportunities for action.
Measurement timeframe:	Year 2014
Denominator:	Projected number of new invasive cancer cases (all ages)
Numerator:	Number of cancer patients (≥19 years) newly enrolled in cancer-related therapeutic clinical trials or clinical research at provincial cancer centers.
Exclusion criteria:	Projected cancer cases other than in-situ bladder were excluded from all cancer cases
Data availability:	BC, AB, SK, MB, ON, NB, NS, PE and NL
Stratification:	1) By province
Data source:	Provincial cancer agencies and programs; Canadian Cancer Society, Canadian Cancer Statistics
Data retrieval date:	September 2015
Variables details:	1) For patient enrolled in multiple clinical trials, all occurrences were counted 2) Cancer site/types in ICD-O3 were not specified for selecting clinical enrollment (based on indicator specification)
Notes from Jurisdictions:	**AB**: Included non-intervention cases
Methodology notes:	1) Data presented include all cancer cases combined. 2) The projected number of new invasive cancer cases were for all ages from the Canadian Cancer Statistics, which includes cases for all ages (0+). 3) All cancer cases combined included in-situ bladder cases.
Changes to definition compared to previous years:	No applicable

Self-reported cervical cancer screening by income quintile, immigrant status and language spoken at home

Definition:	Age-standardized percentage of women aged 18-69 who had at least one Papanicolau (Pap) smear in the past 3 years
Rationale for measurement:	Regular screening reduces cervical cancer incidence and mortality through early detection, allowing for more effective treatment of earlier stage cancers and pre-cancerous lesions. Participation rates by income quintile, immigrant status and language spoken at home allows to identify disparities and opportunities for improving screening services amongst under-screened (or never screened) populations
Measurement timeframe:	Year 2012
Denominator:	Number of women aged 18-69
Numerator:	Number of women aged 18–69 reporting having had at least one Pap test in the past 3 years
Exclusion criteria:	1) Women reporting having had a hysterectomy were excluded 2) Territories were excluded from income analysis 3) Answers to questions with "don't know", "Refusal" or "Not stated" were excluded
Data availability:	All provinces and territories
Stratification:	1) Household income: quintile Q1 – Q5 2) Immigrant status: <10 years, 10+ years, Canadian-born 3) Language spoken at home: English/French, other than English/French
Data source:	Statistics Canada; Canadian Community Health Survey (CCHS)
Data retrieval date:	February 2015
Variables details:	1) Having had Pap test was identified by the questions: • Have you ever had a Pap smear test? • When was the last time? • Have you had a hysterectomy? 2) Household income quintile was classified by the derived variable INCDRCD --- household income distribution (deciles) 3) Immigrant status was classified by the derived variable SDCDRES --- length of time in Canada since immigration 4) Language spoken at home was classified by the derived variable SDCDLHM --- first official language
Notes from Jurisdictions:	Not applicable
Methodology notes:	1) Data presented include all provinces/territories combined, ages 18-69. 2) The Canadian Community Health Survey (CCHS) data is based on a representative sample which is then extrapolated by weights to the overall population.

	3) Screening percentages were age-standardized to 2011 Canadian population
Changes to definition compared to previous years:	Not applicable

Mastectomy and breast conserving surgery rates by place of residence and travel time to nearest radiation treatment facility

Definition:	The percentage of surgical resections among women with unilateral invasive breast cancer that are mastectomies.
Rationale for measurement:	Although breast conserving surgery is as effective and less invasive as a mastectomy, restricted access to radiation therapy may influence a patient's decision in favour of a mastectomy to avoid traveling long distances to the radiation treatment facility or having to be away from home for an extended period of time. Identifying mastectomy and breast-conserving surgery rates can indicate whether populations have equitable access to cancer surgery regardless of place of residence or distance to treatment centre.
Measurement timeframe:	Fiscal years 2007/08 to 2011/12
Denominator:	Women with unilateral invasive breast cancer who received breast conserving surgery and/or a mastectomy during measurement timeframe.
Numerator:	Women in the denominator who received a mastectomy first as well as women who received breast conserving surgery first followed by a mastectomy within one year
Exclusion criteria:	1) Bilateral invasive breast cancers were excluded 2) QC was excluded from travel time analysis.
Data availability:	All provinces and territories
Stratification:	1) Place of residence: Urban, rural, rural-remote and rural-very remote 2) Travel time: one-way travel time from place of residence to closest radiation treatment center0-39, 40-89, 90-179 and 180+ in minutes
Data source:	Canadian Information Health Institute (CIHI) Hospital Morbidity Database National Ambulatory Care Reporting System, CIHI Alberta Ambulatory Care Reporting System, Alberta Health and Wellness
Data retrieval date:	February 2013
Variables details:	1) Breast cancer were identified as C50 by ICD-10 with CODING_CLASS='0' 2) Breast mastectomy was identified in CCI: 1.YM.89 to 1.YM.92.
Notes from Jurisdictions:	**AB**: Data were from 2007/08 to 2009/10
Methodology notes:	1) Data presented include ages 18+. 2) The cancer incidence sites/types are classified by World Health Organization, International Classification of Diseases, Tenth Edition (ICD-10). 3) The analysis was done by CIHI in 2013. 4) The distance analysis was performed using the 'closest facility' feature of the Indicator Specifications for 2013

	Special Focus Report on Special Populations Indicator 3SP20 Network Analyst extension of ESRI's ArcGIS 10. This feature can calculate travel time for a set of origins (patients) and the closest destinations (hospitals), with travel time being a function of posted speed limit and road length. The road network data used was produced by Statistics Canada, with speed limit assignments carried out by Earth-To-Map GIS Inc., a GIS consulting company located in Ottawa. Patients and hospitals are mapped (geocoded) using postal codes, with latitude and longitude derived from the PCCF+ Version 5G, which provides automated geographic coding based on Statistics Canada's postal code conversion file (PCCF). Exclusion Criteria: I. The PCCF+ does not produce a latitude and longitude for certain postal codes. II. The postal code is mapped to a location greater than 2km from the road network. III. An incomplete (or fragmented) road network between the patient and hospital prevented a complete travel time calculation (only in more remote regions).
Changes to definition compared to previous years:	Not applicable

Age-standardized incidence rates by income quintile

Definition:	Age-standardized incidence rates per 100,000 population diagnosed for the specified cancer sites respectively by social economic status (SES)
Rationale for measurement:	Data and metrics regarding age-standardized incidence rates across income quintiles are needed to identify disparities in cancer burden.
Measurement timeframe:	Year 2012
Denominator:	2011 Canadian population estimates by year, sex and age group, urban/rural and neighborhood income quintile
Numerator:	Number of new invasive cases for the specified cancers diagnosed in the measurement timeframe
Exclusion criteria:	1) Territories were excluded 2) Cases with assigned unknown income quintile, or unknown urban/rural were excluded 3) Cases with the DA not in population by SES were excluded
Data availability:	All provinces and territories, except QC
Stratification:	1) Cancer site: lung, colorectal 2) Neighborhood Income: quintile Q1 – Q5
Data source:	Statistics Canada, Canadian Cancer Registry
Data retrieval date:	March 2017
Variables details:	The cancer sites/types were defined in ICD-O3 with behavior code 3 (invasive): • Lung: C34 • Colorectal: C18, C19.9, C20.9, C26.0 Cancer cases with histology types 9590-9992 (leukemia, lymphoma and multiple myeloma), 9050-9055 (mesothelioma) and 9140 (Kaposi sarcoma) are excluded.
Notes from Jurisdictions:	QC data from 2011 to 2013 were not available
Methodology notes:	1) Data presented include all provinces (except territories), ages 0+. 2) The cancer incidence sites/types are classified by World Health Organization, International Classification of Diseases for Oncology, Third Edition (ICD- O-3). The International Agency for Research on Cancer (IARC) rules were used for determining multiple primaries sites. 3) Since QC data in 2011 onward were not available, QC incidence cases in 2010 were used. 4) The population by SES was the census population in 2011, estimated using three dataset (files) below, which were created by Statistics Canada: • Census 2011 profile file: population at DA level

	• 2011 geographic attribute dataset: contains CSIZE and SACTYPE at DA level, based on which urban/rural or MIZ were classified • 2006 SES reference file: contains neighborhood income quintile, immigrant tercile, etc. at DA level (2006 DAs). However, all the SES values were based on 2006 census geographic borders. The last two dataset/files were borrowed from PCCF+v6C, the first file was downloaded from SC. The population by SES was first estimated by linking the three dataset at DA level, then rolling up to provincial level. 5) The assignments of SES and urban/rural areas in incidence data (CCR) were obtained by running PCCF+v6C (modified2) with input of postal codes. 6) Incidence rates were age standardized to the Canadian 2011 population using direct method.
Changes to definition compared to previous years:	Not applicable

