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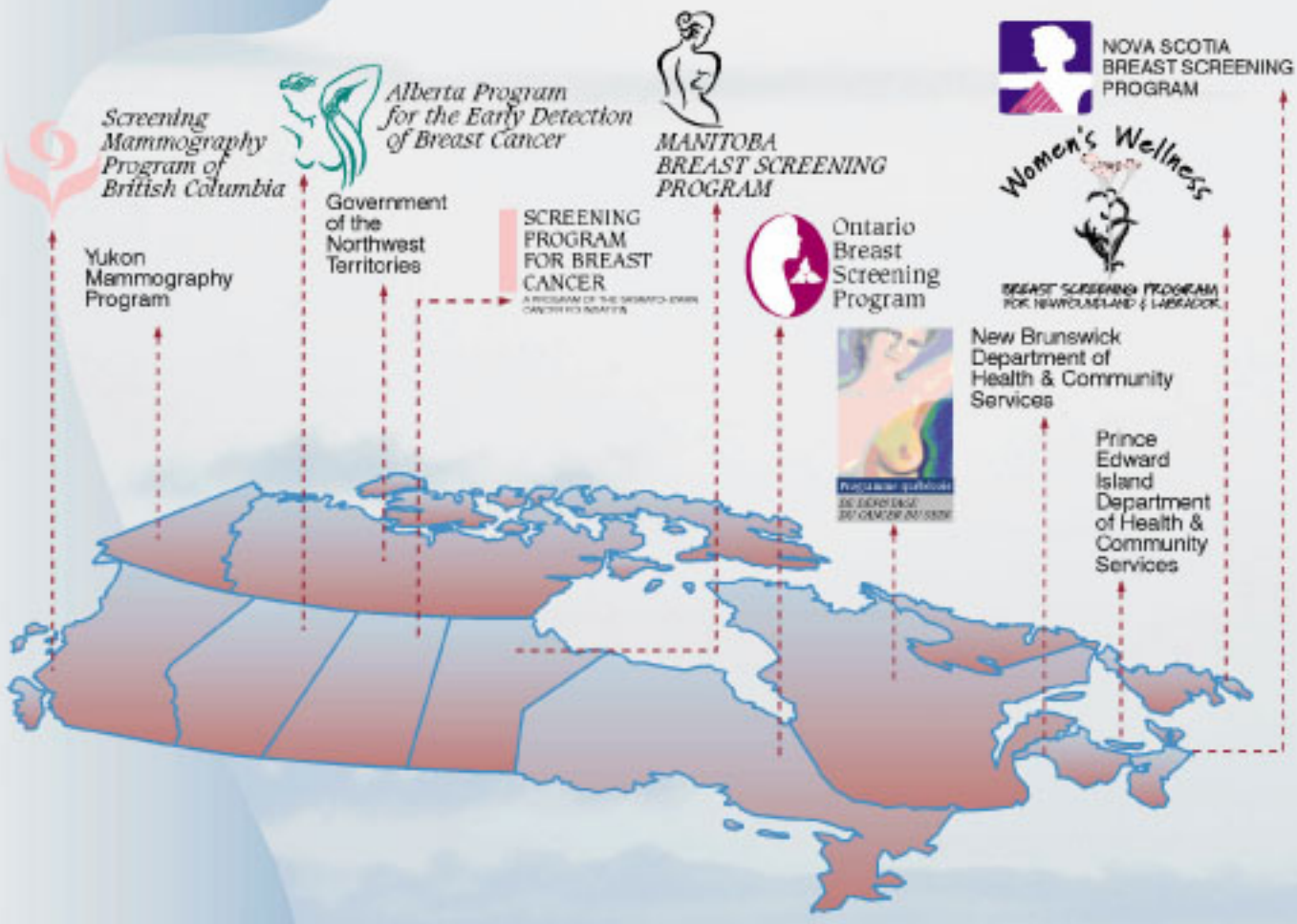
Organized Breast Cancer Screening Programs in Canada



1996 Report

Canada

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For additional copies of this report,
please contact the Cancer Bureau, Laboratory Centre for Disease Control:
(613) 957-0357; Fax: (613) 941-2057;
E-mail: cancer_bureau@hc-sc.gc.ca

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EXECUTIVE SUMMARY

Breast cancer is the most common cancer among Canadian women. Mammographic screening in women aged 50 to 69 years has been shown to reduce the rate of death from breast cancer by up to 40%. In 1988, the Conference of F/P/T Deputy Ministers of Health endorsed the recommendations from a National Workshop on the Early Detection of Breast Cancer that Canadian women aged 50 to 69 be offered mammography every 2 years through dedicated screening programs. In 1999, all 10 provinces and the Yukon have organized screening programs, and the Northwest Territories is in the process of implementing such a program.

This document is the first of a series of biennial reports on organized breast screening programs in Canada, using data from the Canadian Breast Cancer Screening Database. Data from the 1996 calendar year for seven provincial programs are presented. The number of screens occurring within organized screening programs has increased dramatically in the past decade; in 1996 there were 310,359 screens of 310,036 women in seven provinces. Despite the increase, recruitment of women in the target age group (50 to 69 years) remains a challenge. Participation rates within programs ranged from 10.6% to 54.2%. It is suggested that regular attendance by a minimum of 70% of women in the target age group is needed before a screening program will have its optimal effect on breast cancer death rates.

Aside from participation rates, program outcomes compare favourably with international standards. Breast cancers are being detected at a small size, when the prognosis is good. Among women aged 50 to 69, 51.8% of invasive cancers were less than 15 mm in diameter, and 76.6% of invasive cancers did not have lymph node metastases.

