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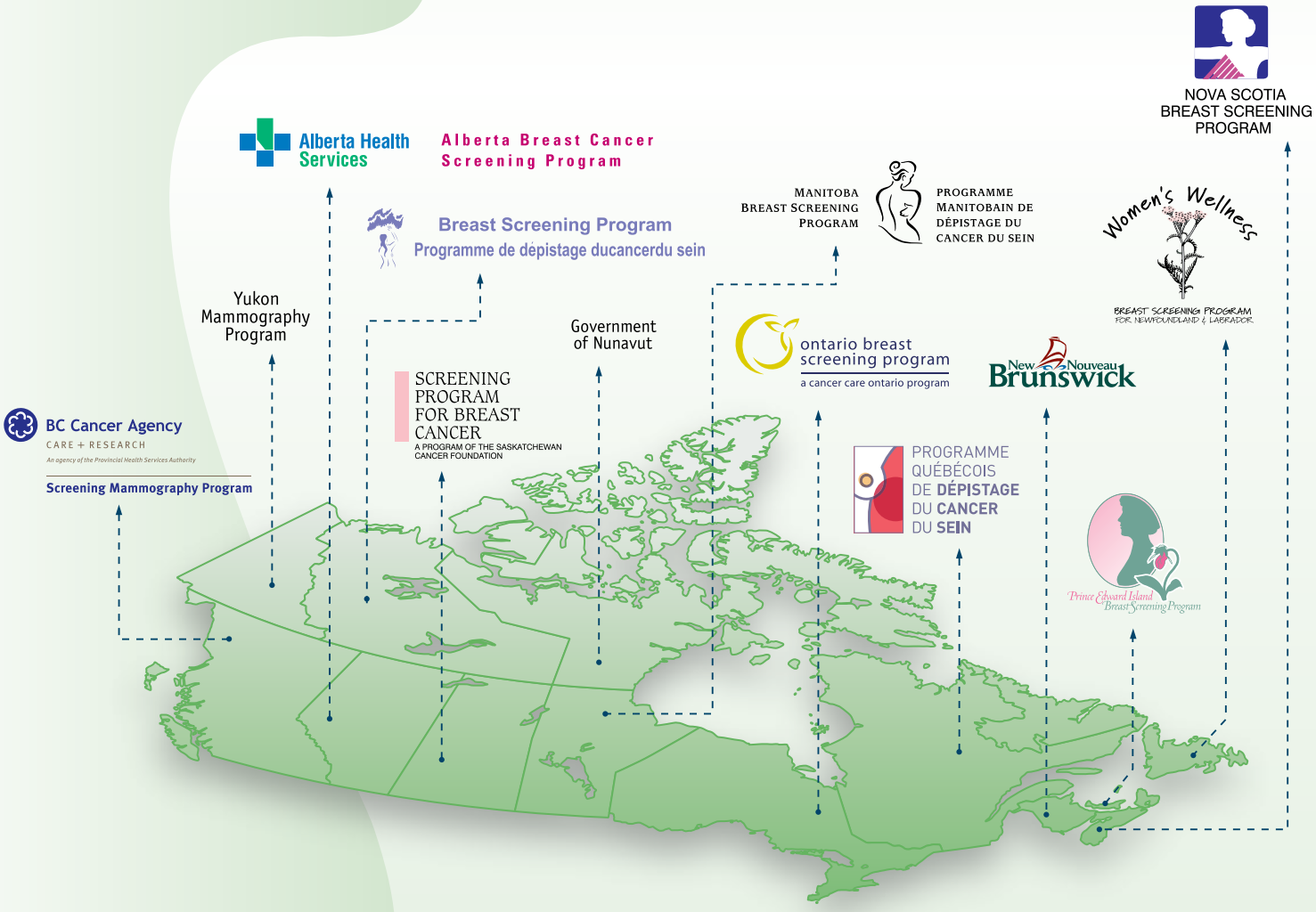
Organized Breast Cancer Screening Programs in Canada



Report on Program Performance in 2005 and 2006

Canada

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Organized Breast Cancer Screening Programs in Canada

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Editorial

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EXECUTIVE SUMMARY

Breast cancer is the most common type of cancer and the second leading cancer cause of death among Canadian women with a projected 23,000 diagnoses and 5,330 deaths in 2010.(1) Incidence rose steadily from 1980 to the early 1990's and now shows a pattern of modest decreases and increases for which the cause is unclear.(1) The mortality rate attributable to breast cancer has declined by 30% over the past twenty years.(1) Although breast cancer can occur at any age, more than half (52%) of new cases occur among women between 50 and 69 years.(1) Early detection, through programmatic screening, combined with effective treatment remains the best option available to continue reducing deaths from breast cancer in this age group.

The monitoring and evaluation of organized breast cancer screening programs provides an opportunity to understand the impact of screening on breast cancer morbidity and mortality, as well as the potential harms associated with screening. Systematic evaluation of organized programs helps to ensure that Canadian women have access to high-quality breast cancer screening programs. This document presents an evaluation of the performance of organized breast cancer screening programs in Canada for the calendar years 2005 and 2006 using data from the Canadian Breast Cancer Screening Database from ten provinces and one territory.

The societal benefits from breast cancer screening are based on the assumption that 70% of eligible women participate in biennial screening mammography; however, meeting this challenge remains elusive for organized screening programs across Canada. While many programs continue to see increases in participation rates, several mature programs have reached a plateau with participation rates just above 50%. When the contribution of opportunistic screening is considered, most programs report participation close to the target, however, are unable to provide associated comprehensive evaluation.

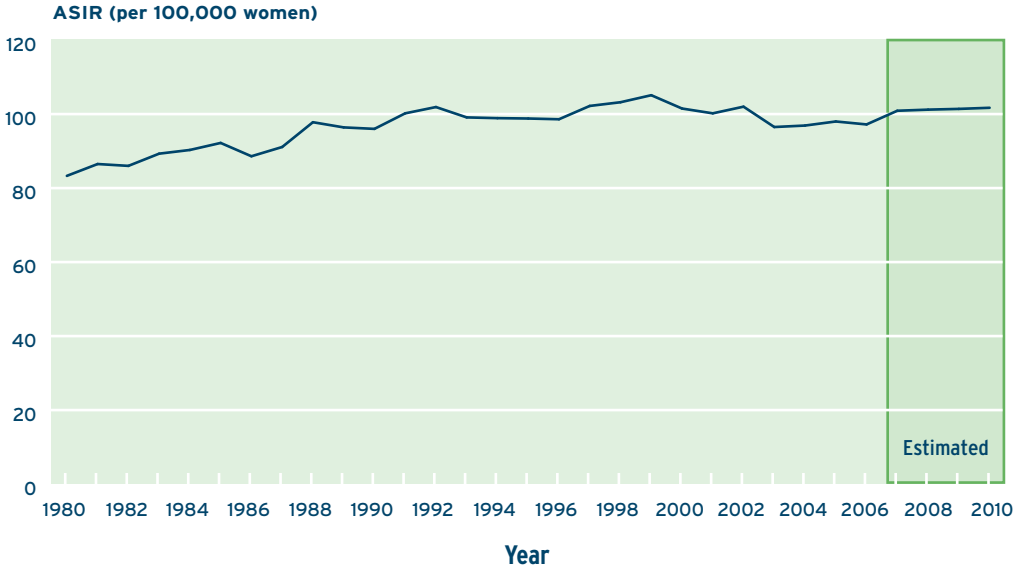
Organized breast cancer screening programs will continue to provide screening services to Canadian women in the coming years. Programs strive to achieve reductions in the morbidity and mortality associated with breast cancer through program evaluation, ongoing research, and adaptation of program policy to reflect new evidence and technologies. The Canadian Breast Cancer Screening Initiative, which supports the production of this report, provides a venue for information sharing to solve screening program challenges. The information provided in this report is available to support governments, cancer agencies, screening program managers, health professionals, and other breast cancer stakeholders to enhance organized screening across Canada.

BACKGROUND

Introduction

An estimated 23,200 women are projected to be diagnosed with breast cancer and 5,300 women to die from the disease in 2010.(1) This makes breast cancer the most common form of cancer[a] and the second leading cancer cause of death[b] in Canadian women.(1) Incidence of breast cancer has risen steadily between 1980 and the early 1990's and now shows a pattern of modest decreases and increases for which the cause is unclear (**Figure 1a.** *below*).(1) In addition, the mortality rate attributed to breast cancer continues to decline and is approximately 30% lower than in 1986 (**Figure 1b.** *pg4*).(1)

Figure 1a. Age-standardized incidence rates (ASIR) per 100,000 women for breast cancer in Canada, 1980-2010



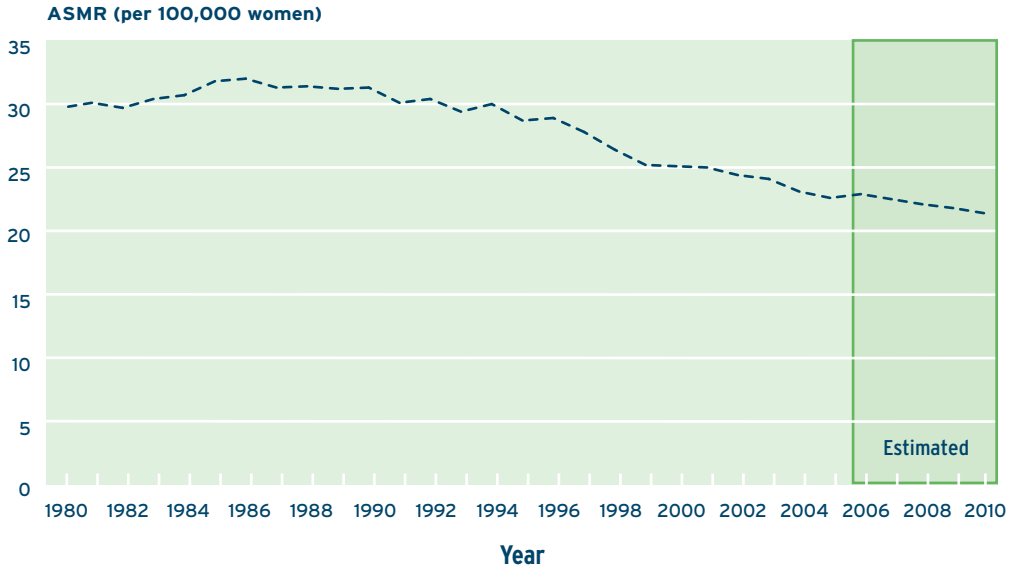
Notes:
1. Incidence rates are estimated for 2007-2010.
2. The national rate is an estimate computed from observed case counts for all provinces and territories.
3. Rates are standardized to the age distribution of the 1991 population.

Source: National Cancer Institute of Canada. Canadian Cancer Statistics 2010. Toronto, Canada, 2010.

[a] Incidence of non-melanoma skin cancer exceeds that of breast cancer in Canada, however, rates are typically not reported due to difficulty estimating true incidence.

[b] Deaths from lung cancer exceed that of breast cancer among women in Canada, with 9,400 deaths expected in 2010.

Figure 1b. Age-standardized mortality rates (ASMR) per 100,000 women for breast cancer in Canada, 1980-2010



Notes:
1. Mortality rates are estimated for 2006-2010.
2. The national rate is an estimate computed from the death counts estimated for each province and territory.
3. Rates are standardized to the age distribution of the 1991 population.

Source: National Cancer Institute of Canada. Canadian Cancer Statistics 2010. Toronto, Canada, 2010.

Early detection of breast cancer, through organized mammography screening programs, is an effective method to reduce death and morbidity associated with breast cancer. This is partially because primary prevention of breast cancer has been limited: most known risk factors are not easily modifiable.

Of known risk factors, age has the strongest influence on breast cancer incidence; roughly, half of all new cases are among women between 50 and 69 years of age. Modelling exercises have shown that the delivery of high quality breast screening programs to this age group has the potential to reduce breast cancer deaths by as much as one third.(2) Among other considerations, this scientific information influences Canadian provinces and territories to provide breast cancer screening services to this age group. Many provinces and territories also provide screening services to other age groups but in a less targeted fashion.

Table 1. Breast cancer screening programs in Canada[a] - usual practices, 2005 and 2006 screen years

Province/territory	Program start date	Clinical breast examination on site	Program practices for women outside the 50-69 year age group		
			Age group	Accept	Recall
Northwest Territories	2003	No	40-49	Yes	Annual
			70+	Yes	Biennial
Yukon Territory	1990	No	40-49	Yes	None
			70+	Yes	None
British Columbia	1988	No	<40	Accept with physician referral	None
			40-49	Yes	Annual
			70-79	Yes	Biennial
			80+	Accept with physician referral	None
Alberta	1990	No	40-49	Yes	Annual
			70-74	Yes	Biennial
			75+	Yes	None
Saskatchewan	1990	No	40-49	No[b]	N/A
			70-74	Yes	Biennial
			75+	Yes	None
Manitoba	1995	No[c]	40-49	Accept to mobile unit with physician referral	Biennial
			70+	Accept to mobile unit with physician referral	None
Ontario	1990	Yes[d]	70-74	Yes	Biennial
			75+	Yes	None
Québec	1998	No	35-49	Accept with physician referral[e]	None
			70+	Accept with physician referral[e]	None
New Brunswick	1995	No	40-49	Accept with physician referral	None
			70+	Accept with physician referral	None
Nova Scotia	1991	Yes[f]	40-49	Yes	Annual
			70+	Yes	None
Prince Edward Island	1998	No	40-49	Yes	Annual
			70-74	Yes	Biennial
Newfoundland and Labrador	1996	Yes[g]	40-49	No	N/A
			70+	Accept if previously enrolled in program	None

[a] Nunavut has not developed an organized breast cancer screening program.
[b] Accept age 49 on the mobile if they would be 50 in that calendar year.
[c] Nurse or Technologist provided CBE service until October 2005.
[d] Nurse provides clinical breast examination at 52% of sites.
[e] Accept with physician referral if done at a program screening centre, but is not officially considered within the program.
[f] Modified examination only, performed by technologist at time of mammography.
[g] Nurse.

History of Breast Cancer Screening in Canada

In December 1992, the Canadian federal government launched the first phase of the Canadian Breast Cancer Initiative (CBCI). The CBCI included 25 million dollars over five years and included the Canadian Breast Cancer Screening Initiative (CBCSI) among its priorities. Federal funding has continued for the CBCSI, initially through Health Canada and now through the Public Health Agency of Canada.