Age-standardized mortality rates by income quintile

Definition:	Age-standardized mortality rates per 100,000 population died from the specified cancer sites respectively by social economic status
Rationale for measurement:	Data and metrics regarding age-standardized incidence rates across income quintiles are needed to identify disparities in cancer burden.
Measurement timeframe:	Year 2012
Denominator:	Canadian population estimates by year, sex and age group and household income quintile
Numerator:	Number of deaths in the measure timeframe from the specified cancers
Exclusion criteria:	1) Territories were excluded 2) Deaths with assigned unknown income quintile, or unknown urban/rural were excluded 3) Deaths with the DA not in population by SES were excluded
Data availability:	All provinces and territories
Stratification:	1) Cancer site: lung, colorectal 2) Neighborhood Income: quintile Q1 – Q5
Data source:	Statistics Canada, Vital Statistics Death Database
Data retrieval date:	March 2017
Variables details:	1) Up to the year 1999, the cause of deaths from invasive cancer sites/types were defined in ICD-9: • Lung: 162 • Colorectal: 153-154 2) After the year 1999, the cause of deaths from invasive cancer sites/types were defined in ICD-10: • Lung: C34 • Colorectal: C18, C19.9, C20.9, C26.0
Notes from Jurisdictions:	Not applicable
Methodology notes:	1) Data presented include all provinces (except territories), ages 0+. 2) The cause of death from cancer sites/types were classified by World Health Organization, International Classification of Diseases (ICD). Up to the year 1999, the Ninth Edition (ICD-9) was used. After the year 1999, the Tenth Edition (ICD-10) was used. 3) The population by SES was the census population in 2011, estimated using three dataset (files) below, which were created by Statistics Canada: 4) Census 2011 profile file: population at DA level 5) 2011 geographic attribute dataset: contains CSIZE and SACTYPE at DA level, based on which urban/rural or MIZ were classified 6) 2006 SES reference file: contains neighborhood income quintile, immigrant tercile, etc. at DA level (2006 DAs).

	However, all the SES values were based on 2006 census geographic borders. The last two dataset/files were borrowed from PCCF+v6C, the first file was downloaded from SC. The population by SES was first estimated by linking the three dataset at DA level, then rolling up to provincial level. 7) Although there are existing SES variables in death dataset, they were not used to aggregate the deaths because the existing variables of SES in death dataset were generated by PCCF+v6B, which had errors in SAS program. Instead, the assignments of SES and urban/rural areas in death data were obtained by running PCCF+v6C (modified2) with input of postal codes. 8) Mortality rates were age standardized to the Canadian 2011 population using direct method.
Changes to definition compared to previous years:	Not applicable

Ratio of lung cancer deaths to lung cancer incidence cases by income quintile

Definition:	Ratio of age-standardized mortality rate to age-standardize incidence rates by social economic status (SES) for the specific cancer sites
Rationale for measurement:	Data and metrics regarding age-standardized incidence and mortality rates across income quintiles are needed to identify disparities in cancer burden.
Measurement timeframe:	Year 2012
Denominator:	Age-standardized incidence rates by SES
Numerator:	Age-standardized mortality rates by SES
Exclusion criteria:	see age-standardized incidence rates by SES, and age-standardized mortality rates by SES respectively
Data availability:	All provinces and territories
Stratification:	1) Neighborhood Income: quintile Q1 – Q5
Data source:	Statistics Canada, Canadian Cancer Registry, Vital Statistics Death Database
Data retrieval date:	March 2017
Variables details:	see age-standardized incidence rates by SES, and age-standardized mortality rates by SES respectively
Notes from Jurisdictions:	Not applicable
Methodology notes:	1) Data presented include all provinces (except territories), ages 0+. 2) The Smith (1987) method (page 138, “Cancer registration: and principles and methods”, IARC) was used to calculate the confidence intervals (CI) for the ratios.
Changes to definition compared to previous years:	Not applicable

Five-year net survival by income quintile

Definition:	Five-year net survival ratio by patient income quintile for the specified cancers
Rationale for measurement:	Monitoring and reporting on cancer survival provides a mechanism for understanding the effectiveness of Canada's cancer care system. Identifying survival disparities among different income groups can help to design cancer control strategies to reach populations at risk of poorer outcomes.
Measurement timeframe:	Years 2004 to 2009
Denominator:	Not available
Numerator:	Not available
Exclusion criteria:	1) NL and territories were excluded 2) Ages beyond 15-99 were excluded
Data availability:	All provinces
Stratification:	1) Age group: ages 15-99 combined 2) Cancer site: breast (female), colorectal, lung and prostate 3) Neighborhood Income: quintile Q1 – Q5
Data source:	Provincial cancer agencies and programs, CONCORD-2 study
Data retrieval date:	May-June 2016
Variables details:	Not available
Notes from Jurisdictions:	Not applicable
Methodology notes:	1) Data presented include ages 15-99. 2) This analysis was conducted by the CONCORD-2 Programme at the London School of Hygiene and Tropical Medicine, as a sub-analysis of the CONCORD-2 study that was funded by the Canadian Partnership Against Cancer. Details on methodologies for calculating survival were published in *The Lancet* in 2015 (http://www.thelancet.com/pdfs/journals/lancet/PIIS0140-6736%2814%2962038-9.pdf). For specific details related to the survival by income quintile analysis, please refer to the methods section in this special feature section. 3) International Cancer Standard Survival Weights (ICSS) was used to standardize the net survival ratios 4) PCCF+v5K was used to derive SES, using postal codes.
Changes to definition compared to previous years:	Not applicable

Breast cancer diagnosis wait times

Definition:	1) The median and 90th percentile wait time (weeks) between an abnormal breast screen result and resolution; 2) Percentage of patients with resolution within the target wait times: • 5 weeks for resolution not requiring a tissue biopsy • 7 weeks for resolution requiring a tissue biopsy
Rationale for measurement:	Monitoring and reporting on breast cancer diagnosis wait times across Canada can help to reveal where efforts need to be targeted to improve how various parts of the system involved in screening and diagnosing breast cancer work together to ensure prompt resolution of abnormal results.
Measurement timeframe:	Screening year 2013
Denominator:	Women aged 50-69 participating in an organized breast screening program and who had an abnormal breast screen result (mammogram or clinical breast examination). Two patient groups were analyzed: 1) Patients requiring a tissue biopsy 2) Patients not requiring a tissue biopsy to resolve the diagnosis
Numerator:	Not applicable
Exclusion criteria:	1) QC and territories were excluded 2) Ages beyond 50-69 were excluded 3) Abnormal screens that took longer than 6 months for definitive diagnosis were excluded
Data availability:	All provinces, except QC and territories
Stratification:	1) By province 2) Tissue biopsy requirement: requiring a tissue biopsy, not requiring a tissue biopsy
Data source:	Provincial breast cancer screening programs
Data retrieval date:	December 2015
Variables details:	Not available
Notes from Jurisdictions:	**ON:** Women with final result unknown/lost to follow-up were excluded.
Methodology notes:	1) Data presented include ages 50-69. 2) Tissue biopsy included core (needle) biopsy with or without image guidance and open (*excisional*) biopsy with or without image guidance. 3) Tissue biopsy did not include fine needle aspiration (FNA). 4) Time to diagnosis was based on the date of the first pathological biopsy result of breast cancer (excludes fine needle aspiration and all inconclusive procedures) or the date of the last benign test or pathological biopsy.