Future directions include ongoing expansion of organized screening within provinces and territories, and increased efforts to encourage participation of women within the target age group. Monitoring and evaluation of organized

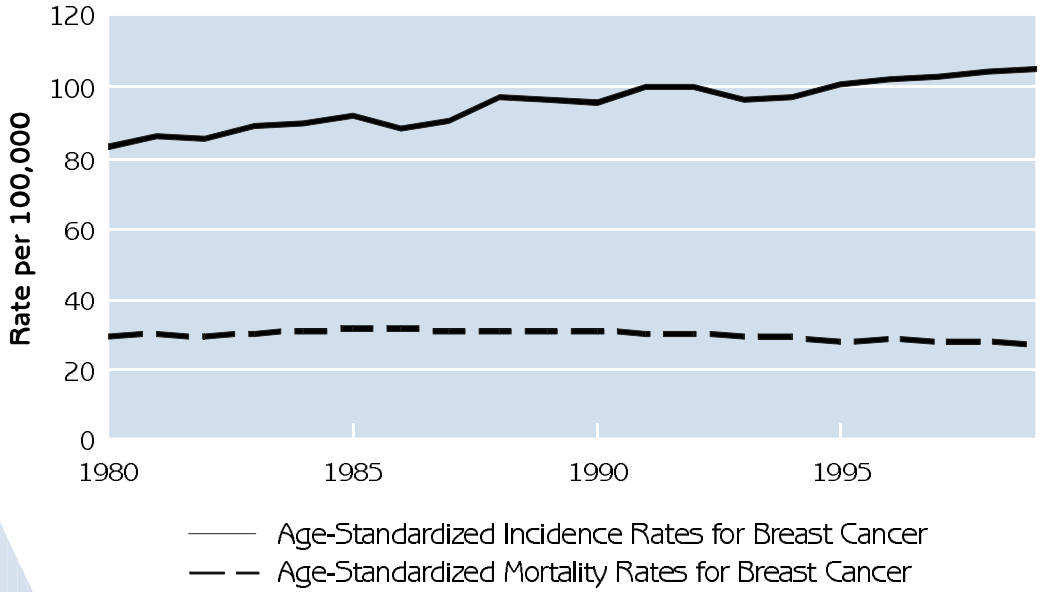
breast cancer screening in Canada will continue, with a biennial report of 1997/98 results planned for the year 2000. As well, representatives of organized programs are in the process of setting priorities for future research efforts in organized breast cancer screening.

BACKGROUND

Breast cancer is the most common cancer diagnosed in women in Canada. As a cause of cancer deaths, breast cancer ranks second to lung cancer. An estimated 18,700 new cases of breast cancer and 5,400 deaths from breast cancer will occur in Canada in 1999.[1] Age-adjusted incidence rates have increased steadily over the past decade, in part because of the greater use of mammography as a breast cancer screening tool. Mortality rates, however, have declined slightly since 1985[1] (see Figure 1).

Figure 1

Age-standardized incidence and mortality rates for breast cancer in Canada, 1980-1999



Source: National Cancer Institute of Canada: Canadian Cancer Statistics 1999, Toronto, Canada, 1999.

Characteristics associated with a higher risk of breast cancer include a family history of primary breast cancer, higher socioeconomic status, early age at menarche, late age at menopause, low parity, and late age at first full-term

pregnancy.[2] Few of these risk factors are easily modified, making primary prevention an unpromising option for reducing breast cancer incidence. Secondary prevention by mammographic screening, however, has been proven to reduce breast cancer deaths. The results of randomized trials have shown that screening can reduce the rate of death from breast cancer by up to 40% among women aged 50 to 69.[3-5]

Breast Cancer Screening in Canada

In March 1988, 28 representatives from government and key voluntary and professional groups from across Canada participated in the National Workshop on the Early Detection of Breast Cancer. The purpose of the workshop was to develop a Canadian position on breast cancer screening.[6]

Based on presentations and discussions of the evidence supporting breast cancer screening, the following recommendation was made: *Canadian women aged 50 to 69 should be offered and encouraged to participate in an early detection program consisting of mammography, physical examination of the breasts by a health care professional, and the teaching and monitoring of breast-self examination every 2 years. Such a program should be offered through dedicated screening centres*.[6]

Dedicated screening centres were recommended because they were identified as the best way to ensure identification and recruitment of the target group, standardization, quality control, appropriate follow-up of women with abnormal findings, and lowest unit cost. In the workshop report, the essential components of a dedicated screening centre are described.[6] Of particular importance are procedures for identification and recruitment of the target group, an effective referral system once an abnormality has been detected, and procedures for evaluating and monitoring the programs. These recommendations were endorsed by the Conference of F/P/T Deputy Ministers of Health in December 1988.

In December 1992, the federal government announced the Canadian Breast Cancer Initiative (CBCI), with a total budget of $25 million over 5 years. One of the first events was the National Forum on Breast Cancer, held in November 1993. The goal of the Forum was to identify priorities to be addressed in the areas of breast cancer research, prevention and screening, treatment and care,

and networking and advocacy. In the area of screening, one of the recommendations was as follows: *To ensure that mammography screening in all provinces and territories is carried out within the context of an organized program which has the following essential components: a population-based outcome goal, information about the target population, special emphasis on hard-to-reach groups (including rural communities), meticulous quality assurance, including equipment and interpretation, outcome data and analysis, information systems and linkages, a woman-centred focus and excellent coordination, with high quality diagnosis and follow-up*.[7] In addition, it was recommended that a national database derived from mammographic screening programs across the country be developed and maintained to allow monitoring and evaluation of breast cancer screening in Canada.[7]

On the basis of the recommendations of the Forum, the Canadian Breast Cancer Screening Initiative (CBCSI), one of the six programmatic components of the CBCI, was structured and is active in providing support and coordination for organized breast cancer screening programs in Canada. As well, it was with the support of the CBCSI that the Canadian Breast Cancer Screening Database was established.