Organized Breast Cancer Screening Programs

Canada's first organized breast cancer screening program began in British Columbia in 1988 and was followed quickly by most provinces (**Table 1.** *pg5*). Organized breast cancer screening programs now exist in all provinces, and the Northwest and Yukon Territories. Nunavut has not developed an organized mammography screening program but provides opportunistic screening to women when appropriate.

All organized programs provide women between 50 and 69, without a prior diagnosis of breast cancer, with a bilateral, 2-view screening mammogram biennially. Some programs also include women outside of this age group (**Table 1.** *pg5*) and some provide screening at more frequent intervals for a variety of reasons. In 2005 and 2006, several programs provided clinical breast examination by a nurse or technologist but most programs had phased out this service based on scientific evidence.(3) Lastly, some programs include breast cancer survivors; however, survivors are excluded from this report.

The Screening Process

Organized breast cancer screening programs offer screening to women who are asymptomatic for breast cancer. Organized programs in Canada typically involved four steps:

- Identification and invitation of the target population,
- Provision of a screening examination,
- Follow-up of any abnormalities detected at screening, and
- Recall after a normal or benign screening episode.

A number of methods are used to invite women to a screening examination and include population-based invitations, personal invitations, physician education to increase referrals, and media campaigns targeting women. Women may enter into organized programs through their personal letter of invitation, physician referral or self referral.

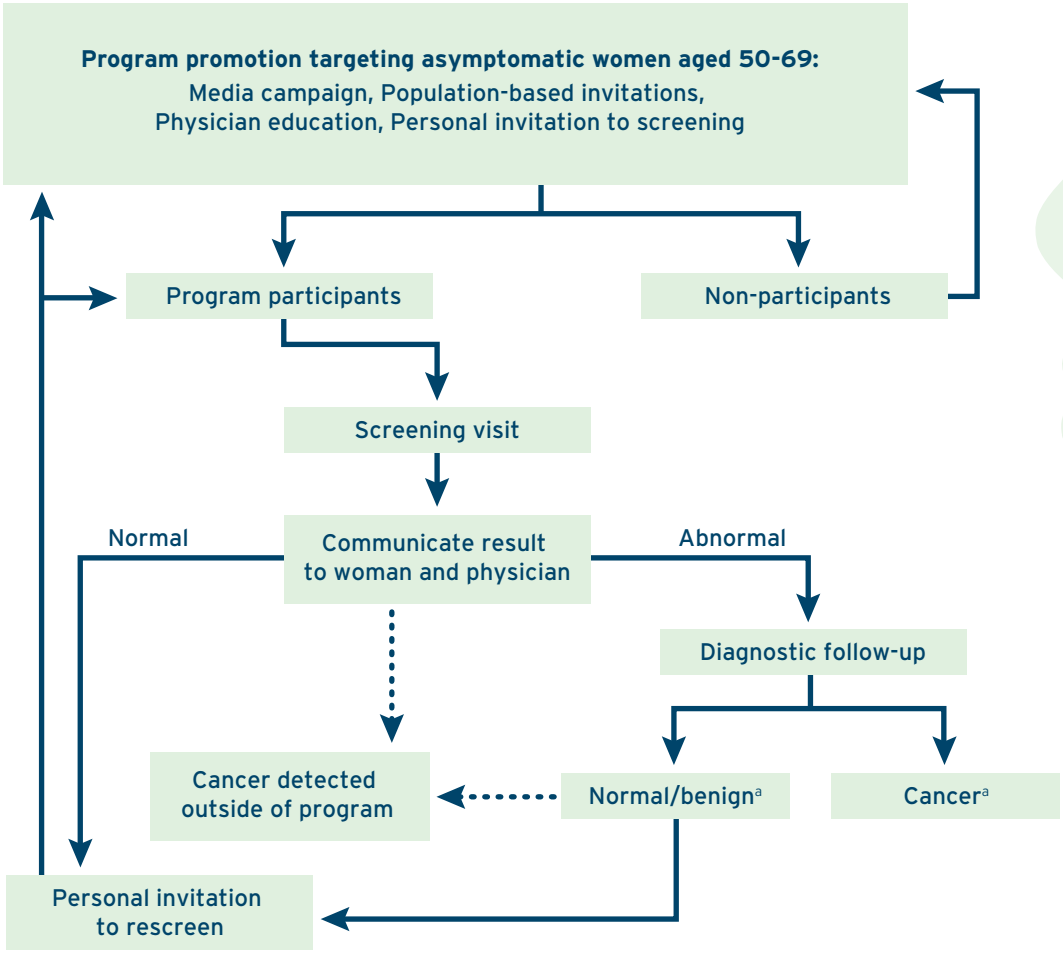
Screening mammograms are provided at both fixed and mobile sites. Fixed sites are located in larger urban areas while mobile sites are typically used to provide service to rural and distant communities. More recently, some mobile sites are used to supplement services at fixed sites.

Results of a screening mammogram are provided to both the woman and her physician. In general, women who have normal screening results are invited back for subsequent screening through a letter of invitation. The interval is generally 24 months; however, some women are invited back after 12 months based on their age, breast density, family history, and results of their screening. After receipt of normal results, women are encouraged to follow-up with their family physicians if they become symptomatic prior to their next scheduled screening visit.

In the case of abnormal results, both the woman and her family physician are informed. The family physician or the screening program then provides coordination of follow-up. This process varies by region. The follow-up process is resolved when a final diagnosis of cancer or normal / benign is concluded (**Figure 2.** *pg8*).

In addition to the systematic methods through which the individual moves through organized breast cancer screening programs, these programs also offer other advantages over opportunistic breast cancer screening. Some of these advantages include population-based recruitment, automatic recall / reminders for subsequent screening, coordinated follow-up for abnormal screening results, systematic quality assurance, and the ability to provide monitoring and evaluation of program performance.

Figure 2. Pathway of a breast cancer screening program



[a] Breast screening programs obtain final diagnoses from sources such as physicians, pathology reports, and cancer registries.

Canadian Breast Cancer Screening Database (CBCSD)

Monitoring and evaluation of organized breast cancer screening programs through the systematic collection, analysis, and interpretation of health data, allows for the enhancement of programming across Canada. The Canadian Breast Cancer Screening Database (CBCSD) provides a method to examine and assess Canadian organized breast cancer screening programs. The CBCSD was established in 1993 and is operated and maintained by the Public Health Agency of Canada on behalf of the Canadian Breast Cancer Screening Initiative. Participating provincial and territorial screening programs contribute to the national database while retaining ownership over their data.

The CBCSD contains screening information from the inception of each organized screening program up to December 2006. At the present time Yukon does not submit records to the CBCSD. They are also excluded from the database. At every screening event, data including demographic characteristics, risk factors, the screening test, screening results and subsequent referral, diagnostic tests, outcomes, and cancer information is collected.

The database is currently used for monitoring, evaluation, and applied screening research. Research priorities are identified on an ongoing basis and the CBCSD is made available to approved researchers external to the Canadian Breast Cancer Screening Initiative. The CBCSD is committed to respecting the privacy of contributors to the dataset. All data is depersonalized and sent securely from the participating programs to the Public Health Agency of Canada. Further, the CBCSD is housed securely at the Public Health Agency of Canada: while participating in the CBCSD, the province/territory owns their data, and thus provinces/territories have unrestricted rights over their data.

Monitoring and Evaluation Using the CBCSD

Monitoring and evaluation of organized screening programs is essential to ensure Canadian women are receiving high quality services. Higher quality services result in the reduction of morbidity and mortality from breast cancer while minimizing the unwanted effects of screening. The results of monitoring and evaluation stemming from the CBCSD are used to enhance the performance of organized screening programs in Canada.

In order to provide fair evaluation for Canadian organized breast screening programs, standardized methods of evaluation have been developed. For detailed information please refer to the most recent Evaluation Indicators Working Group Report.[c] The current Program Performance Measures have been adapted and updated from the previous report. In general, agreed upon performance indicators for women aged 50 to 69 include those related to recruitment and retention (participation rate, retention rate), timeliness (diagnostic interval), mammography interpretation (abnormal call rate, positive predictive value), diagnosis (invasive and in situ cancer detection rate, benign:malignant core biopsy ratio, benign open surgical biopsy rate, benign core biopsy rate), and cancer diagnosis (tumour size, node negative rate in invasive cancers, post-screen invasive cancer rate) (**Table 2.** *pg10*).

[c] The Evaluation Indicators Working Group Report: Guidelines for Monitoring Breast Screening Program Performance: 2nd Edition is available online at www. phac-aspc.gc.ca

Table 2. Performance measures for organized breast cancer screening programs in Canada, women aged 50-69

Indicator	Definition	Target
1. Participation rate	Percentage of women who have a screening mammogram within 30 months as a proportion of the eligible population.[a]	≥70% of the eligible population within 30 months.
2. Retention rate	The estimated percentage of women[b] age 50-67 who are rescreened within 30 months of their previous screen.	≥75% initial rescreen within 30 months; ≥90% subsequent rescreens within 30 months.
3. Abnormal call rate	Percentage of women screened who are referred for further testing because of abnormalities found with a program screen.	<10% (initial screen); <5% (subsequent screens).
4. Invasive cancer detection rate[c]	Number of invasive cancers detected per 1,000 screens.	>5 per 1,000 (initial screen); >3 per 1,000 (subsequent screens).
5. In situ cancer detection rate[c]	Number of ductal carcinoma in situ cancers (rather than invasive cancer) during a screening episode per 1,000 screens.	Surveillance and monitoring purposes only.
6. Diagnostic interval	Total duration from abnormal screen to resolution of abnormal screen.[c]	≥90% within 5 weeks if no tissue biopsy[d] performed; ≥90% within 7 weeks if tissue biopsy[d] performed.
7. Positive predictive value	Proportion of abnormal cases with completed follow-up found to have breast cancer (invasive or in situ) after diagnostic work-up.[c]	≥5% (initial screen); ≥6% (subsequent screens).
8. Benign open surgical biopsy[e] rate	The number of benign open surgical biopsies per 1,000 screens.	Surveillance and monitoring purposes only.
9. Benign core biopsy rate	The number of benign core biopsies per 1,000 screens.	Surveillance and monitoring purposes only.
10. Benign to malignant core biopsy ratio	Among core biopsies, the ratio of number of benign cases to the number of malignant cancer cases.	Surveillance and monitoring purposes only.
11. Invasive cancer tumour size	Percentage of invasive cancers with tumour size of ≤10mm and ≤15mm in greatest diameter as determined by the best available evidence: 1) pathological, 2) radiological, and 3) clinical.	>25% ≤10mm; >50% ≤15mm.
12. Node negative rate in cases of invasive cancer	Proportion of invasive cancers in which the cancer has not invaded the lymph nodes.	>70% (initial and subsequent screens).
13. Post-screen invasive cancer rate[f]	Number of women with a diagnosis of invasive breast cancer after a normal or benign screening episode within 12 AND 24 months of the screen date.	<6 per 10,000 person-years (within 12 months); <12 per 10,000 person-years (within 24 months).

[a] In the case of multiple screens, the first screen within the target population is used.
[b] Eligible women age 50-67 who are rescreened up to age 69.
[c] Resolution of an abnormal screen is set at a maximum of 6 months post screen.
[d] Tissue biopsy does not include fine needle aspiration (FNA).
[e] Open surgical biopsy includes cases that went directly to an open surgical biopsy as their primary diagnostic assessment and those who underwent an inconclusive or incorrect core biopsy prior to a definitive diagnosis by open surgical biopsy.
[f] Calculated based on all women screened from 2002-2003 who developed a post-screen cancer during 2002-2005. Non-compliant cancers were not included in this calculation. Post-screen cancers include all invasive cancers diagnosed after a normal program screen (not referred) or screen detected (referred) cancers that took >6 months to diagnosis (beyond the 'normal screening episode'). Post-screen cancers also include cases referred for diagnostic follow-up with a benign result (calculation includes those missed at screening and at diagnosis).

Note:
1. Program Performance Measures have been adapted and updated from previous report.
Source: Public Health Agency of Canada. Report from the Evaluation Indicators Working Group: Guidelines for Monitoring Breast Cancer Screening Program Performance: Second edition. Ottawa: Minister of Health, 2007.

2005 AND 2006 RESULTS

This report presents statistics for the 2005 and 2006 calendar years using data submitted up to March 2010. Further, the outcomes presented in this report are based on the 2007 report by the Evaluation Indicators Working Group except where otherwise indicated.[d](4) Data submission is staggered and may impact the completeness of cancer-related data for some programs. Unless otherwise noted, the summary statistics include data from all 10 provinces and the Northwest Territories and apply to women aged 50 to 69. These results are based on the experiences of Canadian organized breast cancer screening programs (Appendix A) and not on opportunistic breast cancer screening.

Participation in Organized Breast Cancer Screening Programs

Participation Rate

Adequate participation in breast cancer screening is essential for reductions in mortality to occur in the target population. Based on principles of screening and extrapolation from randomized controlled trials, Canadian programs have established 70% as the target participation rate.(4) The participation rate presented is calculated over a 30 month time period, which is similar to international reporting but results for the traditional 24 months are reported for comparison to previous reports.

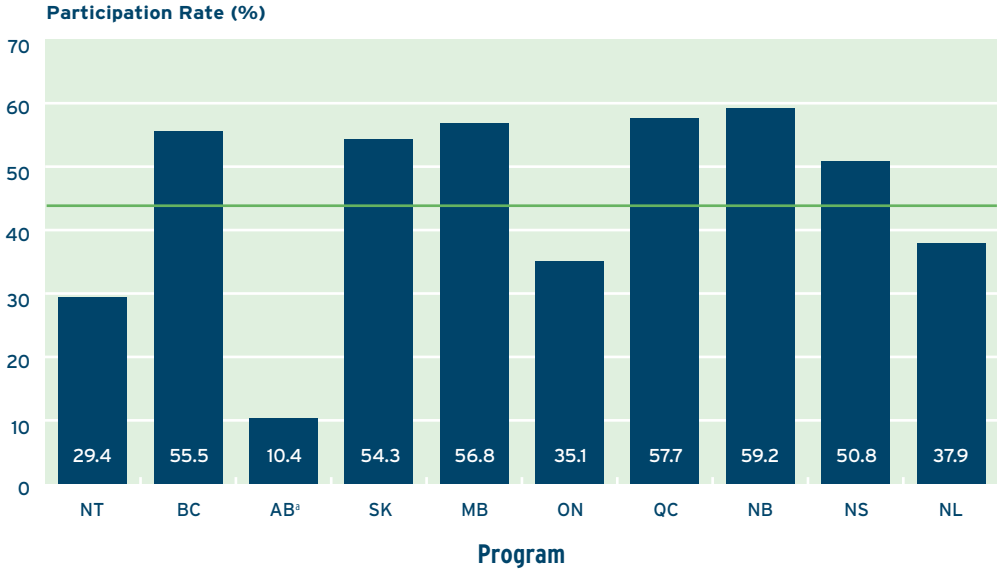
Participation rates include all 10 provinces and the Northwest Territories. Overall, 1,588,699 Canadian women between 50 and 69 (**Table 6.** *pg29*), and 2,031,754 women of all ages (40+)[e], received a screening mammogram through a Canadian organized screening program in 2005 and 2006 (**Table 3.** *pg15*). Since the inception of the first Canadian organized screening program in British Columbia, over 8 million screening mammograms have been performed.