	5) Definitive diagnosis of cancer was the first core or open surgical biopsy that confirms cancer. In rare occasions, FNA biopsy may also be used as a definitive diagnosis of cancer. Definitive diagnosis of a benign case is the last benign test up to 6 months following an abnormal screen.
Changes to definition compared to previous years:	Not applicable

Colorectal cancer diagnosis wait times

Definition:	The median and 90th percentile wait time (days) between an abnormal fecal test result and a follow-up colonoscopy required to resolve the diagnosis
Rationale for measurement:	Monitoring and reporting on colorectal cancer diagnosis wait times across Canada can help to reveal where efforts need to be targeted to improve how various parts of the system involved in screening and diagnosing colorectal cancer work together to ensure prompt resolution of abnormal results.
Measurement timeframe:	Screening years 2013 and 2014
Denominator:	Individuals aged 50-74 with an abnormal fecal test (through colorectal cancer screening) who went on to receive a colonoscopy within 180 days of the fecal test result
Numerator:	Not applicable
Exclusion criteria:	1) Ages beyond 50-74 were excluded 2) Screens outside of the programmatic colorectal screening were excluded 3) Colonoscopies received longer than 180 days after abnormal fecal tests were excluded
Data availability:	AB, SK, MB, NS, PE, NL
Stratification:	1) By province
Data source:	Provincial cancer agencies and programs
Data retrieval date:	October – December 2015
Variables details:	Not available
Notes from Jurisdictions:	**AB:** Multiple databases had been used to capture the follow-up colonoscopies, such as the National Ambulatory Care Reporting System (NACRS), the Discharge Abstract Database (DAD) and claims. The uptake rates were underestimated due to incomplete colonoscopy data, which was caused by delays between the time of colonoscopy and the time the colonoscopy was reported to the databases. In general, reporting delays for NACRS and DAD are at least 1.5 months; some clinics might have longer delay periods. The available physician claims data in the data warehouse covers until March 31, 2014. **PE**: Some of the individuals with long waits for colonoscopy had used the FOBT kit after a recent colonoscopy. This is not in line with guidelines and results in skewed wait time results.
Methodology notes:	1) Data presented include ages 50-74. 2) Date of abnormal fecal test is the date the result is reported by the laboratory for each individual test; if there is more than one abnormal fecal test, the date of the first test is used. 3) The colonoscopy may have been performed inside or outside of the screening program but only for individuals

	who had their fecal test performed in the screening program. 4) The target time between an abnormal fecal test result and a follow-up colonoscopy required to resolve the diagnosis is 60 days
Changes to definition compared to previous years:	Not applicable

Radiation therapy wait times

Definition:	1) The median and 90th percentile radiation therapy wait time (days) from ready-to-treat to start of radiation for patients treated for all types of cancer and for the four most common cancers. 2) The percentage of radiation therapy cases for which the above wait time was within current national target (28 days)
Rationale for measurement:	Reporting on radiation therapy wait times is an important step to understanding the health care system's ability to meet the needs of patients with cancer.
Measurement timeframe:	Year 2013 or 2014
Denominator:	All cancer patients receiving radiation therapy in 2013 or 2014 who have wait time data collected as consistent with the specifications of this indicator.
Numerator:	Not applicable
Exclusion criteria:	In 2014, only cases with external beam radiation therapy (EBRT) done in 2014 are included. Other than that, radiation therapies were excluded
Data availability:	2013: SK and ON 2014: BC, AB, MB, NB, NL; PE (all cancers combined only); NS (colorectal and lung cancers)
Stratification:	1) By province 2) Cancer sites/types: all cancers combined, lung, prostate, colorectal and (female) breast cancer
Data source:	Provincial cancer agencies and programs
Data retrieval date:	December 2015
Variables details:	Not available
Notes from Jurisdictions:	**BC:** Brachytherapy was not included. **AB:** data include all cases who had radiation therapy at a Cancer Control Alberta Facility with their first treatment between January 2, 2014 - December 31, 2014; it includes those who were living in another province at time of diagnosis but receiving radiation therapy in Alberta. Tumor group classification for this indicator is based on referral tumor groups. Brachytherapy was not included. **SK**: Data were for 2013 **ON**: Only provided the percentage of radiation therapy cases for which the wait time was within target < 14 days from February to December 2014. The data were for 2013 **QC:** Only provided the percentage of radiation therapy cases for which the wait time was within target timeframes. **NS**: Patients with more than one treated disease may have contributed to more than one wait time. Procedures around specifying ready-to-treat date have not accurately captured the relevant date for prostate and breast patients, so the wait times for these two cancers are not reported.

	PE: Could not provide site-specific wait times.
Methodology notes:	1) For cancers with radiation therapy, all behavior codes were included. 2) To identify breast, colorectal, lung, prostate cancer and all cancers, provinces included the morphology codes that were used within their registry. 3) Of note for breast cancer data, if the province obtained this data from a wait time database as opposed to a registry, then breast cancer cases were to be included per the database definition. 4) There are known discrepancies in the ways in which different provinces measure wait times. One of the key sources of variation is the way the "ready-to-treat" timeframe is defined. Efforts are underway to standardize these definitions. The following outlines the definitions used by the different provinces. **BC:** The date at which both oncologist and patient agree that treatment can commence. Being ready to treat requires that all diagnostic tests and procedures required to assess the appropriateness of, indications for, and fitness to undergo radiation therapy are complete. **AB:** The date when the patient is physically ready to commence treatment. SK: The date when the patient is ready to receive treatment, taking into account clinical factors and patient preference. In the case of radiation therapy, any preparatory activities (e.g., simulation, treatment planning, dental work) do not delay the ready to treat date. **MB**: The date when a decision has been made by the radiation oncologist and is agreed to by the patient that radiation therapy is appropriate and should commence AND the patient is medically ready to start treatment AND the patient is willing to start treatment. **ON:** The time from when the specialist is confident that the patient is ready to begin treatment to the time the patient receives treatment. **QC** At consultation, the radiation oncologist enters the date at which the patient will be ready to treat on a formulary requesting treatment. **NB:** The date when any planned delay is over and the patient is ready to begin treatment from both a social/personal and medical perspective. **NS:** The date when all pre-treatment investigations and any planned delay are over, and the patient is ready to begin the treatment process from both a social/personal and medical perspective. Nova Scotia did not have a

	ready to treat date until February 2010; a proxy date was used prior to this time. **PE** The date when all pre-treatment investigations and any planned delay are over, and the patient is ready to begin the treatment process from both a social/ personal and medical perspective. **NL:** The date when all pre-treatment investigations and any planned delay are over, and the patient is ready to begin the treatment process from both a social/ personal and medical perspective.
Changes to definition compared to previous years:	Not applicable

Screening for distress

Definition:	Percentage of patient self-assessments (ESAS-r) reporting no distress, low distress, moderate distress or high distress by specific symptoms (i.e., pain, fatigue, anxiety and depression)
Rationale for measurement:	Routine screening of symptoms is important to identify cancer patients' psychological, social, spiritual, practical or physical concerns that may negatively affect a person's ability to cope with cancer and its treatment. One common self-report tool used to measure patient-reported outcomes is the Edmonton Symptom Assessment System (ESAS), which measures nine commonly reported symptoms (pain, tiredness, nausea, depression, anxiety, drowsiness, appetite, lack of well-being and shortness of breath).
Measurement timeframe:	Most recent 3-months data: • NS, MB, ON: January-March 2016; • PE, SK, AB, NL: April-June 2016; • QC: May-July 2016
Denominator:	Total number of questionnaires completed
Numerator:	Number of questionnaires reporting low, moderate or high levels of distress
Exclusion criteria:	Benign hematologic diseases
Data availability:	AB, SK, MB, ON, QC, NS, PE, NL
Stratification:	Level of symptom distress: • No distress: zero score • Low: scores 1-3 • Moderate: scores 4-6 • High: scores 7-10
Data source:	Patient-Reported Outcome (PRO) Initiative partners
Data retrieval date:	October – November 2016
Variables details:	Not applicable
Notes from Jurisdictions:	**MB:** Patients are screened for distress at every physician visit which includes new, on treatment and follow-up appointments. **ON:** Some methodological differences: (1) CPAC excludes age <18, (2) CCO also includes hematological cancers. The denominators vary across symptoms due to skipped questions on paper questionnaires. **NS:** The denominator for this indicator is based on the total number of screens completed by patients from January-March, 2016. The unknown responses are captured in the "No response" column. **PE:** Data reported from April 2016 – June 2016. Data include initial screens done at first consult, re-screens done at end of treatment and ESAS-r completed at every

	physician visit (for the IV chemotherapy group, that started June 1). **NL:** Data reported from April 2016 – June 2016. The unknown responses are captured in the "No response" column.
Methodology notes:	1) Each symptom has a small number of non- responses that were excluded. For pain, 0.4% did not respond. For fatigue, 0.3% did not respond. For anxiety, 0.4% did not respond. For depression, 0.4% did not respond. 2) Data came from PRO partners. As such, BC and NB (provinces that did not participate in the PRO initiative) were not included.
Changes to definition compared to previous years:	Not applicable