Organized Screening Programs in Canada

British Columbia was the first province to institute a provincial breast screening program in 1988, followed closely by Alberta, Saskatchewan, Yukon, Ontario, and Nova Scotia (see Table 1). Currently, all 10 provinces and the Yukon have organized breast screening programs. The Northwest Territories is in the process of implementing such a program. Breast cancer screening in all organized programs includes a two view screening mammogram. Manitoba, Ontario, and Newfoundland also provide a clinical breast examination (CBE) carried out by a trained health professional, and Nova Scotia and Prince Edward Island provide a modified CBE by a technologist. In addition, all programs provide information and/or instruction on breast self-examination.

For the purposes of the Canadian Breast Cancer Screening Database, the target population is defined as asymptomatic women between the ages of 50 and 69 with no prior diagnosis of breast cancer. Some programs also screen women

Table 1
Breast Cancer Screening Programs in Canada; Usual Practices in 1996

Program	Program Start Date	Mammography Interval	Clinical Breast Exam on Site	Target Population, Age
British Columbia*	1988	Annual	No	50-74
Yukon	1990	Biennial	No	50-69
Alberta	1990	Biennial	No	50-69
Saskatchewan	1990	Biennial	No	50-69
Manitoba	1995	Biennial	Nurse or technologist	50-69
Ontario	1990	Biennial	Nurse	50-69
New Brunswick	1995	Biennial	No	50-69
Nova Scotia	1991	Biennial	Technologist	50-69
Newfoundland	1996	Biennial	Nurse	50-69
Breast Cancer Screening Programs Started After 1996				
Quebec	1998	Biennial	No	50-69
Prince Edward Island	1998	Biennial	Technologist	50-69

* In mid-1997 British Columbia changed its recall frequency for women aged 50+ years to biennial.

outside the target age groups. Provincial/territorial practices with regard to women outside the ages of 50 to 69 are presented in Table 2.

The Screening Process

Figure 2 describes the pathway of a woman s contact with an organized breast cancer screening program. Women enter the program by physician referral, personal invitation from the screening program, or self-referral. The screening visit includes a screening mammogram and, depending on the program, a clinical breast examination and instruction in breast self-examination. The results of the screening visit are communicated to the woman and her physician. If the screening visit is normal (negative screening result), the woman is advised to return for her next screening visit after the program s recommended screening interval (1 or 2 years). If the screening visit is abnormal (positive

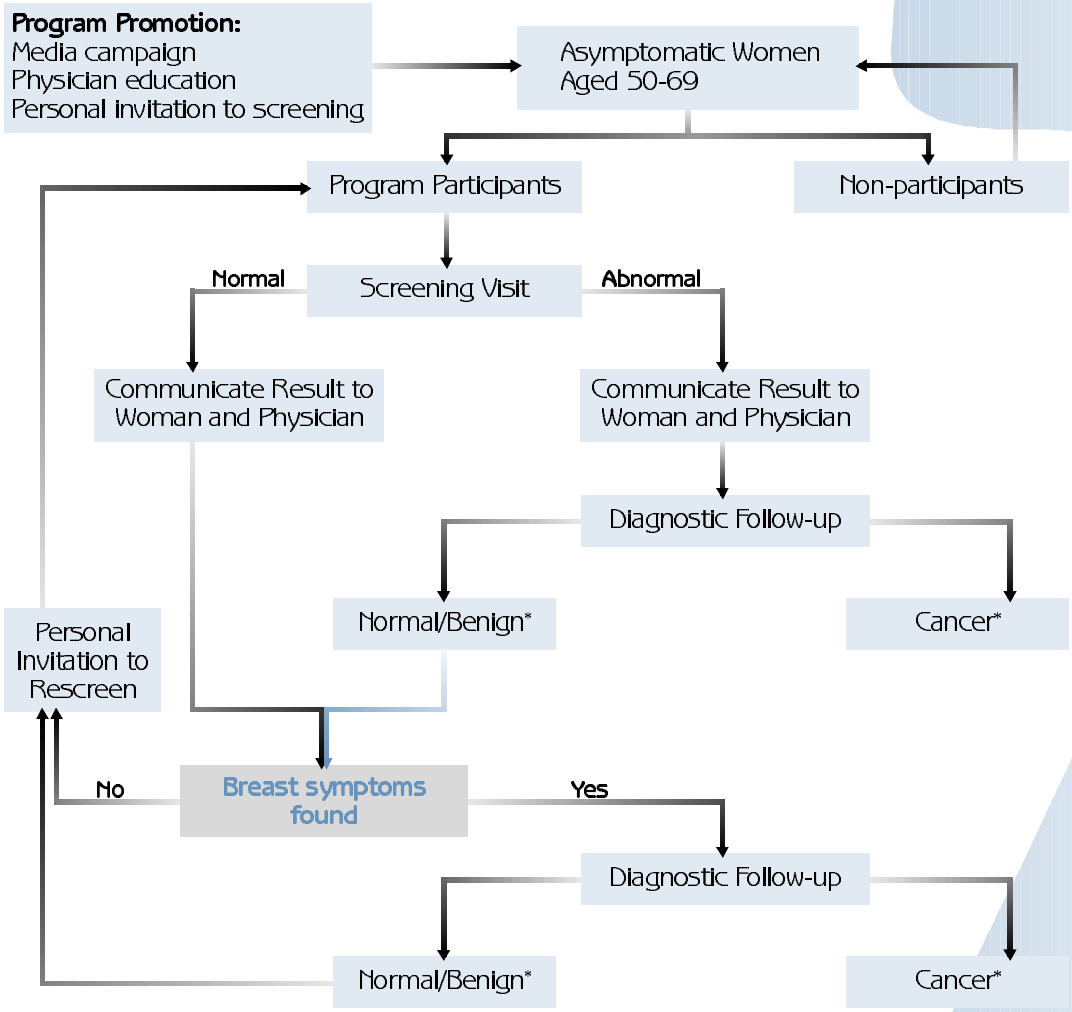
Table 2
Breast Cancer Screening Programs in Canada; Practices Regarding Women Outside the Target Age Group in 1996