[d] Indicators for which a change in calculation methodology has occurred include participation rate (30 months), retention rate, diagnostic tests, and post-screen cancer rate resulting in benign diagnosis. Details of the alterations in calculation methods are presented in the relevant results sections.

[e] This value is underestimated because volume counts are not provided to the CBCSD under 50 years or over 69 years of age by some programs for women.

Although these numbers appear high, the targeted program participation rate of 70% among women 50 to 69 years for biennial screening is far from being reached through organized programs. In 2005 and 2006, 43.9% of the target population received a screening mammogram through an organized program over 30 months and 40.0% over 24 months. The participation rate varies among organized programs from 10.4% to 59.2% over 30 months (**Figure 3a.** *below*) and 9.1% to 53.3% over 24 months (**Figure 3b.** *pg13*).

Figure 3a. Participation in organized breast cancer screening programs within 30 months, women aged 50-69

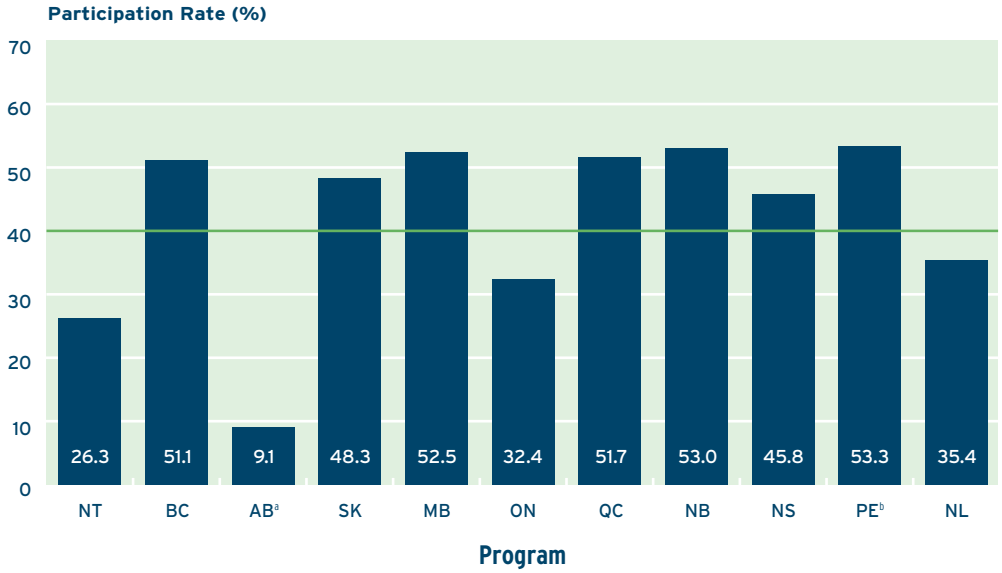


[a] Alberta data were collected from the Screen Test program only. Screen Test is an organized program that conducts approximately 10-12% of screening mammograms in the province. A province-wide breast cancer screening program was implemented in March 2008.

Notes:
1. Population estimates are weighted averaged.
2. The national participation rate of 43.9 % is indicated by the horizontal bar.
3. Prince Edward Island is excluded from this figure as data for 30 months was unavailable.

Source: Statistics Canada data for June 1, 2004 – December 31, 2006 are used for denominator values.

Figure 3b. Participation in organized breast cancer screening programs within 24 months, women aged 50-69, 2005 and 2006 screen years



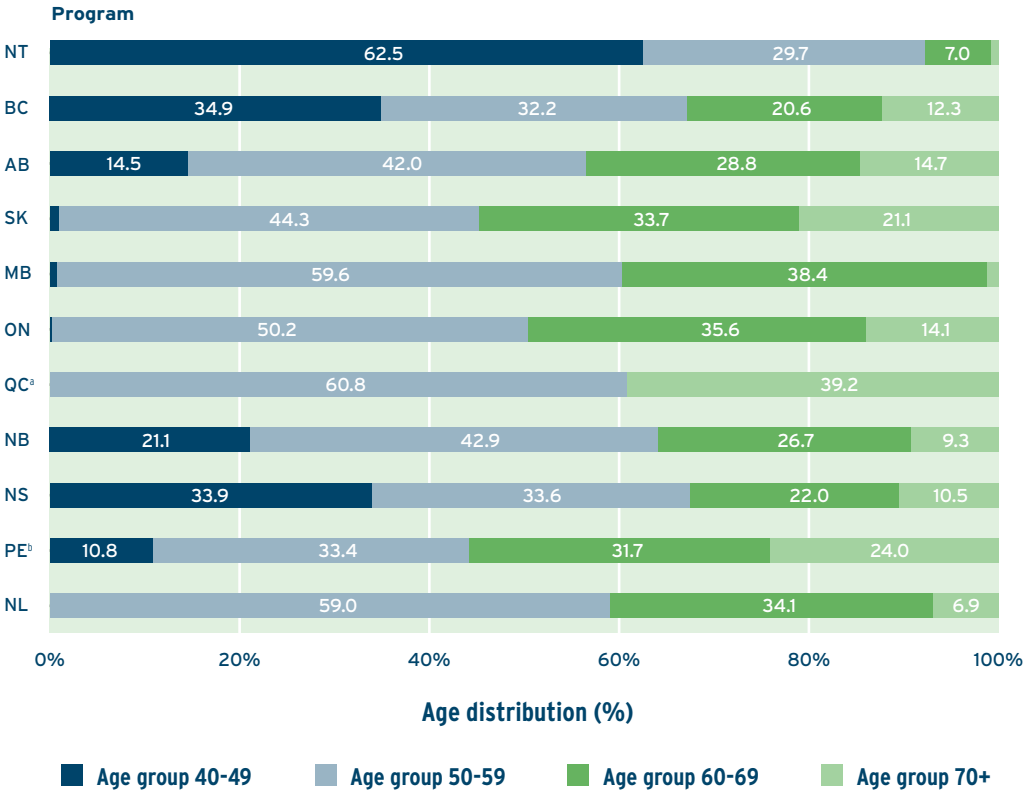
[a] Alberta data were collected from the Screen Test program only. Screen Test is an organized program that conducts approximately 10-12% of screening mammograms in the province. A province-wide breast cancer screening program was implemented in March 2008.
[b] Information for Prince Edward Island was based on data external to the CBCSD and may differ from previous reports.

Notes:
1. Population estimates are averaged.
2. The national participation rate of 40.0% is indicated by the horizontal bar.

Source: Statistics Canada data for January 1, 2005 - December 31, 2006 are used for denominator values.

Participation among women 50 to 69 years is influenced by the proportion of women outside of this age group who are screened. Although there is relative consistency among programs on acceptance of women outside of the 50 to 69 year age group (**Table 1.** *pg5*), the proportion of screening occurring in the target age group (50 to 69) varies considerably from 36.7% to 100% (**Figure 4.** *pg14*).

Figure 4. Age distribution of program screens by province, 2005 and 2006 screen years



[a] Although Québec accepts women aged 35-49 and 70+ with physician referral, they are not officially considered within the program and are not included in this table.

[b] Information for Prince Edward Island was based on data external to the CBCSD and may differ from previous reports.

Table 3. Annual screening volume by program, age 40+, 1988 to 2006 screen years

	Program											
Year	**NT**	**BC**	**AB**	**SK**	**MB**	**ON**	**QC**[a]	**NB**	**NS**	**PE**	**NL**	**Canada**
1988	---	4,370	---	---	---	---	---	---	---	---	---	4,370
1989	---	9,155	---	---	---	---	---	---	---	---	---	9,155
1990	---	22,271	616	6,355	---	590	---	---	---	---	---	29,832
1991	---	54,185	5,871	14,305	---	15,380	---	---	1,876	---	---	91,617
1992	---	80,295	15,441	15,778	---	40,294	---	---	4,346	---	---	156,154
1993	---	99,806	16,146	26,057	---	45,541	---	---	4,885	---	---	192,435
1994	---	118,505	15,370	25,540	---	55,480	---	---	8,457	---	---	223,352
1995	---	143,003	14,169	29,603	2,671	58,287	---	5,648	12,474	---	---	265,855
1996	---	166,304	14,679	28,901	13,594	67,729	---	17,956	15,529	---	3,120	327,812
1997	---	173,516	23,333	33,915	19,163	80,132	---	17,769	19,458	---	4,694	371,980
1998	---	189,612	18,887	34,093	23,454	98,597	43,987	25,716	25,423	---	5,521	465,290
1999	---	217,137	22,408	35,049	28,201	114,059	145,107	30,454	29,253	5,549	6,087	633,304
2000	---	223,156	21,714	35,264	28,563	138,308	152,989	32,106	35,228	6,258	6,790	680,376
2001	---	224,174	23,745	36,286	28,728	163,862	172,062	33,190	35,224	6,685	8,054	732,010
2002	---	234,510	23,342	34,461	29,261	192,233	194,437	36,798	38,567	6,256	8,859	798,724
2003	---	220,662	21,809	35,643	31,636	211,925	207,862	37,242	44,934	6,092	11,038	828,843
2004	1,103	230,550	23,106	36,125	32,301	248,548	220,893	37,150	48,576	6,050	9,819	894,221
2005	1,137	256,669	22,225	35,742	33,698	280,123	237,733	39,714	50,809	7,242	14,812	979,904
2006	1,268	266,490	22,109	34,994	36,585	318,421	253,290	37,614	58,137	7,693	15,249	1,051,850
Total	3,508	2,934,370	304,970	498,111	307,855	2,129,509	1,628,360	351,357	433,176	51,825	94,043	8,737,084

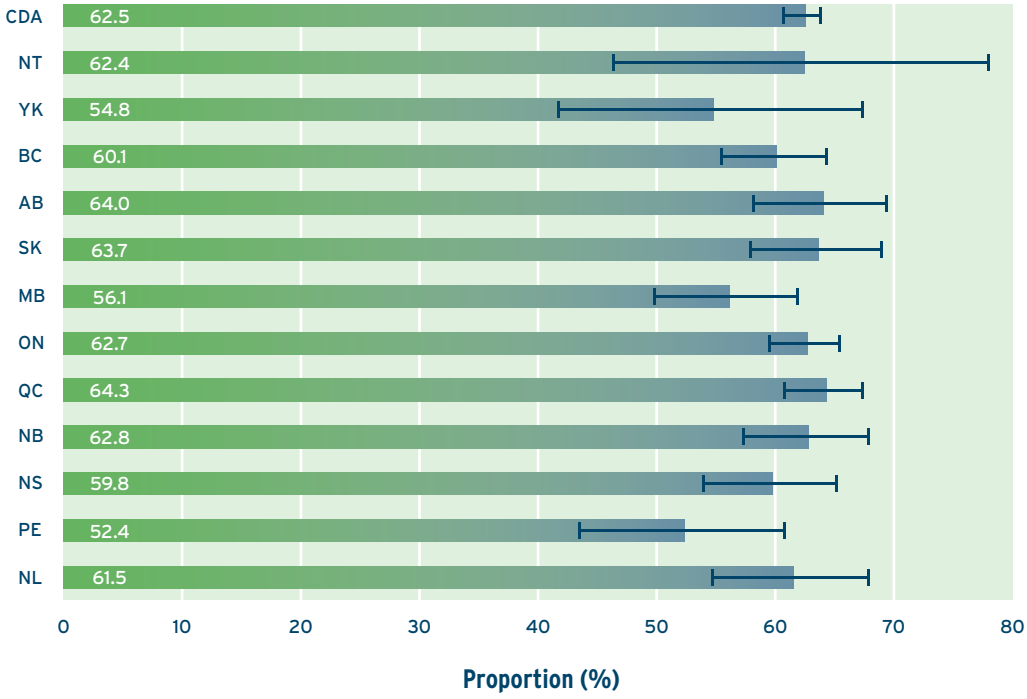
[a] Although Québec accepts women aged 35-49 and 70+ with physician referral, they are not officially considered within the program and are not included in this table.

Notes:

1. Nunavut does not have an organized screening program.
2. Data unavailable for Yukon.
3. Data include all screens; figures have been updated and may vary slightly from previous reports.
4. This value is underestimated because volume counts are not provided to the CBCSD by some programs for women under 50 years or over 69 years of age.

Importantly, these rates do not include women who receive their breast cancer screening outside of an organized program. Results from population health surveys suggest that close to 63% of women between 50 and 69 years received a screening mammogram within the past two years (**Figure 5a.** *below*). This figure is self-reported and may be slightly inflated as survey respondents tend to overestimate desirable behaviours, however, it is more closely aligned with the target of 70% set by the Evaluation Indicators Working Group Report. When attendance to mammography through opportunistic screening[f], in addition to organized screening, is considered screening mammography utilization substantively increases and becomes very similar to self-reported screening

Figure 5a. Proportion of women aged 50-69 with a self-reported screening mammogram



Notes:
1. Data for Nunavut is not presented as the coefficient of variation for this measure does not meet Statistics Canada's quality standard
2. Data reflects the screening experience of women in 2005-2006.

Source: Health Canada. 2007-2008 Canadian Community Health Survey: share file.

[f] Data for opportunistic screening was provided through the Ministry of Health from participating provinces and not obtained from the CBCSD. Opportunistic screening is likely overestimated due to double counting (when screening occurs in both the organized and opportunistic sectors), and incorrect categorization (a proportion of opportunistic bilateral mammograms are preformed on symptomatic women and therefore truly diagnostic).

mammography from the same period (**Figure 5b.** *below*). Data for mammography utilization includes women 50-69 years old with bilateral mammography (including screening mammography in organized programs, screening mammography outside of organized programs, and bilateral diagnostic mammography in provinces that included this in their mammography billing code). The range of screening mammography utilization shows little variation among provinces (60.0%-64.6%), but large variation in the proportion of utilization attributable to organized screening (14.5%-85.2%).

Figure 5b. Mammography utilization among women 50-69 within 24 months by province in 2005-2006

[a] Opportunistic screening data for Manitoba is based on the fiscal year and may not represent 2005-2006.