Place of death

Definition:	The percentage of cancer patients who died in hospital versus non-hospital locations (i.e., private home, other)
Rationale for measurement:	Measuring place of death, although a crude measure, addresses one important aspect of end-of-life care and may contribute to better planning and quality of end-of-life care for cancer patients.
Measurement timeframe:	Years from 2008 to 2012
Denominator:	Number of deaths due to any invasive cancers
Numerator:	Number of deaths due to any invasive cancers grouped into 3 locations: hospital, private home and other places
Exclusion criteria:	Benign hematologic diseases
Data availability:	All provinces and territories
Stratification:	1) By year
Data source:	Statistics Canada, Vital Statistics Death Database
Data retrieval date:	February 2017
Variables details:	Not available
Notes from Jurisdictions:	**QC:** "Hospital" includes residential and long-term care centres. **MB:** Designated palliative care units were included in "Hospital." In other provinces this type of bed may be considered part of long-term care ("Other"). **SK:** A very small proportion of deaths were recorded as private home, so that private home and other were combined together.
Methodology notes:	1) Data presented include ages 0+, provinces/territories combined 2) The percentages of place of death were based on randomly rounded counts using Statistics Canada convention. 3) The definition of hospital varied across provinces. Hospices can be classified as "Other" or "Hospital" depending on province. 4) "Other" included other specified locality, other health care facility, private home and unknown localities.
Changes to definition compared to previous years:	Not applicable

Smoking prevalence

Definition:	The percentage of the population aged 12 or older who reported smoking daily or occasionally in the previous year
Rationale for measurement:	Reporting on tobacco use at the population level allows for the assessment of pan-Canadian prevention and cessation strategies.
Measurement timeframe:	Years 2001 and 2014
Denominator:	Total individuals aged 12 years and older
Numerator:	Number of individuals aged 12 years and older reporting daily or occasional smokers
Exclusion criteria:	Not applicable
Data availability:	All provinces and territories
Stratification:	1) By year
Data source:	Statistics Canada; Canadian Community Health Survey (CCHS)
Data retrieval date:	October 2015
Variables details:	Smoking status were classified based on the questions: • In your lifetime, have you smoked a total of 100 or more cigarettes (about 4 packs)? • Have you ever smoked a whole cigarette? • At the present time, do you smoke cigarettes daily, occasionally or not at all? • Have you ever smoked cigarettes daily?
Notes from Jurisdictions:	Not applicable
Methodology notes:	1) Data presented include ages 12+, provinces and territories combined. 2) The Canadian Community Health Survey (CCHS) data is based on a representative sample which is then extrapolated by weights to the overall population.
Changes to definition compared to previous years:	Not applicable

Human papillomavirus (HPV) vaccination uptake

Definition:	The percentage of girls in the age group (or school grades) targeted for immunization who have completed the HPV vaccine series based on the provincially/territorially recommended vaccination schedule
Rationale for measurement:	Reporting on HPV vaccination uptake helps to inform opportunities to increase efforts in prevention activities.
Measurement timeframe:	Years 2012/13, 2013/14, 2014/15 or 2015/16
Denominator:	Number of girls in the target grade/age group in schools for the provincial/territorial school-based HPV vaccination program.
Numerator:	Number of girls who have received the final dose (second or third dose, depending on the province/territory) of the HPV vaccination through the provincially/territorially organized program
Exclusion criteria:	Not available
Data availability:	All provinces and north territories
Stratification:	1) By province/territory
Data source:	Provincial/territorial immunization programs
Data retrieval date:	September 2016
Variables details:	Not available
Notes from Jurisdictions:	**SK, ON**: HPV vaccination is offered in grade 6 and grade 8 but immunization information is not recorded by grade. Vaccination uptake is therefore assessed at age 13. **ON**: Full course of vaccination for school-based programs is 2 doses. Data are not available for the 2-dose schedule, so data on 3-dose schedule are presented. **NB**: 2-dose schedule has been implemented for grade 7 girls starting in school year 2015/16. **NT:** Vaccination occurs in grades 4–6. The vaccination uptake listed is for grade 7 girls.
Methodology notes:	1) As of 2015/16 school year, full course of vaccination for school-based programs is 3 doses in AB and NU and 2 doses in all other provinces/territories. 2) The target grade and age group varies by province/territory. 3) The denominator does not necessarily represent the entire female population within the target age range for the province.
Changes to definition compared to previous years:	Not applicable

Self-reported breast cancer screening mammography performed on average risk women aged 40-49

Definition:	The percentage of all screening mammograms in the past year that were reported by women aged 40-49 asymptomatic women aged 40-49 who self-reported having had screening mammograms in the past year
Rationale for measurement:	Reporting on mammograms performed outside of the recommended age range can help identify how screening practices can be streamlined across the country to better align with guidelines and recommendations, and to reduce unnecessary and potentially harmful interventions.
Measurement timeframe:	Years 2008 to 2012
Denominator:	The number of women aged 40+ who reported having had a screening mammogram in the past year due to asymptomatic reasons. Refer to details for asymptomatic reasons in methodology section.
Numerator:	The number of women aged 40-49 who reported having a screening mammogram in the past year due to asymptomatic reasons or any reasons Refer to details for asymptomatic reasons in methodology section.
Exclusion criteria:	Not available
Data availability:	2008: All provinces/territories; 2009: AB, NB, NS, NL, NT; 2010: AB, NB, NS, NL, NT; 2011: AB, ON, NL, NU; 2012: All provinces/territories
Stratification:	1) By province
Data source:	Statistics Canada, Canadian Community Health Survey (CCHS)
Data retrieval date:	January 2016
Variables details:	1) Having had screening mammogram was identified by the question: Have you ever had a mammogram that is, a breast x-ray? 2) The time for the screening mammogram was classified based on the question: When was the last time? 3) The reasons for screening mammogram were classified into asymptomatic reasons and symptomatic reason, based on all the applicable questions: Why did you have it? (mark all that apply): • family history; • part of regular check-up/routine screening;

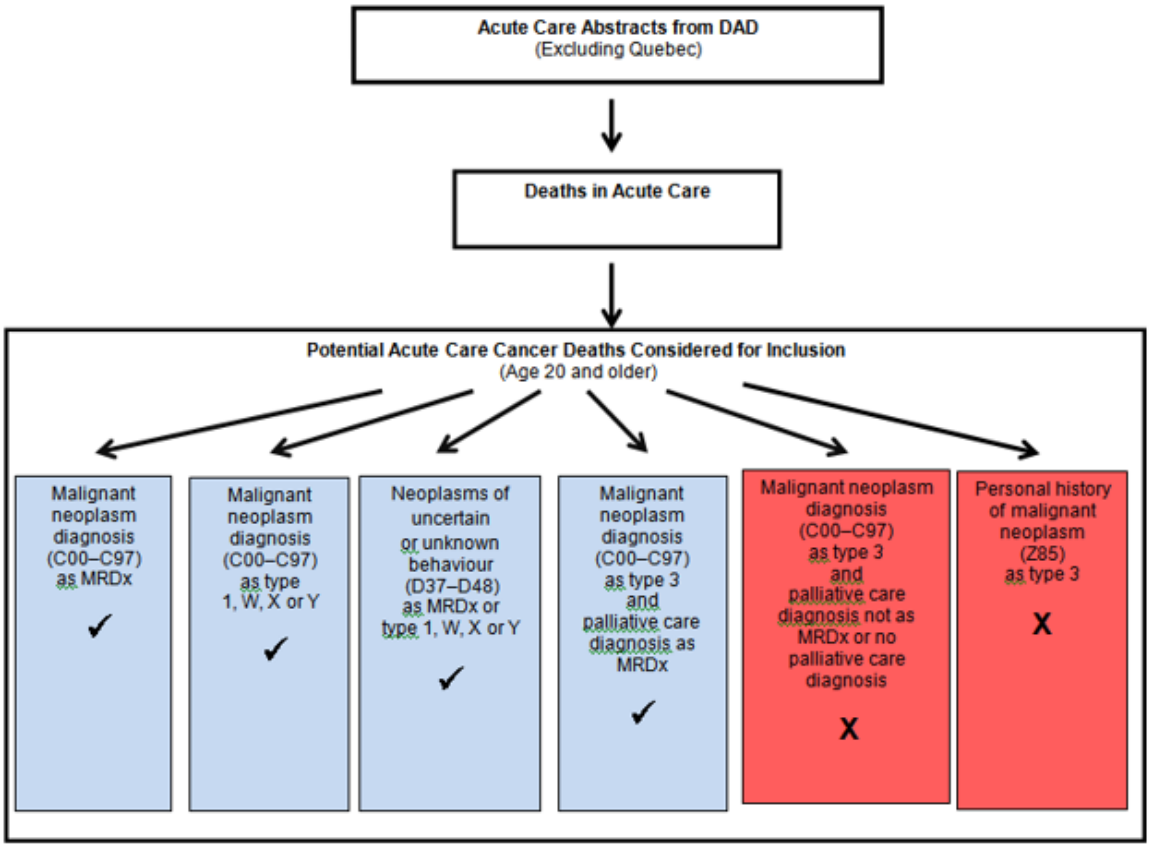
	• age; • on hormone replacement therapy; • lump; • follow-up to breast cancer treatment; • breast problem; other;
Notes from Jurisdictions:	Not available
Methodology notes:	1) The Canadian Community Health Survey data is based on a representative sample which is then extrapolated by weights to the overall population. 2) A woman is deemed to have had screening mammography due to asymptomatic reasons if she had one of the reasons: family history of breast cancer, regular check-up/routine screening, age, or current use of hormone replacement therapy. But none of the reasons: lump, follow-up to breast cancer treatment, breast problem or other.
Changes to definition compared to previous years:	Not applicable