Program	Program Practices Regarding Women Outside Target Age Range		Mammography Interval
British Columbia*	40-49	Accept but do not actively recruit	Annual
	75-79	Recall but do not actively recruit	Annual
	80+	Accept but do not recall	
Yukon	40-49	Accept but do not actively recruit	Biennial
	70+	Accept but do not recall	Biennial
Alberta	40-49	Accept but do not actively recruit	Biennial
	70-74	Recall but do not actively recruit	Biennial
	75+	Accept but do not recall	
Saskatchewan	40-49	Do not accept for screening	N/A
	70+	Recall but do not actively recruit	Biennial
Manitoba	40-49	Do not accept for screening	N/A
	70+	Do not accept for screening	N/A
Ontario	40-49	Do not accept for screening	N/A
	70+	Accept but do not recall	Biennial
New Brunswick	40-49	Accept with physician referral	Biennial
	70+	Accept with physician referral	Biennial
Nova Scotia	40-49	Accept but do not actively recruit	Annual
	70+	Recall but do not actively recruit	Biennial
Newfoundland	40-49	Do not accept for screening	N/A
	70-74	Recall but do not actively recruit	Biennial
Breast Cancer Screening Programs Started After 1996			
Quebec	40-49	Accept with physician referral	Biennial
	70+	Accept with physician referral	Biennial
Prince Edward Island	40-49	Accept but do not actively recruit	Annual
	70-74	Recall but do not actively recruit	Biennial

* In mid-1997 British Columbia changed its recall frequency for women aged 50+ from annual to biennial and changed the age at which it stops accepting women from no upper limit to age 79.

screening result), she is referred by her physician for diagnostic follow-up, which may include tests such as diagnostic mammograms, ultrasounds, and biopsies. The diagnostic follow-up is complete when a final diagnosis is reached, either normal/benign or cancer. Some women who are screened in the program will have breast cancer detected outside the screening program. For example, symptoms may develop in the interval before their next screening visit.

Figure 2
Pathway of a breast cancer screening program



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

Monitoring and Evaluation

The goal of breast cancer screening is a reduction in breast cancer deaths. A reduction of up to 40% is expected to be observed after 7 to 10 years from the point when regular attendance by 70% of women in the target age group is achieved.[3-5] Interim measures have been identified that can help determine whether a program is on course in leading to a reduction in breast cancer deaths.

On the basis of the results from a Swedish randomized trial of breast screening, Day, Williams and Khaw[8] identified three measures that are important to monitor: compliance measures, screening characteristics such as cancer detection rate at first screen, and rate of advanced cancers. Achieving a favourable outcome in each of these interim measures is necessary before breast cancer screening programs can achieve reductions in breast cancer mortality. Other interim measures identified as helpful in monitoring programs are the evaluation of test performance and a description of diagnostic work-up. Similarly, Tabar et al[9] developed specific targets for screening programs based on a Swedish randomized trial of mammographic screening for breast cancer. These targets are presented in Table 3 along with the standards set by the Europe Against Cancer Programme,[10] the United Kingdom NHS Breast Screening Programme,[11] and the Australian National Program for the Early Detection of Breast Cancer.[12] While national standards or indicators have not been adopted in Canada, provincial/territorial screening programs aim to achieve the standards set by other organized programs and monitor their performance accordingly.

Canadian Breast Cancer Screening Database

The Canadian Breast Cancer Screening Database (CBCSD) was established in 1993. The goal of this national breast screening surveillance system is to monitor and evaluate breast cancer screening across Canada. The data collected by the CBCSD enable generation of national statistics, comparison of data interprovincially and internationally, and the provision of a large database for program-related research.

The CBCSD is managed and advised by the Database Management Sub-Committee, which includes representation from Health Canada and the directors of provincial/territorial breast screening programs and which reports to the

Table 3
Standards for Breast Screening Programs

Indicator	Tabar et al, 1992[9]	Europe[10]	United Kingdom[11]	Australia[12]
Attendance rate		≥ 60% (ages 50-64)	≥ 70% (ages 50-64)	70% (ages 50-69)
Abnormal recall rate (%)				
Initial screen	≤ 9	< 7	< 10	< 10
Rescreen	(overall)	< 5	< 7	< 5
Cancer detection rate				
Initial screen	≥ 3xIR*	≥ 3xIR*	≥ 2.7** per 1,000***	> 50 in 10,000
Rescreen	(overall)	1.5xIR*	≥ 3.0** per 1,000***	> 20 in 10,000
Benign to malignant biopsy ratio				
Initial screen	< 3:1	< 2:1		≤ 2:1
Rescreen	(overall)	< 1:1		≤ 1:1
Invasive cancers < 15 mm	> 50%	25% (≤ 10 mm)	≥ 1.5 per 1,000 (initial) ≥ 1.65 per 1,000 (rescreen)	> 8 per 10,000 (≤ 10 mm)
Rate of cancer without lymph node invasion (%)	≥ 70%			
Detected cancers that are in situ				
Initial screen			0.4 - 0.9 per 1,000***	10-20%
Rescreen			0.5 - 1.0 per 1,000***	
Rate of cancers presenting between screening episodes			1.2 per 1,000 screened women within 2 years of screen	< 6 per 10,000 screened women within 1 year of screen

* IR = expected incidence rate in the absence of screening

** Invasive cancers only, excludes cancers that are purely in situ (noninvasive or intraductal)

***Based on women between the ages of 50 to 52.9 attending for initial screen and women between the ages of 53 and 64.9 attending for rescreens

National Committee of the CBCSI. The Technical Sub-Committee develops and puts into effect strategies for uniform collection and sharing of data in the national database. The database is maintained by the Laboratory Centre for Disease Control (LCDC). Appendix 1 contains a list of the members of the Database Management Sub-Committee and the Technical Sub-Committee.