Notes:

1. Organized Screening: Participation in provincial organized screening program within 24 months

Source: Canadian breast cancer screening database (CBCSD) 2005-2006.

2. Opportunistic screening refers to bilateral mammography outside of organized screening. In all provinces, opportunistic screening includes some mammography on symptomatic women. In some provinces, opportunistic screening includes some women already counted in organized screening (double counting).

Source: Provincial billing data 2005-2006.

3. Self-reported: Self-reported screening mammogram in the past two years. Data reflects the screening experience of women in 2005-2006.

Source: Health Canada. 2007-2008 Canadian Community Health Survey: share file.

4. Excludes data from Northwest Territories, Nova Scotia, New Brunswick and Prince Edward Island.

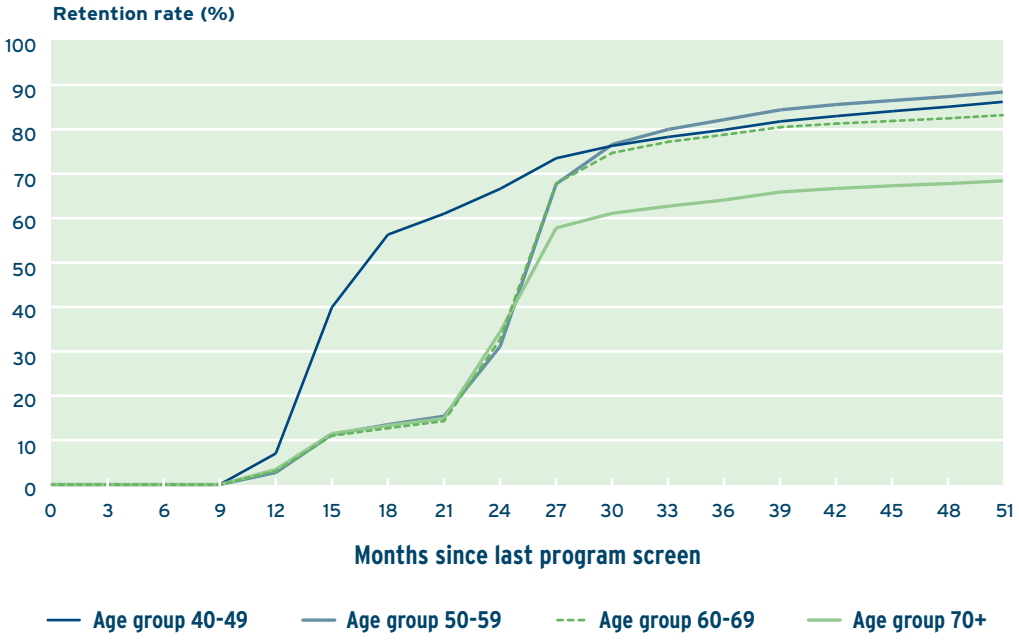
Retention Rate

Optimal benefits from screening programs are achieved when regular participation in screening occurs. Two targets have been set based on an understanding of participation rates, sojourn time, screening interval studies and randomized controlled trials.(5-7) The first, for women undergoing their initial screening mammogram, states that ≥75% of women should return within 30 months. The second states that ≥90% of women undergoing a subsequent screen should return within 30 months. The retention rate for women aged 50 to 67 excludes women who did not return because of death, breast cancer, or age limit (greater than 67 years). This indicator differs from that reported in the Evaluation Indicators Report and has been updated to censor women greater than 67 years to allow more accurate comparison of provinces where screening is strictly limited to between ages 50 and 69.

Overall, most women aged 50 to 67 who received a screening mammogram between 2002 and 2003 were rescreened within 30 months up to 2006. Among women who received their first screening mammogram in the 2002 and 2003 calendar years, 68.9% returned for a subsequent mammogram within 30 months. Among women aged 50 to 67 who received a subsequent screening mammogram in the 2002 and 2003 calendar years, 81.3% returned for a subsequent mammogram within 30 months. (**Tables 6-8.** *pg29-35*)

In general, younger women (40 to 49 years) were more likely to return for subsequent screening within 30 months compared to older women (70+ years) regardless of whether it was an initial (65.2% and 45.5% respectively) or subsequent screen (83.6% and 63.6% respectively) (**Table 7.** *pg32*). Women aged 40 to 49, who choose to have a screening mammogram, are usually recommended for annual screens. Most women, aged 50 to 67, returned for subsequent screening between 21 and 27 months after their 2002 to 2003 screen but women between age 40 and 49 were more likely than older women to return between 12 and 15 months (**Figure 6.** *pg19*).

Figure 6. Cumulative probability of returning for a subsequent program screen by age group, 2002 and 2003 screen years



Note:
Northwest Territories and Prince Edward Island are not included in this analysis.

Results of Organized Breast Cancer Screening Programs

The goal of organized screening programs is to identify disease in asymptomatic women and at the same time minimize the number of healthy women who receive abnormal screening results and associated follow-up tests. Both the abnormal call rate and the positive predictive value offer insight into the process of accurately identifying asymptomatic women with breast cancer.

Abnormal Call Rate

The abnormal call rate refers to the percentage of all women screened who are referred for further testing because of abnormalities found during the screening mammogram and is one way to measure the quality of a screening program. The Canadian target is <10% for women undergoing their first screen and <5% of women undergoing their subsequent timely screens.

Figure 7. Abnormal call rate[a] by age group, 2005 and 2006 screen years

[a] Includes mammography and clinical breast examination as screening modalities.

Notes:

1. The median time for women to return for screening and the total screens in each group is as follows:
   Rescreen (>9 months - ≤18 months) by 12.7 months, N=443,030 screens;
   Rescreen (>18 months - ≤30 months) by 24.5 months, N=897,566 screens;
   Rescreen (>30 months) by 40.8 months, N=218,240 screens.
2. Prince Edward Island is not included as data was unavailable.

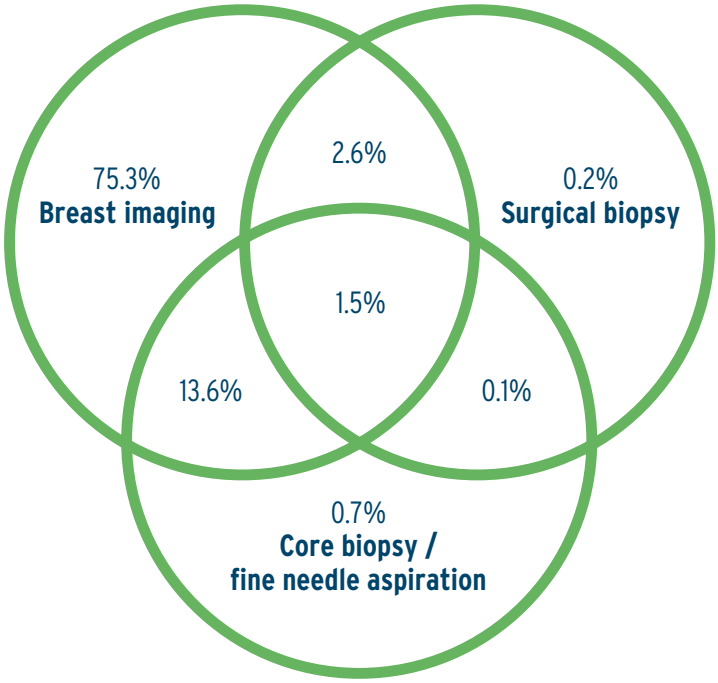
Among women 50 to 69 years, the abnormal call rate for women receiving their first screening mammogram is 12.2% and for a subsequent screening mammogram is 6.0% (**Table 6.** *pg29*). Radiologist inexperience and/or low reading volumes can contribute to unnecessarily high abnormal call rates, as can delays in rescreening. For all age groups, the abnormal call rate rises after a screening interval of 30 months indicating the importance of regular screening intervals (**Figure 7.** *above*).

Positive Predictive Value

The positive predictive value is determined by the proportion of women with an abnormal call who go on to be diagnosed with invasive or in situ cancer. A high positive predictive value reflects the minimization of unnecessary follow-up procedures. The Canadian target is ≥5% for first screens and ≥6% for subsequent timely screens.

Among women aged 50 to 69 years, and based on detection by mammography alone, the positive predictive value meets these targets for subsequent screening (7.8%) and is close to meeting the target for initial mammograms (4.7%). It is worth noting that positive predictive value is sensitive to the age distribution of the screened population, which is among the reasons why the Canadian targets are only intended for women age 50 to 69. The positive predictive value increases dramatically with age: it is as low as 2.0% for women between 40 and 49 years undergoing their initial screening mammogram and as high as 13.9% in women over 70 years (**Tables 6-8.** *pg29-35*).

Figure 8. Combinations of diagnostic procedures after an abnormal screen, women aged 50-69, 2005 and 2006 screen years



6.0% of women had none of the above procedures[a].

[a] For women who had none of the above procedures, 94.3% were referred based on an abnormal clinical breast examination (CBE) and may have had their final diagnosis established by their primary care provider. Québec data included for all procedures but not calculated for CBE referral status.

Note:
Prince Edward Island not included as data was unavailable.

Diagnostic Process used by Organized Breast Cancer Screening Programs

As suggested by the positive predictive value, most women who receive abnormal screening results do not actually have breast cancer; however, additional assessment is required to determine the definitive diagnosis. The provision of timely, well coordinated, and minimized follow-up assessment has been shown to reduce fear and anxiety associated with abnormal results.(8) Women who receive abnormal screening results require additional radiological or surgical assessment including diagnostic mammography, ultrasonography, core or open biopsy, and/or fine needle aspiration.

Table 4. Diagnostic procedures after an abnormal screen, by mode of referral, women aged 50-69, 2005 and 2006 screen years

	Modes of referral							
	All modes of referral		**Referred by mammography alone**		**Referred by clinical breast examination alone**		**Referred by both mammography and clinical breast examination**	
Diagnostic procedure	Number[a] (%[b]) (Range%[c])		Number[a] (%[b])		Number[a] (%[b])		Number[a] (%[b])	
Diagnostic mammogram	91,798 (52.6 - 92.1)	(75.1)	90,252	(80.1)	331	(4.4)	1,215	(58.6)
Ultrasound[d]	67,461 (30.6 - 75.8)	(55.2)	60,608	(53.8)	5,031	(66.3)	1,822	(87.9)
Fine-needle aspiration	3,595 (0.0 - 5.3)	(2.9)	3,160	(2.8)	277	(3.7)	158	(7.6)
Core biopsy	16,513 (6.4 - 30.6)	(13.5)	15,757	(14.0)	233	(3.1)	523	(25.2)
Open biopsy with or without fine wire localization	5,303 (2.6 - 13.2)	(4.3)	4,888	(4.3)	267	(3.5)	148	(7.1)

[a] All provinces combined excluding Prince Edward Island (data unavailable).
[b] Proportion of all abnormal screens that had this diagnostic procedure by mode of referral.
[c] Range among provinces.
[d] Ultrasound may be underestimated in Québec as tests performed outside the program are not included.

Notes:
1. Proportions will not add up to 100% since a woman is likely to have a combination of procedures performed during her work-up.
2. Resolution of an abnormal screen is set at a maximum of 6 months post screen.

In 2005 and 2006, 75.3% of women who received an abnormal screen were followed-up with additional breast imaging only. Breast imaging includes diagnostic mammography, ultrasound, or magnetic resonance imaging (MRI). A further 13.6% received breast imaging combined with core biopsy or fine needle aspiration; similar to the 13.0% in the previous reported interval (2003 and 2004) (**Figure 8.** *pg21*). Lastly, there was a shift from the use of open biopsy to core biopsy in 2005 and 2006 compared to the previous reported interval (2003 and 2004) . Core biopsy increased from 12.3% (13,648 women) to 13.5% (16,513 women) and open biopsy decreased from 5.6% (6,188 women) to 4.3% (5,303 women) (**Table 4.** *pg22*).

Diagnostic Interval

The diagnostic interval is defined as the duration of time from the abnormal screen to its resolution. Excessively long diagnostic intervals can have negative psychological impact and potentially worsen prognosis.(8) The Canadian target is ≥90% of abnormal screens will be resolved with 5 weeks if no tissue biopsy is required and ≥90% within 7 weeks if a tissue biopsy is ever required during diagnostic follow-up. This methodology differs from that reported in the Evaluation Indicators Report and has been updated to close the diagnostic interval after 6 months of benign test results.

Nationally, 75.0% of women not requiring a tissue biopsy received resolution within five weeks and 46.7% of women requiring tissue biopsy received resolution within seven weeks. The proportion of women who did not require tissue biopsy and received resolution within five weeks has been showing gradual improvement, and has now stabilized at approximately 75%. The proportion of women requiring at least one tissue biopsy who received resolution within seven weeks has been relatively stable over time (**Tables 6-8.** *pg29-35*).

Benign Open Surgical Biopsy Rate

The rate of open surgical biopsy can provide an indication of the quality of pre-surgical assessment but no target has been set for this indicator.

In 2005 and 2006, the benign open surgical biopsy rate was 3.4 and 2.1 per 1,000 screens (initial and subsequent screens respectively). The biopsy rate is lower among older women (70+ years) undergoing their first screening mammogram compared to younger women. The rates among women undergoing subsequent screening mammograms shows little variation by age group. Since 2002, the rate has decreased for both initial and subsequent screening mammograms suggesting a shift away from the use of open surgical biopsy (**Tables 6-8.** *pg29-35*).

Benign to Malignant Open Surgical Biopsy Ratio

This indicator has been removed due to the small number of open biopsies performed on a provincial basis. This has occurred because there has been a shift to the use of core biopsy as a means to achieve definitive diagnosis resulting in less stable ratios that are sensitive to small changes and have become difficult to interpret.

Benign Core Biopsy Rate

The rate of benign core biopsy can provide an indication of the quality of pre-surgical assessment but no target has been set for this indicator.

In 2005 and 2006, the benign core biopsy rate was 13.0 and 4.8 per 1,000 screens (initial and subsequent screens respectively). The biopsy rate is lowest among older women (70+ years) undergoing subsequent screens. Since 2002, the rate has increased for both initial and subsequent screening mammograms suggesting a shift toward the use of core biopsy (**Tables 6-8.** *pg29-35*).

Benign to Malignant Core Biopsy Ratio

The ratio of benign to malignant core biopsies, can provide an indication of the quality of pre-surgical assessment but no target as yet has been set for this indicator. As with the open surgical biopsy rate this indicator has been updated to close the diagnostic interval after 6 months of benign test results.