Fractionation of palliative radiation therapy for bone metastases in cancer patients

Definition:	Percentage of all cancer patients aged 18+ receiving palliative radiation therapy to the bone who receive more than one fraction of radiation
Rationale for measurement:	Identifying variations in the use of single- versus multi-fraction regimens can inform future strategies to encourage evidence-based use of radiation therapy for bone metastases, which can improve quality of life and convenience.
Measurement timeframe:	Year 2013
Denominator:	The number of all cancer patients receiving palliative radiation therapy to the bone
Numerator:	The number of cancer patients receiving palliative radiation therapy to the bone by radiation fraction
Exclusion criteria:	1) Patient younger than 18 were excluded 2) Bone cancer, plasmacytomas and osteosarcoma were excluded
Data availability:	BC, SK, MB, NS, PE
Stratification:	1) By province
Data source:	Provincial cancer agencies and programs
Data retrieval date:	April – June 2015
Variables details:	Not available
Notes from Jurisdictions:	**MB:** The numbers reflected the treatment planned and not the actual treatment received. **NS:** A 'palliative' intent code assigned by the treating oncologist was used to further restrict the treatment courses for analysis. **PE:** Unknown primaries were excluded. Patients diagnosed in another province but who received palliative radiation in PE were included. Potential spinal cord compression included as spine code was included.
Methodology notes:	1) Data presented include ages 18+.
Changes to definition compared to previous years:	Not applicable

Intensive care use in the last 14 days of life

Definition:	1) The percentage of adult cancer patients who were admitted to an intensive care unit (ICU) in the last 14 days of life 2) The percentage of adult cancer patients who died in an acute-care hospital in the last 14 days of life
Rationale for measurement:	Examining interprovincial variations in the use of critical care in the 14 days of life may point to opportunities for learning from other jurisdictions about strategies for optimizing the appropriate use of ICU at the end-of-life for cancer patients.
Measurement timeframe:	Fiscal years 2011/12 to 2014/15
Denominator:	The total number of all cancer patients aged 20 and older who died in hospital
Numerator:	1) The number of adult cancer patients aged 20 and older who were admitted to an ICU in the last 14 days of life; 2) The number of adult cancer patients aged 20 and older who died in an ICU.
Exclusion criteria:	1) Patients aged younger than 20 were excluded 2) Records submitted by Quebec facilities or records with Quebec-issued health cards
Data availability:	All provinces and territories, except QC
Stratification:	1) By province/territory
Data source:	Canadian Institute for Health Information (CIHI), Discharge Abstract Database
Data retrieval date:	November 2015
Variables details:	Not applicable
Notes from Jurisdictions:	Not applicable
Methodology notes:	1) Data presented include ages 20+. 2) Data on ICU included only facilities that reported ICU data. 3) Cancer patients were identified using ICD-10-CA codes for either • A significant diagnosis of malignant neoplasm or neoplasms of uncertain or unknown behavior; or • A most responsible diagnosis of palliative care, with a secondary diagnosis of malignant neoplasm. (See below on how cancer patients were selected) 4) Only records indicating at least one ICU visit within 14 days of death were included in the percentage of patients admitted to ICU in the last 14 days of life. All cancer patients died in ICU, regardless of when they were admitted to an ICU, were included in the percentage of cancer patients died in an ICU.
Changes to definition compared to previous years:	Not applicable



Legend

✓ Included in the study cohort.

X Excluded from the study cohort.

Notes

MRDx: most responsible diagnosis.
Type 1: significant pre-admit diagnosis.
Type W, X or Y (service transfers diagnosis): significant pre-admit diagnosis.
Type 3: secondary diagnosis.
Not shown in the diagram but also excluded were a few cases of C and D codes that had other diagnosis types.

Mastectomies performed as day surgeries

Definition:	Percentage of mastectomies for women with breast cancer that were done as day surgery.
Rationale for measurement:	Reporting on mastectomies performed as day surgery allows detection of variations in practice across provinces, which could help identify opportunities for improving patient experience and reducing system costs by avoiding inpatient stays for patients who could safely recover at home.
Measurement timeframe:	Fiscal years 2009/10 to 2013/14
Denominator:	Total number of mastectomies for women aged 18+ diagnosed with breast cancer
Numerator:	The number of mastectomies performed as day surgery for women aged 18+ diagnosed with breast cancer
Exclusion criteria:	1) Women younger than 18 years of age were excluded 2) Bilateral breast cancer
Data availability:	All provinces and territories
Stratification:	1) By province
Data source:	Canadian Institute for Health Information; Hospital Morbidity Database (HMDB); National Ambulatory Care Reporting System; Alberta Ambulatory Care Reporting System.
Data retrieval date:	September-October 2015
Variables details:	Not applicable
Notes from Jurisdictions:	Not applicable
Methodology notes:	1) Data presented include ages 18+. 2) Patients receiving a mastectomy anywhere within the discharge record containing the surgical episode associated with the patient's first breast resection are considered mastectomy cases. 3) Analysis was conducted by CIHI.
Changes to definition compared to previous years:	Not applicable

Appendix A

Histology Code Exclusions for Neuroendocrine and Squamous Cell Carcinomas (Indicator 1a)

Neuroendocrine

1. Under carcinoma, NOS: 8013, Large Cell Neuroendocrine
2. Under Adenoca with Metaplasia: 8574, Adenoca with Neuroendocrine Differentiation
3. Under Carcinoid Tumour, Malignant: 8094, Neuroendocrine Carcinoma

Squamous Cell Carcinoma (SCC)

1. Under Papillary Carcinoma, NOS: 8052, Papillary SCC
2. Under Lymphoepithelial Carcinoma: 8083, Basaloid SCC & 8084, SCC Clear Cell Type
3. Under Adenoca with Metaplasia: 8570, Adenoca with Squamous Metaplasia
4. Under Adenosquamous Carcinoma: 8560, Adenosquamous Carcinoma
5. Under Basal Cell Carcinoma, NOS: 8094, Basosquamous Carcinoma
6. Under SCC, NOS: 8070, 8071, 8072, 8073, 8074, 8075, 8076, 8078

Sarcoma codes:

ICD-O-3 Histology	English Description
8710	Glomangiosarcoma
8800	Sarcoma
8801	Spindle cell sarcoma
8802	Giant cell sarcoma (except of bone M-9250/3)
8803	Small cell sarcoma
8804	Epithelioid sarcoma
8805	Undifferentiated sarcoma
8806	Desmoplastic small round cell tumour
8810	Fibrosarcoma
8811	Fibromyxosarcoma
8812	Periosteal fibrosarcoma (C40._, C41._)
8813	Fascial fibrosarcoma
8814	Infantile fibrosarcoma
8832	Dermatofibrosarcoma (C44._)
8833	Pigmented dermatofibrosarcoma protuberans (C44._)