Memoranda of Understanding (MOU) exist between LCDC and 11 of the organized screening programs. The MOU clarifies issues of ownership, access, accountability, and confidentiality with respect to data collected under the auspices of the national database.

For each woman screened, information is collected on risk factors for breast cancer, screening history, screening results, referral status (referred for diagnostic follow-up or not), diagnostic tests, and the final diagnosis for all women referred for diagnostic follow-up. Each provincial program also collects data on cancers among women participating in the program that were not detected through the screening process (non-program detected cancers, i.e. non-compliant or interval cancers). Personal identifiers are not collected at the national level.

Provincial/territorial breast screening programs strive for data completeness and accuracy through the use of extensive quality management practices. A survey of quality assurance practices conducted in 1996[13] found that all provincial breast screening programs practice quality management in such areas as training and documentation; client tracking; and data integrity, availability, and confidentiality. This attention to quality is continued at the national level, where the data must first meet the database s business rules, which include range, value list, and logic checks before the data are loaded onto the database. Regular analyses and reporting of data at the national level provide an additional check of the data s integrity.

As of 1998, the database contains screening information from the following programs: British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Nova Scotia, New Brunswick, and Newfoundland for all years since their inception. Quebec, Prince Edward Island, and the Northwest Territories have implemented programs and will be submitting data to the CBCSD within the next 2 years. Plans are under way to involve the participation of the Yukon.

1996 RESULTS

This report presents selected statistics for the 1996 calendar year using data submitted to the CBCSD up to February 1999. Unless otherwise noted, the summary statistics for all programs include data from the following provinces: British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Nova Scotia, and Newfoundland. New Brunswick could not be included because of incomplete data.

Participation in Screening Programs

The number of screens in 1996 totals 310,359 among 310,036 women for all programs. As noted in Table 4, this represents a substantial increase in the number of screens from 1988, when the first province (British Columbia) began with 4,475 screens.

Despite the increase in the number of screens over the past decade, recruitment of women in the target age range continues to pose a challenge (Figure 3). Day et al[8] state that the effect of a program on rates of breast cancer death depends

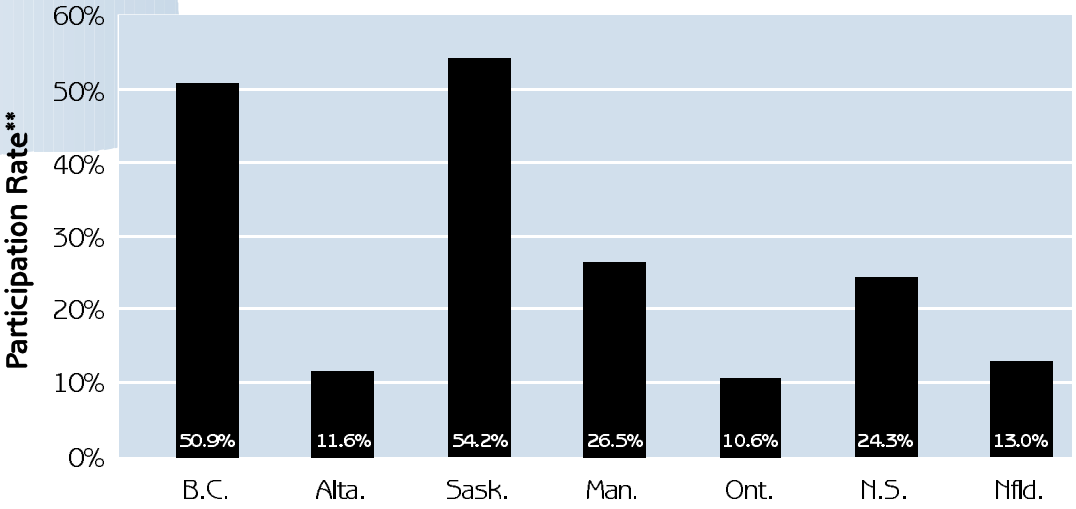
Table 4
Annual Screening Volume by Program, Program Start to 1996

Program	1988	1989	1990	1991	1992	1993	1994	1995	1996
British Columbia	4,475	9,371	22,983	55,882	83,963	104,375	123,875	150,241	166,744
Alberta			616	5,873	15,442	16,148	15,373	14,182	14,696
Saskatchewan			6,355	14,305	15,778	26,056	25,539	29,604	28,891
Manitoba								2,671	13,598
Ontario			591	15,404	40,333	45,592	55,494	58,316	67,763
Nova Scotia				1,876	4,354	4,889	8,461	12,492	15,548
Newfoundland									3,119
Total	4,475	9,371	30,545	93,340	159,870	197,060	228,742	267,506	310,359

directly on the proportion of the target population that is screened. Low participation is problematic not only for program efficacy but also because women who do not participate are likely to be at a higher risk of dying from the disease. Breast screening programs in Australia and the U.K. have a minimum standard of regular attendance of 70% of women in their target age group (see Table 3).

Figure 3

Proportion of target population* who participated in provincial breast cancer screening programs in 1996



* Target population is defined as the population of women aged 50-69. Estimates were derived from Statistics Canada's Population Projections for Canada, Provinces and Territories 1993-2016. The population estimates were halved to approximate participation rates at least once every 2 years.

** Participation Rate is the number of women aged 50-69 at screening in 1996 who participated in the breast screening programs as a percentage of the target population.