In 2005 and 2006, the benign to malignant core biopsy ratio was 2.9:1 for initial screens and 1.4:1 for subsequent screens, and is lowest in older women (70+ years). For women, 50 to 69 years, undergoing subsequent screens the ratio has remained stable at approximately 1.4:1 since 2002. For women undergoing their first screen, the value has been relatively stable since 2002 at approximately 2.8:1 (**Tables 6-8.** *pg29-35*).

Cancer Detection by Organized Breast Cancer Screening Programs

In total, organized screening programs detected 7,872 cancers (invasive, in situ and unclassified types combined) among women aged 50 to 69 during 2005 and 2006 (**Table 6.** *pg29*). In order to ensure consistency between provinces this report identifies screen-detected cancers as those diagnosed within 6 months from the screen date. Other breast cancers among Canadian women were detected by opportunistic screening (outside of an organized program) or when a woman became symptomatic of disease.

Table 5. Characteristics of screen-detected cancers by age group, 2005 and 2006 screen years

	Age group									
	40-49		50-59		60-69		70+		All ages	
	n	%	n	%	n	%	n	%	n	%
Number of cancers[a]										
Invasive	347	71.0	3,005	77.1	3,144	83.0	1,223	85.5	7,719	80.4
DCIS	142	29.0	894	22.9	643	17.0	207	14.5	1,886	19.6
TNM staging										
0 (in situ)	142	30.6	894	34.3	643	25.5	207	16.9	1,886	27.6
I	200	43.1	1,027	39.3	1,257	49.8	717	58.4	3,201	46.9
II	111	23.9	579	22.2	535	21.2	251	20.5	1,476	21.6
III / IV	11	2.4	110	4.2	91	3.6	52	4.2	264	3.9
Invasive (TNM stage missing)[b]	25		1,289		1,261		203		2,778	
Tumour size[c]										
> 0 to < 2 mm	6	1.8	35	1.9	36	1.8	15	1.3	92	1.7
2 to 5 mm	29	8.6	116	6.4	150	7.5	81	6.8	376	7.0
6 to 10 mm	77	22.7	412	22.6	560	28.0	347	29.0	1,396	26.1
11 to 15 mm	90	26.6	482	26.5	573	28.7	357	29.9	1,502	28.0
16 to 20 mm	52	15.3	311	17.1	282	14.1	188	15.7	833	15.6
≥ 21 mm	85	25.1	465	25.5	399	20.0	208	17.4	1,157	21.6
Size unknown[d]	8		1,184		1,144		27		2,363	
Median tumour size (mm)	15.0		15.0		13.0		13.0		13.0	
Positive nodes[ce]										
0	225	71.7	1,261	71.8	1,515	77.5	864	80.5	3,865	75.8
1 to 3	69	22.0	372	21.2	335	17.1	166	15.5	942	18.5
4+	20	6.4	123	7.0	106	5.4	43	4.0	292	5.7
Nodal status unknown[fgh]	33		1,249		1,188		150		2,620	

[a] Unclassified cancers are not included in this analysis.
[b] Québec and Prince Edward Island do not provide TNM staging and account for 78.3% and 1.9% of all cases in the 'Invasive TNM stage missing' category respectively.
[c] This analysis includes invasive cancers only.
[d] Québec and Prince Edward Island do not provide tumour size and account for 90.3% and 2.2% of all cases in the 'Tumour size unknown' category respectively.
[e] Includes pathologically positive nodes only.
[f] Includes missing values (94.9%) and cases in which dissection was not done (5.1%).
[g] New Brunswick has 22.0% positive nodes but number of positive nodes is not provided. New Brunswick accounts for 8.8% of all cases in this category.
[h] Québec and Prince Edward Island do not provide number of positive nodes and account for 81.5% and 2.0% of all cases in this category respectively.

Note:
Alberta is not included in this analysis as data was unavailable.

Among all women diagnosed with cancer through an organized screening program (≥40 years) 80.4% (7,719 women) were diagnosed with invasive and 19.6% (1,886 women) were diagnosed with in situ cancers. The proportion of cancers considered invasive increased with age; 71.0% of women aged 40 to 49 were diagnosed with invasive cancers compared to 85.5% of women 70 or more years. Women aged 50 to 59 and 60 to 69 were diagnosed with 77.1% and 83.0% invasive respectively (**Table 5.** *above*).

In Situ Cancer Detection Rate

Ductal carcinoma in situ (DCIS) is a form of cancer detected through mammography screening, but, there is limited evidence supporting the transition of all forms of DCIS to invasive cancer. Because of this, no target has been set for in situ cancer detection rates in Canada. Despite this, it is important to monitor rates of detection until appropriate targets can be set.

In Canada, women (50 to 69 years) undergoing their first screen had a DCIS detection rate of 1.2 cases per 1,000 screens. Women undergoing subsequent screens had a DCIS detection rate of 0.9 case per 1,000 screens[g] (**Table 6.** *pg29*).

Invasive Cancer Detection Rate

The targets for invasive cancer detection rates established in Canada are >5 per 1,000 first screens and >3 per 1,000 subsequent timely screens.

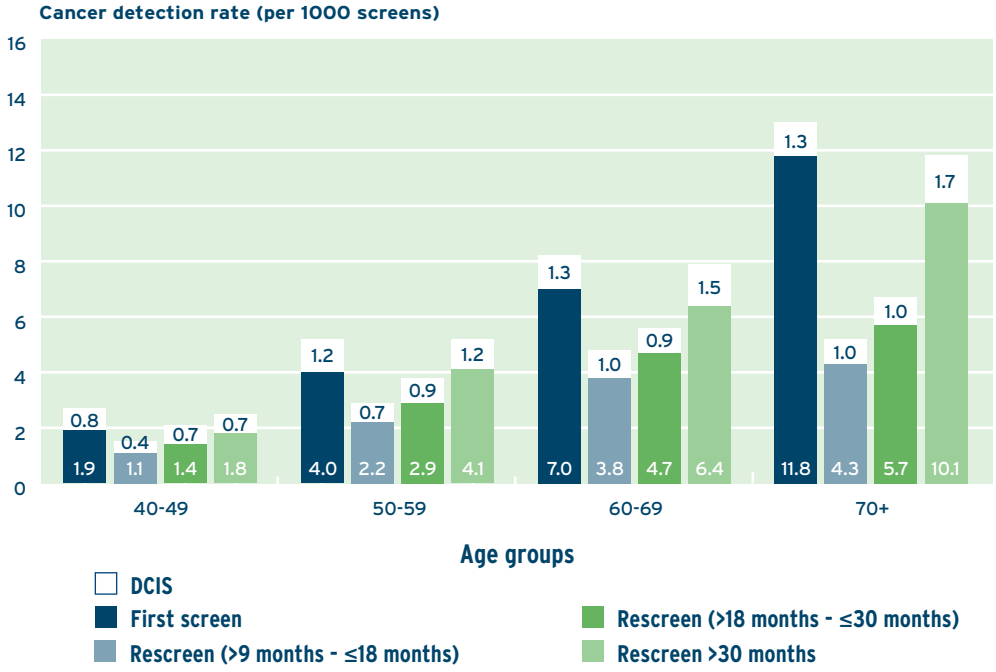
In Canada, women undergoing their first screen had an invasive cancer detection rate of 4.6 cases per 1,000 screens. Women undergoing subsequent screens had an invasive cancer detection rate of 3.7 cases per 1,000 screens[g] (**Table 6.** *pg29*). As anticipated, the invasive cancer detection rates were highest among initial screens and also increased in older women and when subsequent screening was not timely (**Figure 9.** *pg27*).

Invasive Tumour Size and Negative Node Rate

Cancer detected at earlier stages has more treatment options, less recurrence, and improved survival. Research in Canada has shown that among women diagnosed with breast cancer, participants of organized breast cancer screening programs have more breast conserving surgery and less chemotherapy compared to non-participants.(9) In addition, 97.9% of women with stage I breast cancer survive at least five years while only 27.9% of women diagnosed in stage IV survive for five years.(10) Early stage cancer has smaller tumours and no lymph node involvement. The Canadian target is for greater than 25% of invasive tumours to be ≤10mm and greater than 50% of invasive tumours to be ≤15mm. The second target is for >70% of women with invasive cancer to have no lymph node involvement.

[g] Refers to all women including those who may have returned late (≥30 months) from their previous mammogram.

Figure 9. Cancer detection (Invasive and In situ) rate per 1,000 screens by age group, 2005 and 2006 screen years



Notes:

1. The shaded area indicates the rate of invasive cancers detected, while the non-shaded area indicates the rate of DCIS cancers detected.
2. The median time for women to return for screening and the total screens in each group is as follows:
   First program screen: N=447,932 screens;
   Rescreen (>9 months - ≤18 months) by 12.7 months, N=433,655 screens;
   Rescreen (>18 months - ≤30 months) by 24.4 months, N=876,434 screens;
   Rescreen (>30 months) by 40.8 months, N=214,016 screens.
3. Prince Edward Island and Alberta are not included as data was unavailable.

Among women aged ≥40 years, diagnosed with breast cancer in 2005 and 2006, 46.9% of tumours were classified as stage I and 3.9% were classified as stage III/IV (**Table 5.** *pg25*). Among women aged 50 to 69, the proportion of invasive tumours less than 10 mm was 34.1% and almost 75% of women had negative lymph nodes at diagnosis (**Table 6.** *pg29*). A larger proportion of older women had tumours smaller than 10 mm at diagnosis (range: 30.7% to 37.2%) and negative lymph nodes at diagnosis (range: 72.0% to 80.8%) compared to younger women (**Table 7.** *pg32*).

Post-Screen Invasive Cancers

Post-screen invasive cancers are those cancers that develop after a normal screening mammogram but before the next screen, and the post-screen invasive cancer rate serves as an indicator of the sensitivity of the screening program. Post-screen invasive cancers include two types of cancers: those that occur after the recommended 12 or 24 months among women who do not return for their regular annual or biennial screen respectively (non-compliant cancers), or among women who become symptomatic before their next regular screen (interval cancers). This methodology differs from that reported in the Evaluation Indicators Report and has been updated include cases referred for diagnostic follow-up with a benign result that later developed breast cancer.(4) Post-screen invasive cancer rates were calculated based on all women screened from 2002 to 2003 who developed an interval cancer during 2004 to 2005.[h] In order to ensure consistency between provinces this report also considers interval cancers to include those detected by a screening mammogram that have taken longer than 6 months to diagnosis. Due to the changes in the method of calculation, it is anticipated that the rate reported in this report should be higher than in previous reports assuming stability in the true incidence.

The target is for less than 6 women per 10,000 person years to be diagnosed with a post screen cancer within 12 months of screening and less than 12 women per 10,000 person years within 24 months.

Nationally, the post-screen invasive cancer rate was 6.5 per 10,000 person years within 12 months and 8.0 per 10,000 person years within 24 months (**Table 6.** *pg29*).

[h] Non-compliant cancers are not included in this calculation.

Table 6. Performance measures by program, women aged 50-69, 2005 and 2006 screen years

Indicator	Target[a]	Program											
		NT	BC	AB	SK	MB	ON[b]	QC	NB	NS[c]	PE[d]	NL[b]	Canada
Number of screens	N/A[e]	882	275,838	31,384	55,171	68,854	513,388	491,023	53,821	60,625	9,734	27,979	1,588,699
Number of first screens	N/A[e]	422	22,533	6,993	9,193	13,875	159,901	121,356	5,202	11,181	*	9,688	360,344
Number of cancers[f]	N/A[e]	x	1,288	141	282	373	2,368	2,752	196	300	47	125	7,872
Participation rate within 30 months (%)	≥70	29.4	55.5	10.4	54.3	56.8	35.1	57.7	59.2	50.8	*	37.9	43.9
Participation rate within 24 months (%)	N/A[e]	26.3	51.1	9.1	48.3	52.5	32.4	51.7	53.0	45.8	53.3	35.4	40.0
Retention rate (% initial rescreen within 30 months)[gh]	≥75	N/A[i]	54.9	53.0	68.1	67.8	78.5	65.0	55.5	68.6	*	73.7	68.9
Retention rate (% subsequent rescreen within 30 months)[gh]	≥90	N/A[i]	80.2	74.9	84.6	81.7	88.1	77.6	77.5	79.8	*	84.8	81.3
Abnormal call rate (%)[j]													
Abnormal by mammography[k]													
Initial screen	<10	8.1	15.9	6.9	13.7	9.2	10.5	15.0	15.3	8.3	*	7.4	12.2
Rescreen	<5	9.6	5.7	3.1	5.3	4.6	5.5	7.3	6.9	4.3	*	4.9	6.0
Abnormal by any mode of detection													
Initial screen	<10	8.1	15.9	6.9	13.7	9.5	11.9	15.0	15.3	8.4	*	11.1	13.0
Rescreen	<5	9.6	5.7	3.1	5.3	4.7	6.8	7.3	6.9	4.5	*	8.3	6.4
Invasive cancer detection rate (per 1,000 screens)													
Detected by mammography[k]													
Initial screen	>5	x	5.8	*	4.2	5.5	4.1	4.9	4.2	5.1	*	3.8	4.6
Rescreen	>3	x	3.4	*	4.2	4.2	3.4	4.2	2.8	3.9	*	3.2	3.7

Table 6. Performance measures by program, women aged 50-69, 2005 and 2006 screen years (con't)