8840	Myxosarcoma
8850	Liposarcoma
8851	Liposarcoma, well differentiated
8852	Myxoid liposarcoma
8853	Round cell liposarcoma
8854	Pleomorphic liposarcoma
8855	Mixed liposarcoma
8857	Fibroblastic liposarcoma
8858	Dedifferentiated liposarcoma
8890	Leiomyosarcoma
8891	Epithelioid leiomyosarcoma
8894	Angiomyosarcoma
8895	Myosarcoma
8896	Myxoid leiomyosarcoma
8900	Rhabdomyosarcoma
8901	Pleomorphic rhabdomyosarcoma, adult type
8902	Mixed type rhabdomyosarcoma
8910	Embryonal rhabdomyosarcoma, NOS
8912	Spindle cell rhabdomyosarcoma
8920	Alveolar rhabdomyosarcoma
8921	Rhabdomyosarcoma with ganglionic differentiation
8930	Endometrial stromal sarcoma (C54.1)
8931	Endometrial stromal sarcoma, low grade (C54.1)
8933	Adenosarcoma
8935	Stromal sarcoma
8936	Gastrointestinal stromal sarcoma
8963	Rhabdoid sarcoma
8964	Clear cell sarcoma of kidney (C64.9)
8980	Carcinosarcoma, NOS

8981	Carcinosarcoma, embryonal
8991	Embryonal sarcoma
9040	Synovial sarcoma
9041	Synovial sarcoma, spindle cell
9042	Synovial sarcoma, epithelioid cell
9043	Synovial sarcoma, biphasic
9044	Clear cell sarcoma, NOS (except of kidney M-8964/3)
9051	Sarcomatoid Mesothelioma
9120	Hemangiosarcoma
9124	Kupffer cell sarcoma (C22.0)
9140	Kaposi sarcoma
9170	Lymphangiosarcoma
9180	Osteosarcoma (C40._, C41._)
9181	Chondroblastic osteosarcoma (C40._, C41._)
9182	Fibroblastic osteosarcoma (C40._, C41._)
9183	Telangiectatic osteosarcoma (C40._, C41._)
9184	Osteosarcoma in Paget disease of bone (C40._, C41._)
9185	Small cell osteosarcoma (C40._, C41._)
9186	Central osteosarcoma (C40._, C41._)
9187	Intraosseous well differentiated osteosarcoma (40._, C41._)
9192	Parosteal osteosarcoma (C40._, C41._)
9193	Periosteal osteosarcoma (C40._, C41._)
9194	High grade surface osteosarcoma (C40._, C41._)
9195	Intracortical osteosarcoma (C40._, C41._)
9220	Chondrosarcoma (C40._, C41._)
9221	Juxtacortical chondrosarcoma (C40._, C41._)
9231	Myxoid chondrosarcoma
9240	Mesenchymal chondrosarcoma
9242	Clear cell chondrosarcoma (C40._, C41._)

9243	Dedifferentiated chondrosarcoma (C40._, C41._)
9250	Giant cell sarcoma of bone
9251	Malignant giant cell tumour of soft parts
9252	Malignant tenosynovial giant cell tumor
9260	Ewing sarcoma
9270	Odontogenic sarcoma
9290	Ameloblastic odontosarcoma
9330	Ameloblastic fibrosarcoma
9342	Odontogenic carcinosarcoma
9442	Gliosarcoma (C71._)
9480	Cerebellar sarcoma, NOS (C71.6) [obs]
9530	Meningial sarcoma
9539	Meningeal sarcomatosis
9581	Alveolar soft part sarcoma
9591	Reticulosarcoma
9662	Hodgkin sarcoma [obs]
9684	Immunoblastic sarcoma
9740	Mast cell sarcoma
9755	Histiocytic sarcoma
9756	Langerhans cell sarcoma
9757	Interdigitating dendritic cell sarcoma
9758	Follicular dendritic cell sarcoma
9930	Myeloid sarcoma (see also M-9861/3)

Appendix B

The entire squamous cell neoplasia list is below:

- 8050/3 Papillary carcinoma, NOS (not otherwise specified)
- 8051/3 Verrucous carcinoma, NOS
- 8052/3 Papillary squamous cell carcinoma
- 8070/3 SCC, NOS
- 8071/3 Keratinizing
- 8072/3 Non-keratinizing
- 8073/3 SCC, small cell, non-keratinizing
- 8074/3 SCC, spindle cell
- 8075/3 SCC, adenoid
- 8076/3 SCC, micro invasive
- 8078/3 SCC with horn formation
- 8082/3 Lymhoepithelial carcinoma
- 8083/3 Basaloid scc
- 8084/3 SCC, clear cell type

Impact Calculations

Impact of meeting the programmatic breast cancer screening abnormal call rate targets

Measure	Reduction in the number abnormal mammogram findings if the current abnormal mammogram finding rates were reduced to the ideal rates for initial and subsequent screens.
Ideal scenario	Abnormal finding rate: • Initial screen: 10% • Subsequent screen: 5%
Current scenario	2011-2012 programmatic breast cancer screening • Abnormal findings from initial screens: - Number: 403,348 - Rate:15.3% • Abnormal findings from subsequent screens: - Number: 2,106,458 - Rate: 7.2%
Methodology	Impact was estimated using two steps: 1) Calculate the difference of counts between the ideal findings and the current findings for the first screens and the subsequent screens separately, using the formula: $(rate_{current} - rate_{ideal}) \times N_{curent}$ 2) Add the difference of counts for the initial screens and the subsequent screens together
Note	• The data for current scenario was from CIHI. • The impact number was for two years (2011-2012). To present it as per year, it was divided by 2.

Impact of increasing referrals to specialists post-surgery for patients with stage II or IIIA non-small cell lung cancer

Measure	Increase in the number of referrals if all patients with stage II or IIIA NSCLC were referred to an oncology specialist after surgery.
Ideal scenario	• From a 2008 chart review, 14.3% of patients with NSCLC were not referred to a specialist • 85% of all lung cancers were NSCLC • From 2010 and 2011, 21.1% of all lung cancers were stage II or IIIA
Current scenario	• In 2012, the number of lung cancers: 24,420
Methodology	Impact was estimated using three steps: 1) Estimate the number of NSCLC cases by: $N_{NSCLC} = N_{lung} \times 85\%$ 2) Estimate the number of NSCLC cases that are stage II or IIIA by: $N_{stage\ II\ or\ IIIA,NSCLC} = N_{NSCLC} \times 21.1\%$ 3) Calculate the potential increase in the number patients with stage II or IIIA NSCLC who are referred to an oncology specialist post-surgery if the non-referred patients were referred to a specialist: $N_{stage\ II\ or\ IIIA,NSCLC} \times 14.3\%$

Note	• The non-referral rate for the ideal scenario was from a chart review conducted in 2008. • The percentage of patients with NSCLC was from internet consensus (refer to reference section below). • The percentage of patients with stage II or IIIA NSCLC was from provincial cancer agencies. • Data for the current scenario were from the Canadian Cancer Registry (CCR) [CANSIM]. • The non-referral rate in 2008 was based on data from AB, SK, MB and PE. The total lung cancer cases in 2012 was for all provinces and territories. Results should be interpreted with caution.
Reference	https://www.cancer.org/cancer/non-small-cell-lung-cancer/about/what-is-non-small-cell-lung-cancer.html http://emedicine.medscape.com/article/279960-overview

Impact of increasing adult clinical trial participation

Measure	Increase in the number of adult cancer patients participating in clinical trials if the current clinical trial participation rate was increased to the ideal rate.
Ideal scenario	Clinical trial participation rate (in United Kingdom): 12%
Current scenario	Clinical trial participation in 2014: • Participation rate: 4.5% • Estimated adult cancer cases (excluding QC): 141,000
Methodology	Calculate the difference of counts using the formula: $(rate_{ideal} - rate_{current}) \times N_{current}$
Note	• The current participation rate was from provincial cancer agencies. • The number of adult cancer cases was from Canadian Cancer Registry (CCR). • The estimated impact does not include QC. Results should be interpreted with caution.

Impact of changing breast cancer mastectomies to less-invasive (but equally effective) breast-conserving surgeries

Measure	Increase in the number of women receiving breast-conserving surgery (BCS) if the BCS rate for women living in rural areas was increased to the rate for women living in urban areas.
Ideal scenario	Fiscal years 2007/08-2011/12 combined: • BCS rate: 62.5% for women living in urban areas
Current scenario	Fiscal years 2007/08-2011/12 combined (same period): • BCS rates and counts Urban: Rate (%) 62.5, Count 29,561 Rural: Rate (%) 61.6, Count 1,594 Rural-Remote: Rate (%) 58.1, Count 2,513 Rural-Very Remote: Rate (%) 47.7, Count 1,969
Methodology	Impact was estimated using two steps: 1) Calculate the difference in counts if each rural area had the same BCS rates as urban areas, using the formula: $(rate_{ideal} - rate_{current}) \times N_{current}$

	2) Add the difference in counts for all the rural areas
Note	• The data for the ideal and current scenarios were from CIHI. • The impact number was for 5 years (2007/08-2011/12). To present it as per year, it was divided by 5.