None of the provincial programs achieved a 70% participation rate in 1996. Saskatchewan had the highest participation rate, with 54.2% of women in the target age group screened in that year. In contrast, Ontario had the lowest participation rate, of 10.6%. These figures, however, do not represent the complete picture of breast cancer screening in Canada. A large proportion of women in the target age group still have mammograms outside of organized breast screening programs.[14] In 1994, in Saskatchewan and British Columbia, over half of all bilateral mammograms performed on women between the ages of 50 and 69 were conducted through organized breast screening programs. In other provinces, most mammography provided to women in the target age group

occurred outside of organized screening programs.[14] However, there are no systematically collected data that enable assessment of the performance of opportunistic screening mammography. With the expansion of provincial/territorial screening programs, the number of women participating in organized screening is expected to continue increasing.

Recruitment and Retention

Recruitment of women and retention of previously screened women are two key objectives of screening programs, although methods vary across programs. In 1996, Alberta, Saskatchewan, and Manitoba sent letters of invitation to women in the target age group based on a population list (usually health insurance files). In Ontario, letters of invitation were sent to women using mainly physicians patient lists; in Nova Scotia, physicians were urged to send letters to women; and in British Columbia, letters of invitation were sent to a limited number of women in specific communities. In addition to those who received a letter of invitation, women attending for the first time included women referred by their physician and women who were self-referred.

Table 5 provides information on the number of initial (first screens) and subsequent screens (rescreens) by age group. The percentage of total screens within the target age group (50-69 years) varies between 51.9% and 99.9% according to province.

Results of Screening

An important requirement of mammographic screening is high specificity the probability of a negative screening result if the disease is truly absent. This minimizes the number of healthy women who are informed that their screen was abnormal and who are then subjected to further diagnostic investigations, which can cause psychological distress and financial costs to the woman and society. Figure 4 indicates that between 11% and 12.4% of first screens were reported as abnormal. For rescreens, the abnormal recall rate was much lower (5.1% to 5.7%). The abnormal recall rate differed little among age groups.

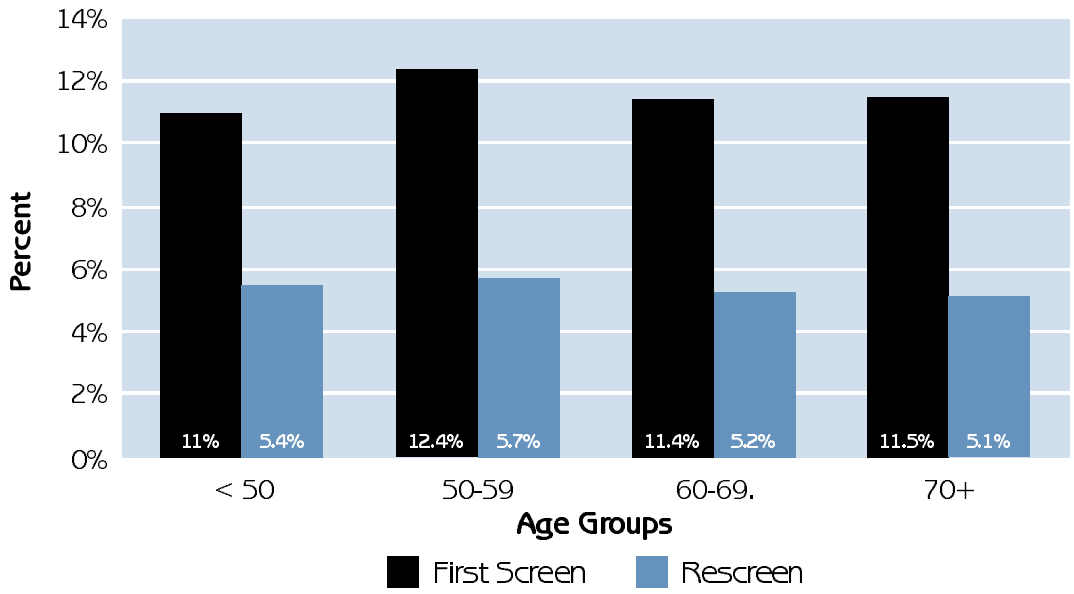
Table 5
Distribution of Screens by Program According to Age Group, 1996

Program	Age Group				
	< 50* n (%)	50-59 n (%)	60-69 n (%)	70 + n (%)	All Ages N
British Columbia					
First screens	20,216 (48.2)	10,106 (24.1)	7,057 (16.8)	4,597 (11.0)	41,976
Rescreens	35,169 (28.2)	38,549 (30.9)	30,762 (24.7)	20,288 (16.3)	124,768
Total screens	55,385 (33.2)	48,655 (29.2)	37,819 (22.7)	24,885 (14.9)	166,744
Alberta					
First screens	442 (11.0)	1,920 (47.9)	1,357 (33.8)	290 (7.2)	4,009
Rescreens	109 (1.0)	3,914 (36.6)	5,231 (48.9)	1,433 (13.4)	10,687
Total screens	551 (3.7)	5,834 (39.7)	6,588 (44.8)	1,723 (11.7)	14,696
Saskatchewan					
First screens	953 (15.8)	3,308 (54.8)	1,299 (21.5)	474 (7.9)	6,034
Rescreens	0	8,684 (38.0)	10,043 (43.9)	4,130 (18.1)	22,857
Total screens	953 (3.3)	11,992 (41.5)	11,342 (39.3)	4,604 (15.9)	28,891
Manitoba					
First screens	65 (0.5)	6,779 (50.5)	6,134 (45.7)	456 (3.4)	13,434
Rescreens	0	76 (46.3)	73 (44.5)	15 (9.1)	164
Total screens	65 (0.5)	6,855 (50.4)	6,207 (45.6)	471 (3.5)	13,598
Ontario					
First screens	159 (0.7)	13,072 (54.3)	7,194 (29.9)	3,656 (15.2)	24,081
Rescreens	0	16,397 (37.5)	17,874 (40.9)	9,411 (21.5)	43,682
Total screens	159 (0.2)	29,469 (43.5)	25,068 (37.0)	13,067 (19.3)	67,763
Nova Scotia					
First screens	2,308 (35.6)	2,550 (39.4)	1,408 (21.7)	211 (3.3)	6,477
Rescreens	2,323 (25.6)	3,819 (42.1)	2,616 (28.8)	313 (3.5)	9,071
Total screens	4,631 (29.8)	6,369 (41.0)	4,024 (25.9)	524 (3.4)	15,548
Newfoundland					
First screens	2 (0.1)	2,114 (68.1)	989 (31.8)	1 (0.03)	3,106
Rescreens	0	7 (53.8)	6 (46.2)	0	13
Total screens	2 (0.1)	2,121 (68.0)	995 (31.9)	1 (0.03)	3,119
All Programs					
First screens	24,145 (24.4)	39,849 (40.2)	25,438 (25.7)	9,685 (9.8)	99,117
Rescreens	37,601 (17.8)	71,446 (33.8)	66,605 (31.5)	35,590 (16.8)	211,242
Total screens	61,746 (19.9)	111,295 (35.9)	92,043 (29.7)	45,275 (14.6)	310,359