Indicator	Target[a]	Program											
		NT	BC	AB	SK	MB	ON[b]	QC	NB	NS[c]	PE[d]	NL[b]	Canada
Detected by any mode of detection													
Initial screen	>5	x	5.8	*	4.2	5.5	4.3	4.9	4.2	5.2	*	4.0	4.7
Rescreen	>3	x	3.4	*	4.2	4.2	3.6	4.2	2.8	3.9	*	3.5	3.7
In situ cancer detection rate (per 1,000 screens)													
Initial screen	N/A[e]	x	1.4	*	1.1	1.1	1.0	1.5	1.0	1.0	*	0.5	1.2
Rescreen	N/A[e]	x	1.1	*	0.9	0.9	0.7	1.1	0.7	0.8	*	0.6	0.9
Diagnostic interval (%)[lm]													
Completed with no tissue biopsy, within 5 weeks	≥90	72.4	66.5	51.5	67.0	73.4	83.4	70.4	87.7	75.3	*	63.9	75.0
Completed with tissue biopsy, within 7 weeks	≥90	40.0	39.9	50.6	33.6	39.3	57.4	41.6	43.8	57.8	*	40.1	46.7
Positive predictive value (%)[f]													
Detected by mammography[k]													
Initial screen	≥5	x	4.5	5.0	3.9	7.2	4.9	4.3	3.6	7.3	*	5.9	4.7
Rescreen	≥6	x	7.8	15.5	9.7	11.2	7.5	7.3	5.3	10.8	*	8.3	7.8
Detected by any mode of detection													
Initial screen	≥5	x	4.5	5.2	3.9	6.9	4.4	4.3	3.6	7.3	*	4.2	4.5
Rescreen	≥6	x	7.8	15.5	9.7	10.8	6.3	7.3	5.3	10.4	*	5.3	7.3
Benign open surgical biopsy rate (per 1,000 screens)[mnop]													
Initial screen	N/A[e]	x	7.9	0.9	6.3	3.2	2.6	N/A[p]	10.6	1.5	*	5.0	3.4
Rescreen	N/A[e]	x	2.8	0.4	3.1	1.1	1.6	N/A[p]	3.4	0.8	*	4.2	2.1
Benign core biopsy rate (per 1,000 screens)[mn]													
Initial screen	N/A[e]	x	11.1	8.0	6.1	10.7	9.9	18.3	8.7	21.7	*	7.3	13.0
Rescreen	N/A[e]	x	2.6	2.5	1.2	3.3	4.3	7.5	3.6	8.3	*	3.3	4.8
Benign to malignant core biopsy ratio[mn]													
Initial screen	N/A[e]	x	2.7 : 1	2.9 : 1	3.1 : 1	1.8 : 1	2.4 : 1	3.3 : 1	3.5 : 1	4.1 : 1	*	2.4 : 1	2.9 : 1
Rescreen	N/A[e]	x	1.1 : 1	0.6 : 1	0.6 : 1	0.7 : 1	1.3 : 1	1.7 : 1	2.0 : 1	2.0 : 1	*	1.6 : 1	1.4 : 1

Table 6. Performance measures by program, women aged 50-69, 2005 and 2006 screen years (con't)

Indicator	Target[a]	Program											
		NT	BC	AB	SK	MB	ON[b]	QC	NB	NS[c]	PE[d]	NL[b]	Canada
Invasive cancer tumour size (%)[q]													
≤10 mm	>25	x	35.1	*	35.2	39.1	34.2	*	30.6	30.5	*	28.2	34.1
≤15 mm	>50	x	64.8	*	68.1	65.9	60.0	*	58.6	58.9	*	57.3	61.8
Node negative rate in cases of invasive cancer (%)[qr]	>70	x	75.0	*	78.3	78.2	74.0	*	75.5	74.6	*	70.9	74.8
Post-screen invasive cancer rate (per 10,000 person-years)[qs]													
Within 12 months	<6	x	6.1	6.8	6.5	6.8	6.4	*	10.2	5.8	*	3.2[t]	6.5
Within 24 months	<12	x	8.5	6.6	8.0	8.7	7.9	*	9.4	6.3	*	4.0[t]	8.0

[a] Targets apply to women aged 50-69 years.
[b] Screening visit includes mammography and clinical breast examination at 52% of sites.
[c] Screening visit includes mammography and modified CBE by technician.
[d] Information for Prince Edward Island was based on data external to the CBCSD and may differ from previous reports.
[e] Surveillance and monitoring purposes only.
[f] Includes invasive, in situ, and unclassified cancers. Does not include bilateral cancers (Cases of bilateral cancer = Ontario (36), Saskatchewan (2), British Columbia (19).
[g] Data for 2002 and 2003 screen years are used.
[h] Retention rate for women aged 50-67. This calculation method has been updated from previous reports.
[i] Northwest Territories is excluded from this measure as data is not available for 2002-2003 (program began in 2004).
[j] Total abnormal screens by mammography (Initial + Rescreen) for Prince Edward Island = 1,122.
[k] Independent of CBE or its findings.
[l] Tissue biopsy does not include fine needle aspiration (FNA). Time to diagnosis is based on the date of the first pathological biopsy result of breast cancer (excludes FNA and all inconclusive or incorrect procedures) or the date of the last benign test or pathological biopsy.
[m] Excludes tests beyond 6 months post screen. This calculation method has been updated from previous reports.
[n] Includes all final biopsy test results (may include bilateral tests).
[o] Includes direct to open surgical biopsy diagnosis and cases who underwent an inconclusive or incorrect core biopsy prior to a definitive diagnosis by open surgical biopsy.
[p] Québec calculates the benign to malignant open biopsy ratio using a different method. Canada total excludes Québec data.
[q] Missing values are excluded from calculations. Expressed as a proportion of screen-detected invasive cancers with complete data on tumour size or number of positive nodes.
[r] New Brunswick does not provide the number of pathologically positive nodes; rate is calculated based on N stage of disease data.
[s] Calculated based on all women screened from 2002-2003 who developed a post-screen cancer during 2002-2005. Non-compliant cancers were not included in this calculation. Post-screen cancers include all invasive cancers diagnosed after a normal program screen (not referred) or screen detected cancers (referred) that took >6 months to diagnosis (beyond the 'normal screening episode'). Post-screen cancers also include cases referred for diagnostic follow-up with a benign result (missed at diagnosis). This calculation method has been updated from previous reports.
[t] Rates in Newfoundland and Labrador may be underestimated due to incomplete cancer registry incidence data.

Notes:
* Province/territory is excluded from this measure (information unavailable). Canadian total excludes indicated province(s)/territory.
x Province/territory is excluded from this measure due to small values. Canadian total excludes indicated province(s)/territory.

Table 7. Performance measures by age group, 2005 and 2006 screen years

Indicator	Target[a]	Age group[b]				
		40-49	50-59	60-69	70+	All ages
Number of screens[c]	N/A[d]	247,710	952,390	636,309	195,345	2,031,754
Number of first screens	N/A[d]	78,239	284,932	75,412	19,142	457,725
Number of cancers[cef]	N/A[d]	498	3,998	3,874	1,483	9,853
Participation rate within 30 months (%)[g]	≥70	7.7	44.4	43.2	10.9	24.6
Participation rate within 24 months (%)[cg]	N/A[d]	7.0	39.7	40.4	9.8	22.4
Retention rate (% initial rescreen within 30 months)[ghij]	≥75	65.2	69.2	67.7	45.5	66.4
Retention rate (% subsequent rescreen within 30 months)[ghij]	≥90	83.6	80.8	81.7	63.6	78.0
Abnormal call rate (%)[k]						
Abnormal by mammography[l]						
Initial screen	<10	13.7	12.7	10.3	9.3	12.3
Rescreen	<5	6.6	6.2	5.7	5.1	6.0
Abnormal by any mode of detection						
Initial screen	<10	13.7	13.5	11.1	10.2	13.0
Rescreen	<5	6.7	6.7	6.2	5.6	6.4
Invasive cancer detection rate (per 1,000 screens)[fm]						
Detected by mammography[l]						
Initial screen	>5	2.0	3.9	6.9	11.7	4.4
Rescreen	>3	1.2	2.8	4.7	5.8	3.7
Detected by any mode of detection						
Initial screen	>5	2.0	4.0	7.1	11.8	4.5
Rescreen	>3	1.2	2.9	4.8	5.9	3.7
In situ cancer detection rate (per 1,000 screens)[fm]						
Initial screen	N/A[d]	0.8	1.2	1.2	1.2	1.1
Rescreen	N/A[d]	0.5	0.9	1.0	1.1	0.9
Diagnostic interval (%)[no]						
Completed with no tissue biopsy, within 5 weeks	≥90	70.9	74.7	75.6	75.6	74.4
Completed with tissue biopsy, within 7 weeks	≥90	41.7	45.3	48.8	49.3	47.5
Positive predictive value (%)[ef]						
Detected by mammography[l]						
Initial screen	≥5	2.0	4.0	7.9	13.9	4.5
Rescreen	≥6	2.6	6.0	10.1	13.8	7.7
Detected by any mode of detection						
Initial screen	≥5	2.0	3.9	7.5	12.8	4.3
Rescreen	≥6	2.6	5.7	9.4	12.7	7.3
Benign open surgical biopsy rate (per 1,000 screens)[fopqr]						
Initial screen	N/A[d]	5.6	3.8	2.5	2.1	3.9
Rescreen	N/A[d]	2.1	2.1	2.1	2.0	2.1

Table 7. Performance measures by age group, 2005 and 2006 screen years (con't)

Indicator	Target[a]	Age group[b]				
		40-49	50-59	60-69	70+	All ages
Benign core biopsy rate (per 1,000 screens)[fop]						
Initial screen	N/A[d]	13.0	13.6	10.5	8.1	12.8
Rescreen	N/A[d]	3.6	4.9	4.8	3.1	4.5
Benign to malignant core biopsy ratio[fop]						
Initial screen	N/A[d]	8.5 : 1	3.4 : 1	1.7 : 1	0.8 : 1	3.0 : 1
Rescreen	N/A[d]	3.7 : 1	1.7 : 1	1.1 : 1	0.7 : 1	1.4 : 1
Invasive cancer tumour size (%)[fst]						
≤10 mm	>25	33.3	30.7	37.2	37.0	34.7
≤15 mm	>50	60.1	57.2	65.9	66.9	62.8
Node negative rate in cases of invasive cancer (%)[fstu]	>70	72.4	72.0	77.4	80.8	75.9
Post-screen invasive cancer rate (per 10,000 person-years)[hvw]						
Within 12 months	<6	5.0	6.2	6.9	7.4	6.3
Within 24 months	<12	3.9	7.8	8.3	8.3	7.4

[a] Targets apply to women aged 50-69 years.
[b] Prince Edward Island is excluded for all age groups unless otherwise indicated (information unavailable).
[c] Prince Edward Island is included in this indicator.
[d] Surveillance and monitoring purposes only.
[e] Includes invasive, in situ, and unclassified cancers. Does not include bilateral cancers (Cases of bilateral cancer) = 40-49 (9), 50-59 (21), 60-69 (36), 70+ (20).
[f] Northwest Territories is excluded from this measure due to small values.
[g] In the case of multiple screens, the first screen within the target population is used (40-49, 50-69 and 70+).
[h] Data for 2002 and 2003 screen years are used.
[i] Retention rate for women aged 50-67. This calculation method has been updated from previous reports.
[j] Northwest Territories is excluded from this measure as data is not available for 2002-2003 (program began in 2004).
[k] Total abnormal screens by mammography (Initial + Rescreen) for Prince Edward Island: 40-49 =577, 50-59 =697, 60-69 =425, 70+ =247.
[l] Independent of clinical breast examination or its findings.
[m] Alberta is excluded from this measure as data was unavailable.
[n] Tissue biopsy does not include fine needle aspiration (FNA). Time to diagnosis is based on the date of the first pathological biopsy result of breast cancer (excludes FNA and all inconclusive or incorrect procedures) or the date of the last benign test or pathological biopsy.
[o] Excludes tests beyond 6 months post screen. This calculation method has been updated from previous reports.
[p] Includes all final biopsy test results (may include bilateral tests).
[q] Includes direct to open surgical biopsy diagnosis and cases who underwent an inconclusive or incorrect core biopsy prior to a definitive diagnosis by open surgical biopsy.
[r] Québec calculates the benign to malignant open biopsy ratio using a different method. Canada total excludes Québec data.
[s] Québec, Alberta, and Prince Edward Island were excluded from this measure as data was unavailable.
[t] Missing values are excluded from calculations; Expressed as a proportion of screen-detected invasive cancers with complete data on tumour size or number of positive nodes.
[u] New Brunswick does not provide the number of pathologically positive nodes; rate is calculated based on N stage of disease data.
[v] Post-screen detected cancer rates are calculated with 2002 and 2003 data and include the following provinces: British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, New Brunswick, Nova Scotia and Newfoundland and Labrador.
[w] Calculated based on all women screened from 2002-2003 who developed a post-screen cancer during 2002-2005. Non-compliant cancers were not included in this calculation. Post-screen cancers also include all invasive cancers diagnosed after a normal program screen (not referred) or screen detected cancers (referred) that took >6 months to diagnosis (beyond the 'normal screening episode'). Post-screen cancers alsot include cases referred for diagnostic follow-up with a benign result (missed at diagnosis). This calculation method has been updated from previous reports.

Table 8. Performance measures by year, women aged 50-69

Indicator	Target[a]	Screen year				
		2002	2003	2004	2005[b]	2006[b]
Number of screens[c]	N/A[d]	609,202	646,605	699,610	765,517	823,182
Number of first screens	N/A[d]	169,633	159,136	162,636	172,737	187,607
Number of cancers[cef]	N/A[d]	3,205	3,327	3,487	3,818	4,054
Participation rate within 30 months (%)[g]	≥70	37.3	38.8	40.1	41.9	43.9
Participation rate within 24 months (%)[cg]	N/A[f]	33.9	35.3	36.5	38.1	40.0
Retention rate (% initial rescreen within 30 months)[hi]	≥75	68.6	69.2	N/A[j]	N/A[j]	N/A[j]
Retention rate (% subsequent rescreen within 30 months)[hi]	≥90	81.7	80.8	N/A[j]	N/A[j]	N/A[j]
Abnormal call rate (%)[k]						
Abnormal by mammography[l]						
Initial screen	<10	11.7	12.0	12.2	12.2	12.2
Rescreen	<5	6.6	6.6	6.4	6.0	6.0
Abnormal by any mode of detection						
Initial screen	<10	12.7	12.8	13.0	13.0	13.0
Rescreen	<5	7.3	7.1	6.9	6.5	6.4
Invasive cancer detection rate (per 1,000 screens)[fm]						
Detected by mammography[l]						
Initial screen	>5	4.9	4.9	4.6	4.4	4.7
Rescreen	>3	3.9	3.8	3.6	3.7	3.7
Detected by any mode of detection						
Initial screen	>5	5.0	5.0	4.7	4.5	4.8
Rescreen	>3	3.9	3.8	3.7	3.8	3.7
In situ cancer detection rate (per 1,000 screens)[fm]						
Initial screen	N/A[d]	1.1	1.2	1.3	1.2	1.2
Rescreen	N/A[d]	1.0	0.9	1.0	1.0	0.9
Diagnostic interval (%)[no]						
Completed with no tissue biopsy, within 5 weeks	≥90	73.6	75.3	74.8	75.1	74.9
Completed with tissue biopsy, within 7 weeks	≥90	48.7	48.4	48.8	47.3	46.0
Positive predictive value (%)[ef]						
Detected by mammography[l]						
Initial screen	≥5	5.1	5.1	4.8	4.6	4.8
Rescreen	≥6	7.3	7.2	7.3	7.8	7.7
Detected by any mode of detection						
Initial screen	≥5	4.8	4.9	4.6	4.4	4.6
Rescreen	≥6	6.8	6.7	6.8	7.4	7.3
Benign open surgical biopsy rate (per 1,000 screens)[fopqr]						
Initial screen	N/A[d]	5.6	4.9	4.3	3.6	3.3
Rescreen	N/A[d]	3.0	3.0	2.6	2.2	1.9