Impact of increasing five-year survival for patients with breast, lung and colorectal cancer

Measure	Increase in the number of cancer survivors if our cancer system could ensure that all Canadians had the same five-year survival chances that high-income populations have.
Ideal scenario	5-year net survival ratios in the highest neighbourhood income area (quintile 5: Q5) for 2004-2009 diagnosis years combined, for the selected cancers: • Breast: 87.9% • Lung: 18.9% • Colorectal: 65.3%
Current scenario	• 5-year net survival ratios for 2004-2009 diagnosis years combined (same period) by neighborhood income quintile (Q), for the selected three cancers: Q1: Breast Ratio (%) 82.8; Lung Ratio (%) 16.1; Colorectal Ratio (%) 59.3 Q2: 84.1; 16.9; 61.6 Q3: 85.5; 18.1; 62.9 Q4: 85.7; 17.7; 63.9 Q5: 87.9; 18.9; 65.3 • The number of incidence cases in 2012 by neighbourhood income quintile: Q1: Breast N 3,855; Lung N 5,575; Colorectal N 3,970 Q2: 4,300; 5,095; 4,365 Q3: 4,185; 4,585; 4,125 Q4: 4,165; 3,940; 3,805 Q5: 4,325; 3,375; 3,605
Methodology	Separately for each cancer, calculate the difference in the number of patients that would survive if all patients had the same 5-year net survival as in Q5, using the formula: $\sum_{all\ Q} (ratio_{ideal} - ratio_Q) \times N_Q$
Note	• This is a proxy calculation. • Data for 5-year net survival ratios were from CONCORD-2. • Data for the number of incidence cases were from Canadian Cancer Registry (CCR). • PE and territories were not included in the 5-year net survival; territories were not included in the incidence cases.

Impact of decreasing breast cancer diagnosis wait times

Measure	Increase in the number of women receiving a diagnosis (cancer or benign) within wait time targets if 90% of all abnormal breast screens were resolved within wait time targets.
Ideal scenario	• 90% of all abnormal breast screens receive definitive diagnosis within target wait times (5-weeks for women who do not require a tissue biopsy and 7-weeks for women who do require a biopsy to resolve the diagnosis).

	• Approximately 85% of abnormal screens do not require a tissue biopsy for diagnostic resolution; 15% of abnormal screens require tissue biopsy.
Current scenario	Breast cancer resolutions for 2013-2014 combined: • Number of abnormal screens ($N_{abnormal}$): 231,687 • Number of screens: - Initial screens: 403,116 - Subsequent screens: 2,223,899 • Percentage of abnormal findings: - Initial screen: 16.6% - Subsequent screens: 7.6% • Estimated percentage of abnormal screens that were followed by a diagnostic procedure: 98.2% • Average percentage of abnormal breast screens resolved within wait time target across provinces ($percent_{avg}$): - Without tissue biopsy: 86.7% - With tissue biopsy: 66.9%
Methodology	Impact was estimated using three steps: 1) Estimate the total number of abnormal breast screens: $$N_{abnormal} = \sum_i N_i \times percent_{abnormal,i} \times (0.982)$$ Where i refers to initial or subsequent screens. 2) Estimate the number of abnormal breast screens that were followed by diagnostic procedures: - without tissue biopsy: $$N_{no\ biopsy} = N_{abnormal} \times 85\%$$ - with tissue biopsy: $$N_{biopsy} = N_{abnormal} \times 15\%$$ 3) Calculate the number of screens where 90% of all abnormal breast screens receive definitive diagnosis within the target wait time, without and with tissue biopsy: $$(90\% - percent_{avg}) \times N_{no\ biopsy}$$ $$(90\% - percent_{avg}) \times N_{biopsy}$$
Note	• Data for the current scenario were from Canadian Breast Cancer Screening Database (CBCSD). • QC and territories were not included in the average percentage of abnormal breast screens resolved within wait time target. Results should be interpreted with caution. • The impact number was for 2 years combined (2013-2014). To present the number as per year, it was divided by 2.

Impact of increasing the number of cancer patients who die at home

Measure	1) Decrease in the number of cancer deaths in hospital if all provinces achieved the lowest death rate in hospitals across provinces. 2) Increase in the number of cancer deaths at home if all provinces achieved the highest death rate in private homes across provinces.
Ideal scenario	In 2012 across provinces and territories: 1) The lowest percentage of deaths in hospital: 49.2% 2) The highest percentage of death in private home: 22.7%

<table>
<tr>
<td>Current scenario</td>
<td>
1) In 2012, for each province and the territories combined, the number of cancer deaths in hospital and the corresponding rates were as follow:
<table>
<tr><th></th><th>/territories</th><th>Province Rate (%)</th><th>N deaths</th></tr>
<tr><td>BC</td><td>49.2</td><td>4,625</td><td></td></tr>
<tr><td>AB</td><td>62.8</td><td>3,745</td><td></td></tr>
<tr><td>SK</td><td>67.1</td><td>1,530</td><td></td></tr>
<tr><td>MB</td><td>87.8</td><td>2,365</td><td></td></tr>
<tr><td>ON</td><td>63.1</td><td>17,280</td><td></td></tr>
<tr><td>QC</td><td>76.7</td><td>15,610</td><td></td></tr>
<tr><td>NB</td><td>76.4</td><td>1,405</td><td></td></tr>
<tr><td>NS</td><td>68.6</td><td>1,750</td><td></td></tr>
<tr><td>PE</td><td>64.4</td><td>235</td><td></td></tr>
<tr><td>NL</td><td>77.7</td><td>1,060</td><td></td></tr>
<tr><td>TR</td><td>62.5</td><td>100</td><td></td></tr>
</table>
2) In 2012, for each province and territories, the number of cancer deaths in private home and the corresponding rates were as follow:
<table>
<tr><th></th><th>/territories</th><th>Province Rate (%)</th><th>N deaths</th></tr>
<tr><td>BC</td><td>15.7</td><td>1,480</td><td></td></tr>
<tr><td>AB</td><td>10.1</td><td>600</td><td></td></tr>
<tr><td>SK</td><td>13.3</td><td>750</td><td></td></tr>
<tr><td>MB</td><td>10.9</td><td>295</td><td></td></tr>
<tr><td>ON</td><td>20.3</td><td>5,550</td><td></td></tr>
<tr><td>QC</td><td>4.7</td><td>960</td><td></td></tr>
<tr><td>NB</td><td>13.3</td><td>245</td><td></td></tr>
<tr><td>NS</td><td>22.7</td><td>580</td><td></td></tr>
<tr><td>PE</td><td>11.0</td><td>40</td><td></td></tr>
<tr><td></td><td>NL</td><td>11.7</td><td>160</td></tr>
<tr><td>TR</td><td>21.9</td><td>35</td><td></td></tr>
</table>
</td>
</tr>
<tr>
<td>Methodology</td>
<td>
1) Calculate the difference in the current rate and the ideal rate for hospital deaths for each province and territories, and multiply by each corresponding number of deaths in hospital. Take the sum using the formula:
$$\sum_{jurisdiction} \left(rate_{jurisdiction} - 49.2\%\right) \times N_{jurisdiction}$$
Where N refers to the number of deaths in hospital.

2) Calculate the difference in the current rate and the ideal rate for deaths in private home for each province and territories, and multiply by each corresponding number of deaths in private homes. Take the sum using the formula:
$$\sum_{jurisdiction} \left(rate_{jurisdiction} - 22.7\%\right) \times N_{jurisdiction}$$
Where N refers to the number of deaths in private home.
</td>
</tr>
<tr>
<td>Note</td>
<td>
• Data for both ideal and current scenarios were from Vital Statistics Database.
• Due to a small number of deaths in private home in SK, data for private homes were combined with “Other” location. The percentage of deaths in private home was estimated based on the ratio (1.48) of “Other” to “private home” from other provinces/territories.
</td>
</tr>
</table>

Impact Calculations using OncoSim

Canadian Partnership Against Cancer modelling

The OncoSim model (formerly the Cancer Risk Management Model, or CRMM), developed by the Canadian Partnership Against Cancer and in collaboration with Statistics Canada, through funding from Health Canada, was designed to evaluate the impact of cancer care policy changes in the Canadian system. OncoSim incorporates the risk of developing and dying from cancer and other causes, as well as screening and clinical management with healthcare costs and labour data and can be used to assess both health outcomes and economic impact. OncoSim includes a suite of models for lung, colorectal, cervical and breast cancers.