* Age is not rounded. For programs that do not screen women under the age of 50, this age group includes women who were 49 at the time of screen, but were invited to participate in the program because they were turning 50 that year.

The rate of abnormal screens was slightly higher for first screens in comparison with standards set by other national breast screening programs (see Table 3), which specify that less than 7-10% of first screens should be abnormal. However, these programs use mammography as the sole modality of screening, whereas several Canadian programs also use clinical breast examination. Table 6 shows that, with the exception of women under 50, the use of clinical breast examination accounted for approximately one fifth of the abnormal screens. For those over 50 years of age, the rates of abnormalities detected by mammography only are in line with the standards set by the U.K. and the Australian breast screening programs.

Figure 4
Abnormal recall rate* by age group, 1996



* Includes mammography and clinical breast examination as screening modalities.

Diagnostic Investigations

Screening provides only enough information to determine whether the screening visit is normal or whether further evaluation is necessary. Diagnostic tests are needed to arrive at a final diagnosis. Information on diagnostic procedures is available for 95.8% of women who had an abnormal screening visit in 1996. The remaining 4.2% were lost to follow-up or are still in the process of follow-up.

Table 6
Abnormal Recall Rates by Mode of Detection, 1996

Mode of Detection	< 50 %	50-59 %	60-69 %	70+ %	All Ages %
Abnormal by mammography alone					
First screens	10.6	9.0	8.1	8.6	9.1
Rescreens	5.2	4.5	4.1	3.9	4.4
Abnormal by mammography and CBE*					
First screens	0.2	0.9	0.8	0.8	0.7
Rescreens	0.1	0.3	0.2	0.2	0.2
Abnormal by CBE* alone					
First screens	0.1	2.5	2.5	2.1	1.9
Rescreens	0.0	0.9	0.9	0.9	0.8
All modes of detection**					
First screens	10.9	12.4	11.3	11.5	11.7
Rescreens	5.3	5.7	5.2	5.0	5.4

* Manitoba, Ontario, Nova Scotia, and Newfoundland provide CBE by a nurse or technologist and of these programs all but Nova Scotia restrict program participation to women aged 50 and older.

** Rates may be slightly different from those in Figure 4 as a result of rounding error.

Programs differ in their definition of completed follow-up: some programs report follow-up as complete before all staging information is available, and others wait for all details of the final diagnosis. Loss to follow-up can occur when a woman refuses follow-up testing, moves out of the region, or the attending physician declines to provide the follow-up information. The proportion of abnormal screens with completed follow-up differed by province (87.9% to 99.9%).

Diagnostic procedures typically involve further imaging techniques (diagnostic mammogram and/or ultrasound), fine needle aspiration, or core biopsy before surgical biopsy is resorted to.[9] Table 7 provides information on the types of procedures received in 1996 and how these varied by province. The most common procedure performed was a diagnostic mammogram (57.3% of all procedures), followed by ultrasound (27.4%). A further 3.3% of procedures were fine needle aspirations, and 13.4% involved some type of biopsy: 10.7% were open biopsies with or without fine wire localization, and 2.7% were core biopsies.

Table 7
Types of Diagnostic Procedure by Age Group, 1996

Procedure	Age Group				
	< 50 n (%)* Range**	50-59 n (%) Range	60-69 n (%) Range	70+ n (%) Range	All Ages N (%) Range
Diagnostic mammogram	3,913 (58.8) 47.2 - 59.3	6,385 (56.6) 49.1 - 61.2	4,430 (57.0) 47.9 - 62.9	2,096 (57.5) 48.4 - 67.1	16,824 (57.3) 48.8 - 60.7
Ultrasound	1,922 (28.9) 27.5 - 36.8	3,226 (28.6) 14.5 - 33.1	2,035 (26.2) 12.6 - 31.8	871 (23.9) 10.0 - 26.4	8,054 (27.4) 13.6 - 30.9
Fine needle aspiration	243 (3.7) 0.5 - 5.6	362 (3.2) 0.2 - 8.5	244 (3.1) 0 - 8.5	112 (3.1) 0 - 4.3	961 (3.3) 0.2 - 8.4
Core biopsy	127 (1.9) 1.1 - 12.5	303 (2.7) 0.4 - 14.8	225 (2.9) 0.6 - 20.3	131 (3.6) 0 - 25.8	786 (2.7) 0.5 - 15.5
Open biopsy with or without fine wire localization	480 (7.2) 2.1 - 9.4	1,210 (10.5) 5.2 - 16.2	998 (12.6) 6.5 - 23.9	503 (13.5) 9.7 - 18.6	3,191 (10.7) 5.4 - 18.1

* All provinces combined
** Range between provinces, reported as a percentage of total tests within age group