Table 8. Performance measures by year, women aged 50-69 (con't)

Indicator	Target[a]	Screen year				
		2002	2003	2004	2005[b]	2006[b]
Benign core biopsy rate (per 1,000 screens)[fop]						
Initial screen	N/A[d]	10.6	11.6	12.2	12.5	13.4
Rescreen	N/A[d]	4.1	4.7	5.0	4.8	4.9
Benign to malignant core biopsy ratio[fop]						
Initial screen	N/A[d]	2.9 : 1	2.8 : 1	2.9 : 1	2.9 : 1	2.8 : 1
Rescreen	N/A[d]	1.4 : 1	1.5 : 1	1.6 : 1	1.4 : 1	1.4 : 1
Invasive cancer tumour size (%)[fst]						
≤10 mm	>25	37.5	36.9	34.9	34.8	33.5
≤15 mm	>50	66.1	65.0	63.8	61.7	61.8
Node negative rate in cases of invasive cancer (%)[fstu]	>70	75.7	75.6	73.9	75.3	74.4
Post-screen invasive cancer rate (per 10,000 person-years)[vw]						
Within 12 months	<6	7.1	5.9	N/A[j]	N/A[j]	N/A[j]
Within 24 months	<12	8.4	7.7	N/A[j]	N/A[j]	N/A[j]

[a] Targets apply to women aged 50-69 years.
[b] Prince Edward Island is excluded for 2005-2006 unless otherwise indicated (information unavailable).
[c] Prince Edward Island is included in this indicator for all screen years.
[d] Surveillance and monitoring purposes only.
[e] Includes invasive, in situ, and unclassified cancers. Does not include bilateral cancers (Cases of bilateral cancer) = 2002 (12) , 2003 (22), 2004 (22), 2005 (30), 2006 (27)
[f] Northwest Territories is excluded from this measure due to small values and where data is not available (program began in 2004).
[g] Participation rate was calculated in two year intervals due to biennial recall (Screen Years: 2001-2002, 2002-2003, 2003-2004, 2004-2005, 2005-2006).
[h] Retention rate for women aged 50-67. This calculation method has been updated from previous reports.
[i] Northwest Territories is excluded as data is not available for 2002-2003 (program began in 2004).
[j] Insufficient time for follow-up to ensure data completeness.
[k] Excludes Prince Edward Island in 2005-2006; Total abnormal screens by mammography (Initial + Rescreen): 2005 = 604, 2006 = 518.
[l] Independent of clinical breast examination or its findings.
[m] Ablerta is excluded from this measure for 2005-2006 as data was unavailable for this time period.
[n] Tissue biopsy does not include fine needle aspiration (FNA). Time to diagnosis is based on the date of the first pathological biopsy result of breast cancer (excludes FNA and all inconclusive or incorrect procedures) or the date of the last benign test or pathological biopsy.
[o] Excludes tests beyond 6 months post screen. This calculation method has been updated from previous reports.
[p] Includes all final biopsy test results (may include bilateral tests).
[q] Includes direct to open surgical biopsy diagnosis and cases who underwent an inconclusive or incorrect core biopsy prior to a definitive diagnosis by open surgical biopsy.
[r] Québec calculates open biopsies using a different method. Canada total excludes Québec data.
[s] Excludes Alberta and Québec (2005-2006) and Prince Edward Island (2002-2006) as data was unavailable.
[t] Missing values are excluded from calculations. Expressed as a proportion of invasive cancers with complete data on tumour size or number of positive nodes.
[u] New Brunswick does not provide the number of pathologically positive nodes; rate is calculated based on N stage of disease data.
[v] Post-screen detected cancer rates are calculated with 2002 and 2003 data and include the following provinces: British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, New Brunswick, Nova Scotia and Newfoundland and Labrador.
[w] Calculated based on all women screened from 2002-2003 who developed a post-screen cancer during 2002-2005. Non-compliant cancers were not included in this calculation. Post-screen cancers also include all invasive cancers diagnosed after a normal program screen (not referred) or screen detected (referred) cancers that took >6 months to diagnosis (beyond the 'normal screening episode'). Post-screen cancers do not include cases referred for diagnostic follow-up with a benign result (calculation includes those missed at screening and excludes those missed at diagnosis). This calculation method has been updated from previous reports.

Note:
Figures have been updated and may vary slightly from previous reports.

SPECIAL TOPIC

Decision Analysis Models for Outcomes Related to Breast Cancer Screening

Introduction

Breast cancer is the second most frequent cancer[i] among Canadian women, with a projected 23,200 new cases in 2010 alone.(1) At current rates, 11% of Canadian women are expected to develop breast cancer at some point in their lives, although only 2 to 3% of women between 50 and 90 years of age are expected to develop the disease in the next ten years.(11) About 2/3 of cases are expected to survive, yet breast cancer is still the second-leading cause of cancer mortality among Canadian women, with a projection of 5,300 deaths in 2010.(1) The average 5-year survival rate is 87%.(11) Survival increases to 96% (+/- 3%) if the cancer is found at Stage I, yet can be as low as 26% (+/- 10%) if found at Stage IV.(12) Finding breast cancer early is critical.

Regular mammography screening can help detect breast cancers early, and consequently improves survival rates. Current Canadian guidelines recommend women to be screened biennially (every two years) in their 50s and 60s. Above the age of 70, early detection is deemed to have less benefit due to an increase in other competing risks for mortality. Below the age of 50, the risk for breast cancer is lower and it is preferable to avoid unnecessary exposure to radiation and unwanted anxiety. Yet almost half of all breast cancers occur in these age groups. Literature suggests there may be untapped screening benefits outside the 50 to 69 target screening population.(13-16)

Decision support tools, often referred to as decision aids, are applications built based on data obtained through decision analysis. Decision support tools assist in informed decision making by providing important information regarding the risks and benefits of difficult health decisions, in this case, related to breast cancer screening mammography. A better understanding of the true outcomes related to breast cancer screening improve informed decision making and may increase the number of women returning for timely mammography (retention) which in turn increases the benefits from screening. Therefore a Markov decision analysis model for mammography screening among Canadian women was built to assess the potential long-term benefits and harms of screening and used to inform a decision support tool (**www.publichealth.gc.ca/decisionaids**).

[i] Incidence of non-melanoma skin cancer exceeds that of breast cancer in Canada, however, rates are typically not reported due to difficulty estimating true incidence.

Methods

A Markov decision analysis model was developed to estimate the outcomes related to three hypothetical cohorts of women and their screening experiences over a ten to 20 year period. The age cohorts and their comparators that were included were:

- 40 to 49 years screening annually for 10 years compared to no screening,
- 50 to 69 years screening biennially for 20 years compared to no screening, and
- 70 to 79 years screening biennially for 10 years compared to screening biennially for 20 years and stopping after age 69.

Detailed technical notes and literature references are available at **www.publichealth.gc.ca/decisionaids**.

The model was developed using TreeAge software and was based on an analogous Australian model.(17) The model tracks a variety of outcomes including: number of abnormal and normal screen results, follow-up imaging and biopsy requirements, breast cancers detected, stage of disease at diagnosis, and deaths due to breast cancer or other causes. False negatives screens were estimated by the number of interval cancers within 12 months of the last screen among women in their forties, and within 24 months among women within their fifties. The model assumes time-constant transition probabilities, full compliance for return to screening and independent screening outcomes. Before applying the model to Canadian data, its structure was successfully validated against the Australian model outcomes generated by 1996-1998 BreastScreen Australia data.(17)

Screening data were acquired from the Canadian Breast Cancer Screening Database (2000-2004), aggregate pan-Canadian data from provincial screening programs in practice. All provinces contributed some data and specific contributions are noted in Appendix A. Among the 40 to 49 year cohort, screening data were contributed predominately by British Columbia. Breast cancer mortality, breast cancer incidence, population counts, and all-cause mortality were obtained from Statistics Canada (2000-2004). Canadian Community Health Survey cycles 1.1 and 2.1 were used to estimate national participation in screening. A literature review was performed to obtain relative risk reductions in breast cancer mortality due to screening.

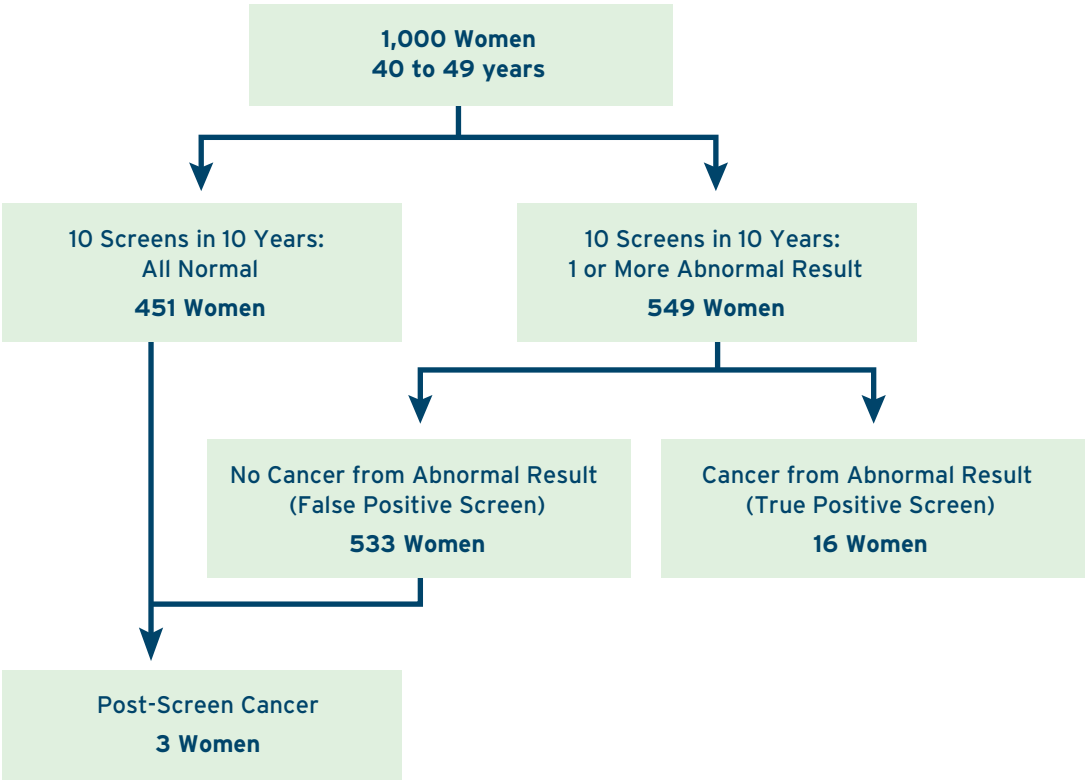
A long-term scenario (10 to 20 years) was used to account for the mortality lag observed in a new screening population.(17) Cancers observed in younger women are typically more aggressive therefore we applied the scenario of annual screening for women in their 40's but biennial screening for women 50 and above. For women between 40 and 69, we contrasted screening with

full participation versus no screening to highlight the full range of differences between screeners and non-screeners. For women between 70 and 79, we contrasted screening with full participation starting at age 50 to 79 versus screening with full participation between age 50 and 69 only.

Results

The results indicated that 3,000 women, aged 40 to 49 years, would need to be screened annually in order to prevent 1 death from breast cancer. Comparatively, 250 women aged 50 to 69 and 400 women aged 70-79, would need to be screened biennially to prevent 1 death from breast cancer.

Figure 10. Simulated flow through health states of 1,000 women, aged 40 to 49 years, participating in annual screening for a total of 10 mammograms each (10,000 mammograms collectively).



Most women who undertake mammography screening are given peace of mind from knowing they are breast-cancer free. Among women aged 40 to 49 years, 631 of the 10,000 mammograms will be abnormal resulting in 549 women being recalled at least once. After further testing, 533 abnormal screens will result in no breast cancer and 16 cancers will be detected. Three post-screen cancers will be diagnosed between rounds of screening (**Figure 10.** *pg39* and **Table 9.** *below*).

Table 9. Simulated health state outcomes for 1,000 women, aged 40 to 49 years, participating in annual screening for a total of 10 mammograms each (10,000 mammograms collectively) compared to women who did not participate.

	Screened Women	Unscreened Women
	# Cancers / 1,000 women over 5 years	# Cancers / 1,000 women over 5 years
Cancer Stage		
DCIS	5	0
Stage I	9	4
Stage II	4	5
Stage III - IV	1	2
Total	19	11
Vital Status		
Death from Breast Cancer	1	2
Death from Other Causes	12	12
Alive	987	986

Similarly, among women aged 50 to 69 years, 717 of the 10,000 mammograms will be abnormal resulting in 574 women being recalled at least once. After further testing, 529 abnormal screens will result in no breast cancer and 45 cancers will be detected. Fifteen post-screen cancers will be diagnosed between rounds of screening (**Figure 11.** *pg41* and **Table 10.** *pg41*).

Figure 11. Simulated flow through health states of 1,000 women, aged 50 to 69 years, participating in biennial screening for a total of 10 mammograms each (10,000 mammograms collectively).

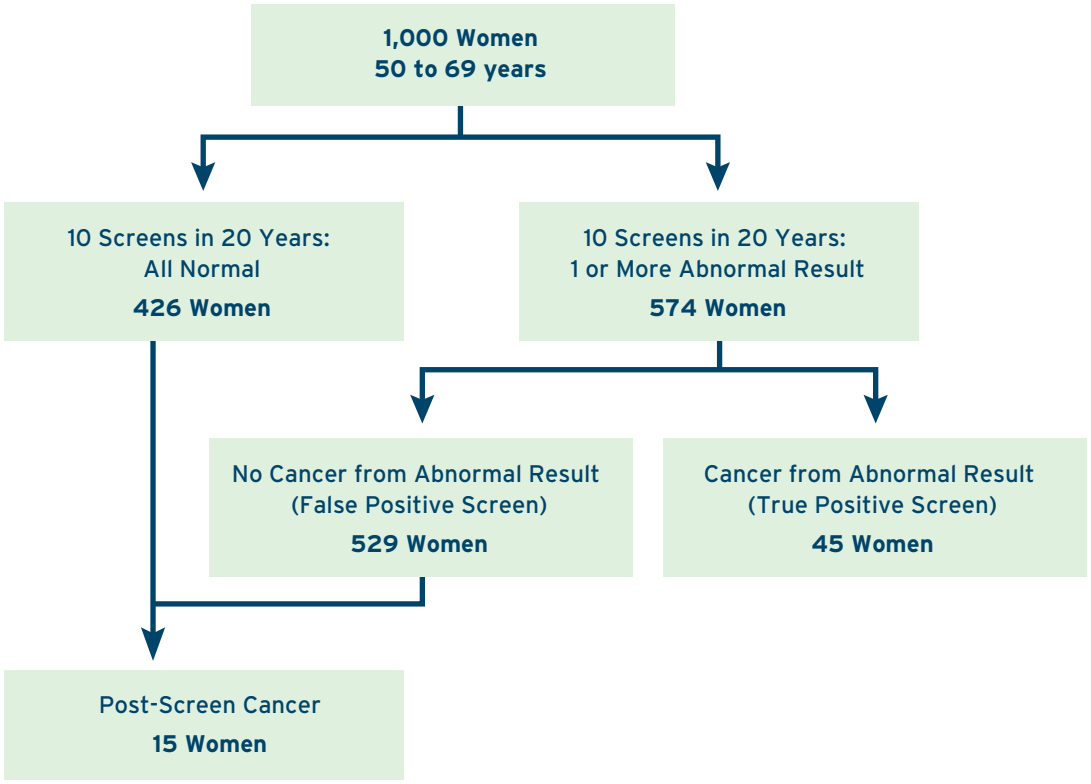


Table 10. Simulated health state outcomes for 1,000 women, aged 50 to 69 years, participating in biennial screening for a total of 10 mammograms each (10,000 mammograms collectively) compared to women who did not participate.