OncoSim rests on a microsimulation platform, which uses real-world clinical and economic evidence and can integrate data from a variety for sources. It is supported by a user-friendly, web-enabled platform to allow for browsing and custom scenario development by registered users (https://oncosim.cancerview.ca). It models the natural development and progression of disease for the most common cancers that affect the Canadians. Resulting clinical and economic outputs can be used to assess health consequences and inform resource allocation for cancer control interventions. Specifically, OncoSim can evaluate cancer control strategies for prevention, screening and treatment of common cancers, by comparing projections of incidence, mortality, resources needs, direct health care costs and broader economic impacts such as lost wages.

All OncoSim simulation results are based on version 2.3.0.1 using 32 million simulated cases (scaled to the size of the Canadian population). The in-depth analysis was conducted to assess the potential impact of:

- Reducing the smoking prevalence from 19.3 % to 5% by 2035 on future lung cancer incidence, mortality, treatment costs and quality-adjusted life years.

Data

OncoSim simulates and projects a representative sample of the Canadian population using Statistics Canada's official demographic projections. OncoSim takes into account births, mortality, immigration and inter-provincial migration to represent the age-sex, provincial structure of the population. The Canadian Cancer Registry is a fundamental source of cancer data used to inform the incidence and staging of colorectal, lung and cervical cancers. Healthcare costs were obtained predominantly from Ontario sources and included the Ontario Health Insurance Plan Schedule of Benefits for physician fees, the Ontario Case Costing Initiative for hospital costs, Ontario's Drug Formulary and Cancer Care Ontario's New Drug Funding Program. Costs are reported in 2016 Canadian dollars. Sources for economic data included census and other simulation models at Statistics Canada. Multiple data sources and expert opinion have been utilized for standard disease-specific diagnostic and treatment practices, health care costs and utilities, expected personal income and tax revenue. (1-3) Additional data sources for parameters (see Table V) were obtained from randomized controlled trials, academic publications and grey literature, including survival data, data to inform natural history of cancer progression, end-of-life care costs and efficacy of screening. [1]

Lung cancer simulations

Methods

The lung cancer module of OncoSim can be used to assess the health and economic impacts of tobacco reduction strategies, variable uptake of conventional and new therapies, and potential lung screening strategies. It has been validated extensively, and is well described.(2, 3, 6, 7) "Briefly, the program simulates individual lives from birth through development of cancer and progression to death, tracking health-related quality of life, health care interventions and costs. OncoSim then aggregates these results across millions of heterogeneous individuals. Data are derived from a wide range of sources including vital statistics, health surveys, cancer registry data, the medical literature, drug and hospital costs, and expert opinion when necessary. Cancer incidence and mortality data produced by the model have aligned well with cancer registry data, have been internally validated and have been compared with other models with good face validity." (3, 7)

The OncoSim lung cancer module includes a screening component that can be used to assess low-dose computed tomography scans for a variety of screening strategies, including thresholds of risk for eligibility to program, age to start and end screening, screening frequency, and various participation and cost assumptions. The module has been calibrated and assessed against the U.S.-based National Lung Screening Trial results.(3)

OncoSim simulates the hazard of developing lung cancer using a risk equation from the literature (8) that combines the risk associated with cumulative lifetime radon and smoking exposure and was aligned with the number of cases reported to the Canadian Cancer Registry by age, sex and province. Smoking behaviour was simulated to match Canadian survey data over time, by age, sex and province, based on the 1979 Canada Health Survey, the 1994/1995 National Population Health Survey and the 2008 Canadian

[1] For a comprehensive list of sources please contact oncosim@partnershipagainstcancer.ca.

Community Health Survey.(9-11) Smoking trajectories were externally validated against other survey years and tobacco manufacturers' data. (12) Trajectories before 1979 were extrapolated and compared with smoking data previously compiled for Canada.(13) Recent smoking trends were extrapolated after 2008.(3)

Baseline incidence rates were calibrated to the number of new cases in the Canadian Cancer Registry for 2005 and assessed for alignment across years 1999 to 2009. Lung cancer mortality was calibrated to the Canadian Mortality Database for 2005 and compared across time.(3)

The limitations of OncoSim have been reported in detail.(14) Briefly, resource costs were derived predominantly from one province in Canada, although analysts can modify various OncoSim inputs for region-specific analyses. Costs from the patient perspective were not assessed.

Scenarios

Scenarios were run to show the impact of reducing the smoking prevalence from 19.3% to 5% by 2035. Outcomes reported include lung cancer treatment costs, lung cancer incidence, mortality and impact on the quality-adjusted life years.

To achieve a 5% smoking rate, a cessation parameter was modified by altering the proportion of light and heavy smokers that quit for life. The smoking cessation efforts run from 2017-2040. This was compared to the base case (reference scenario) in which the model projects background quit rates that vary between 2.8% and 5% over time. We did not model the inclusion of any costs associated with smoking cessation intervention in either scenario.

Definitions:

- Light smoker is defined as smoking fewer than 20 cigarettes per day
- Heavy smoker is defined as smoking 20 or more cigarettes per day

Assumptions include:

- Proportion of light smokers that become non-smokers = 9.4 %
- Proportion of heavy smokers that become non-smokers = 9.4%
- Both light and heavy smokers quit for life

Table III highlights the two scenario assumptions.

Table III

Scenario	Cessation start year	Cessation end year	Age start	Age end	Proportion of light smokers who quit	Proportion of heavy smokers who quit	Proportion of quitters that quit for life
Base Case (Reference)	9999	9999	0	99	0 %	0 %	0 %
5% smoking rate by 2035	2017	2040	0	99	9.40%	9.40%	100%

Table IV shows the decreasing trend in smoking rates/100 by year in both scenarios

Table IV

	Smokers (rate per 100)	
Scenario	Base case (Reference)	5% smoking rate by 2035
2016	19.3	19.3
2017	19.2	18.3
2018	19.1	16.6
2019	19.0	15.0
2020	18.9	13.6
2021	18.8	12.4
2022	18.7	11.3
2023	18.6	10.3
2024	18.6	9.5
2025	18.5	8.8
2026	18.4	8.2
2027	18.3	7.6
2028	18.3	7.1
2029	18.2	6.7
2030	18.1	6.3
2031	18.1	6.0
2032	18.0	5.7
2033	18.0	5.4
2034	18.0	5.2
2035	17.9	5.0

Results

Projected impact of reducing the smoking prevalence to 5% by 2035

The results generated by OncoSim show that by 2035, compared to the reference scenario, the following impacts are seen: (Numbers reported are an average (2016-2035))

- Incidence: Average reduction in lung cancer incidence of 1,560 cases per year
- Mortality: Average reduction in lung cancer mortality by 1,040 deaths per year
- *Quality-adjusted life years (QALYs): Average gain of 23,000 QALYs per year
- *Cost of treatment: Reduction in lung cancer treatment costs by average of $34 million per year (Canadian dollars).

*Both costs and QALYs are undiscounted and costs are reported in 2016 Canadian dollars.

Table V: Data sources

Data Type	Source
Mortality, birth, population projections	Vital Statistics (1950-2005), Census (2006, 2011)
Incidence, staging, survival	Canadian Cancer Registry (1992-2010)
Cancer survival by stage	British Columbia Cancer Registry Data (1992-2012) Chart review (1991-92), Literature (1981, 1990-2000, 2005)
Smoking rates	Canadian Community Health Survey (2000-2007), National Population Health Survey (1994-2004), Canadian Health Survey (1979)
Time use data	General Social Survey (2005)
Earnings, transfers and taxes	Census 2006, SPSD/M v16.1 (2005)
Total health care expenditures	Canadian Institute for Health Information (2006)
Health care costs: diagnosis, treatment, follow-up, palliative and terminal care	Ontario Case Costing Initiative (2007-2008), Provincial formulary (2009), Provincial Ministries of Health (2009)
Current treatment practice	Expert Opinion, Ontario administrative data
Screening, Lung cancer risk equation, Radon exposure, sexual network, HPV virus transmission	Canadian Breast Cancer Screening Database, British Columbia administrative data, CCHS, Reports, Literature
Health status	Classification and Measurement System, CCHS

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