	Screened Women	Unscreened Women
	# Cancers / 1,000 women over 20 years	# Cancers / 1,000 women over 20 years
Cancer Stage		
DCIS	9	1
Stage I	31	17
Stage II	18	13
Stage III - IV	2	5
Total	60	36
Vital Status		
Death from Breast Cancer	7	12
Death from Other Causes	107	107
Alive	886	881

Lastly, among women 70 to 79 years, 270 of the 5,000 mammograms performed will be abnormal, resulting in 244 women being recalled at least once. After further testing, 213 abnormal screens will result in no breast cancer and 31 cancers will be detected. Eight post-screen cancers will be diagnosed between rounds of screening (**Figure 12.** *below* and **Table 11.** *pg43*).

Figure 12. Simulated flow through health states of 1,000 women, aged 70 to 79 years, participating in biennial screening for a total of 5 mammograms each (5,000 mammograms collectively).

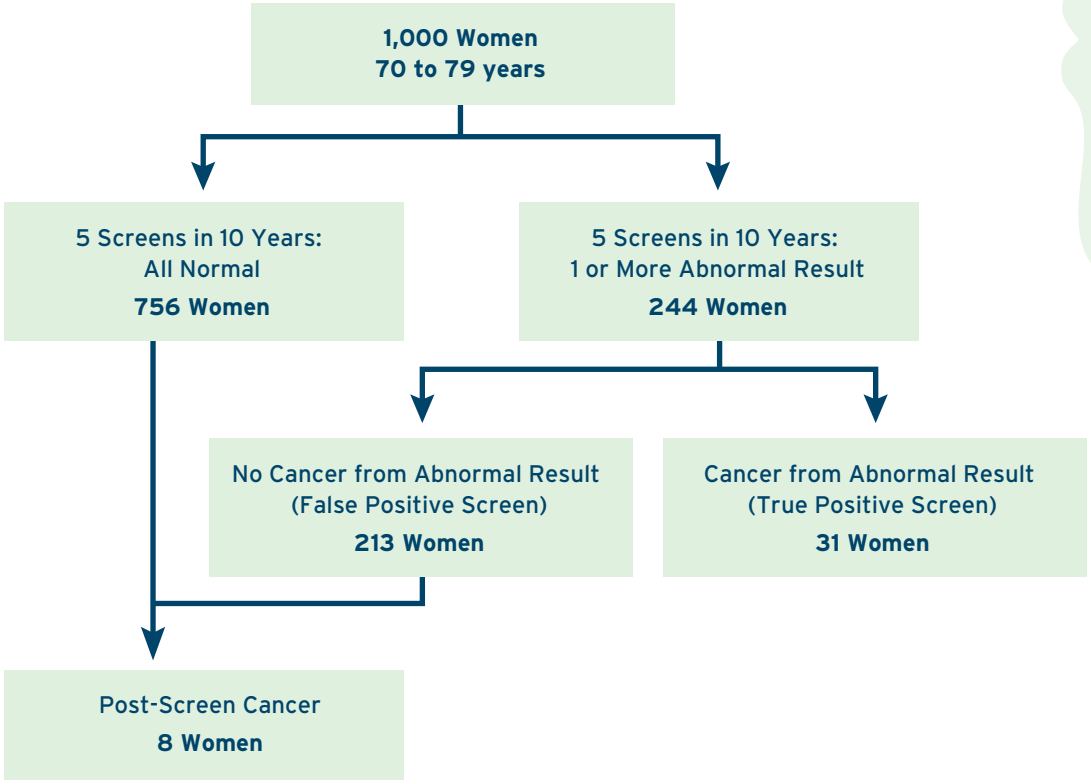


Table 11. Simulated health state outcomes for 1,000 women, aged 70 to 79 years, participating in biennial screening for a total of 5 mammograms each (5,000 mammograms collectively) compared to women who did not participate.

	Screened Women	Unscreened Women
	# Cancers / 1,000 women over 5 years	# Cancers / 1,000 women over 5 years
Cancer Stage		
DCIS	5	0
Stage I	23	10
Stage II	9	6
Stage III - IV	2	3
Total	39	19
Vital Status		
Death from Breast Cancer	7	10
Death from Other Causes	208	208
Alive	785	782

Discussion

The results of this modelling exercise suggest important variation in outcomes related to mammography screening among women of different age groups, highlighting the need for informed decision making by women considering attendance. In addition, the benefits and limitations of a modelling approach to screening outcomes are important to understand, as is the method in which the results are presented to women.

A high number of abnormal screening mammograms were predicted for all age groups (**Table 9-11.** *pg40-43*). This seems like disturbing news; a large proportion of screened women will expect to receive further testing only to confirm they have no cancer. The impact of this anxiety should not be underestimated because women who experience false positive mammograms are less likely to return for regular screening in the future. However, these abnormal results represent a small fraction of the total mammograms performed. Because we assumed independent outcomes, screening recall rates were applied at random to the population, resulting in a high cumulative chance of being recalled at least once over the 10 to 20 year screening period. In practice, some women (those with dense breasts or prior false positive screens) are more likely to receive a false positive than others; the model did not reflect such individual factors. Further, technological changes, such as the introduction of digital mammography, will change outcomes likely altering numbers of abnormal screening mammograms and patterns of cancer diagnoses, and ultimately will require changes to the decision support tool.

The primary benefit of screening is early detection, which typically results in simpler treatment, a lower chance of recurrence and a greater chance of survival. All screened cohorts had a fewer number of cancers found at a late stage (III or IV) and a greater number of cancers found at stage I than the unscreened cohorts (**Table 9-11.** *pg40-43*). Yet there were also more cancers found overall. Some may assume that screening increases breast cancer incidence through exposure to radiation; however, research suggests that benefit from screening outweighs the risk attributed to radiation exposure.(18-20) The likely cause of increased breast cancers among women who were screened is due to the detection of a large number of asymptomatic ductal carcinoma in situ (DCIS) that would not have been found without screening. DCIS is considered to be stage 0 breast cancer that can be easily treated, and does not pose an immediate threat to the woman. Overdetection, the detection of cancers that never would have presented clinically during the patient's lifetime, is also an issue in screening mammography.(21) Randomized controlled clinical trials need to be conducted to accurately estimate overdetection in Canada.

Prevention of death through screening is a strong motivation for women to undertake regular mammography. The greatest mortality benefit falls within the target screening group of 50 to 69 years, followed by the 70 to 79 year group. Women in their 40's received a lesser mortality benefit. The benefits of screening by women in different age groups may vary depending which outcomes are considered. Years of life saved may be an important measure among younger women where fewer deaths are expected but they occur at an earlier age compared to older women.

It should be noted that the model uses "average" population-level results to give relative estimates of likelihoods in the screening process. Individual risks and experiences will differ, depending on risk factors such as the BRCA mutation, age, and family history. It is important to take such factors into consideration when trying to assess an individual's risks. The decision support tool is accompanied by risk factor information to facilitate this (**www.publichealth.gc.ca/decisionaids**).

Models can never fully and completely predict future outcomes but can add evidence to the bigger picture to inform decision-making. These outcomes are included in the decision support tool (**www.publichealth.gc.ca/decisionaids**) to help women make informed decisions about participation in mammography screening. The decision aids contain general information about mammography and specific sections targeted at three age groups: 40 to 49, 50 to 69, and 70 to 79. For each age group, outcomes derived from Figures 1 through 3 are used to provide a general picture of each outcome. Mortality benefits are also shown. Women are then given an opportunity to rank their feelings about each benefit and limitation of the screening experience. The goal is to use a combination of these personal feelings, individual risk factors, and provided simulated outcome data to make a more informed decision about mammography screening.

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APPENDICES

Appendix A: Contributing Organized Breast Cancer Screening Programs

Breast Screening Program of Newfoundland and Labrador
St. John's: (709) 777-5070
Gander: (709) 256-5597
Corner Brook: (709) 634-8558
Toll Free: 1-800-414-3443

Nova Scotia Breast Screening Program
www.breastscreening.ns.ca
1-800-565-0548

Prince Edward Island Breast Screening Program
Health and Wellness
P.O. Box 3000, Summerside, PEI: C1N 2A9
1-888-592-9888

New Brunswick Breast Cancer Screening Services
New Brunswick Cancer Network (New Brunswick Department of Health)
P.O.Box 5100, 2nd Floor HSBC Place, 520 King Street
Fredericton, New Brunswick, E3B 5G8

Programme québécois de dépistage du cancer du sein
Ministère de la Santé et des Services sociaux du Québec
www.msss.gouv.qc.ca/sujets/santepub/pqdcs/index.php?accueil

Ontario Breast Screening Program: A Cancer Care Ontario Program
www.cancercare.on.ca
1-800-668-9304

Manitoba Breast Screening Program: CancerCare Manitoba
25 Sherbrook Street: Unit 5
Winnipeg, Manitoba R3C 2B1
(204) 788-8633 / 1-800-903-9290
www.cancercare.mb.ca/mbsp

Screening Program for Breast Cancer:
A Program of the Saskatchewan Cancer Foundation
South Saskatchewan: 1-800-667-0017
North Saskatchewan: 1-800-567-7271

Alberta Health Services
Alberta Breast & Cervical Cancer Screening Programs
Health Promotion, Disease and Injury Prevention
Population and Public Health – Alberta Health Services
Holy Cross Site: 2202-2nd Street S.W.
Calgary, Alberta, T2S 3C1
www.screeningforlife.ca

The BC Cancer Agency's Screening Mammography Program
Vancouver, British Columbia
Phone: (604)-877-6187 (Lower Mainland),
1-800-663-9203 (Rest of British Columbia)
www.smpbc.ca

Breast Screening Program: Stanton Territorial Health Authority
Northwest Territories
Yellowknife, Northwest Territories
Phone: (867) 873-0452
Fax: (867) 873-2109
www.srhb.org/services/contact_program.php?id=10

Appendix B: Database Management Committee of the CBCSI

This Committee advises on the content, management process, and use of the Canadian Breast Cancer Screening Database. It is responsible to the National Committee for the Canadian Breast Cancer Screening Initiative, and is advisory to the Centre for Chronic Disease Prevention and Control, Public Health Agency of Canada.

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Appendix C: Technical Sub-committee of the CBCSI

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Appendix D: Glossary

Asymptomatic
A woman who does not report symptoms and appears without signs of disease.

Breast cancer
Includes malignant invasive and ductal carcinoma in situ (DCIS) of the breast.

Clinical breast examination (CBE)
A physical examination of the breasts performed by a trained health professional.

Core biopsy
A needle biopsy of the breast used to remove samples of tissue for microscopic evaluation. Most core biopsies are image guided.

Definitive diagnosis
Definitive diagnosis of cancer is the first core or open surgical biopsy that confirms cancer. In rare occasions fine needle aspiration (FNA) biopsy may also be used as a definitive diagnosis of cancer. Definitive diagnosis of benign cases is the last benign test up to 6 months following an abnormal screen.

Ductal carcinoma in situ (DCIS)
A non-invasive tumour of the breast, arising from cells that involve the lining of a breast duct. The cells have not spread outside the duct to other tissues in the breast. DCIS is also referred to as stage 0 cancer.

Fine-needle aspiration biopsy
A needle is inserted into a lesion and cells are drawn out using a syringe. The cells are stained and examined by a cytologist in a laboratory to determine if there are any malignant cells.

Initial screen
The first screening mammogram provided to a women by a Canadian organized breast screening program.

Interval cancer
Any invasive breast cancer diagnosed during the interval between a normal screen or benign diagnostic test and before the next scheduled screening examination.

Invasive cancer
Cancerous cells invading beyond the basement membrane of the milk duct or lobule. A ductal carcinoma in situ component may also be present in cases of invasive cancer. Invasive cancer includes stage I-IV.

Normal screening episode
A screening episode that concludes with normal (non-cancer) findings. This includes both a normal screening mammogram and an abnormal screening mammogram with a normal (non-cancer) finding.

Open surgical biopsy
Surgical removal of a breast abnormality under local anesthesia for subsequent microscopic examination by a pathologist.

Post-screen cancer
Cancers that occur after the recommended 12 or 24 months in women who do not return for their regular annual or biennial screen respectively (non-compliant cancers) or women who become symptomatic before their next regular screen (interval cancers).

Prevalent cancer
The proportion of the population with cancer at a given point in time.

Screen
Includes mammography, or both clinical breast examination and mammography, delivered by a program.

Screening episode (completed)
A normal / negative screening episode is defined as the date of the last screen. For abnormal screens, the screening episode is completed at the date of first pathologic or cytologic (core or open surgical biopsy) diagnosis of cancer. Screening episode completion for benign cases is the last benign test up to 6 months following an abnormal screen. A "negative screening episode" can include all follow-up, provided that the end result is negative (normal).

Rescreening
Subsequent screening after the initial (first) screening under the program. This includes women who return after missing a scheduled round of screening.

Screen-detected cancer
Cancer detected as a result of a positive (abnormal) test with histologic confirmation attributed to the screening findings of the program.

Sojourn time
The time interval between the onset of detectable pre-clinical disease and symptomatic disease.

Total person-years at risk
Within a 12 or 24-month period after a negative (normal) screening episode, women are considered at risk for post-screen detected cancer. Women contribute a count in the denominator for each year or fraction of a year within the period of interest before a post-screen detected cancer or the next regular program screen.