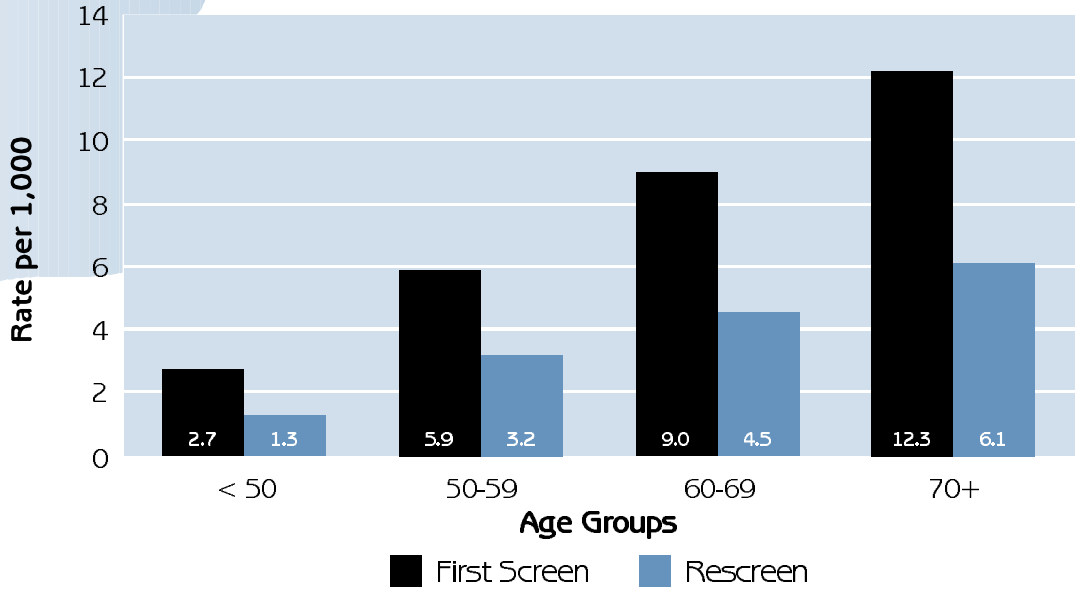
The proportion of tests performed varied among provinces (Table 7). Reasons for these variations may include the use of clinical breast examination as a screening modality, an actual difference in the assessment process among provinces, or different methods for obtaining and recording test result information. Although data were collected on surgical consultations and physical examination by the family doctor, these figures are not presented because of inconsistent definitions and data collection procedures across provinces.

Cancer Detection

The cancer detection rate was higher among women having their first screen as compared with subsequent screens (Figure 5). The cancer detection rate increased with advancing age for both first screens and rescreens.

As shown in Table 8, few cancers were detected by clinical breast examination alone. Among women 50 and over, the cancer detection rates compare well with standards set by the U.K. and Australia (see Table 3).

Figure 5
Cancer detection per 1,000 screens by age group, 1996



Screening activity in 1996 resulted in the detection of 1,443 breast cancers, 82.7% of which were invasive (Table 9). The remaining 17.3% of cancers were ductal carcinoma in situ (DCIS). DCIS occurs when the cancer cells are located within a milk duct and there is no invasion of the surrounding fatty breast tissue. The proportion of screen-detected cancers that were DCIS declined with increasing age. The overall proportion of in situ cancers (17.3%) lies within the standards developed by the Australian program (10%-20%). It is important that most of the cancers detected are small invasive ones rather than in situ cancers, because the detection of a large number of in situ cancers may not result in a reduction in breast cancer mortality.[9]

The primary objective of screening is to detect invasive cancers before they have had a chance to spread in the body. This involves detecting breast cancers at a small size (< 15 mm diameter) and without axillary (armpit) lymph node involvement at diagnosis. Stage, tumour size and nodal involvement are three

Table 8
Cancer Detection Rates per 1,000 Screens by Mode of Detection, 1996

Mode of Detection	< 50	50-59	60-69	70+	All Ages
Detected by mammography alone					
First screens	2.2	4.4	7.2	9.0	5.0
Rescreens	1.3	2.8	3.8	5.3	3.3
Detected by mammography and CBE*					
First screens	0.5	1.3	1.6	3.2	1.4
Rescreens	0.03	0.4	0.6	0.6	0.4
Detected by CBE alone*					
First screens	0.04	0.2	0.3	0.1	0.2
Rescreens	0	0.01	0.1	0.2	0.06
All modes of detection**					
First screens	2.7	5.9	9.1	12.3	6.6
Rescreens	1.3	3.2	4.5	6.1	3.8

* Only Manitoba, Ontario, Nova Scotia and Newfoundland provide CBE by a nurse or technologist.
** Rates may be slightly different from those in Figure 5 because of rounding error.

outcomes that allow programs to measure the extent of invasive cancer at the time of diagnosis. In terms of these outcomes, Canadian breast screening programs compare favourably with previously established standards and guidelines. Tabar et al[9] state that to achieve a substantial reduction in mortality, 50% of screen-detected invasive cancers should be less than 15 mm in diameter, and at least 70% of screen-detected tumours should not have lymph node metastases. Within Canadian breast screening programs, of invasive cancers detected, 50.8% were less than 15 mm and 77.7% did not have lymph node metastases.

The guidelines developed by Tabar et al[9] and national programs such as those in the U.K.[11] and Australia[12] were developed for women in target age groups (i.e. 50-64 or 50-69). As Table 9 shows, outcomes from Canadian provinces are particularly favourable for women between the ages of 50 and 69 years.

Summary of Outcomes

Table 10 summarizes outcomes among women within the target age group (50-69 years) by province. The large variation in the proportion of first screens is

Table 9
Characteristics of Cancers Detected by Age Group, 1996

	< 50		50-59		60-69		70+		All Ages	
	n	%	n	%	n	%	n	%	N	%
Number of cancers										
Invasive	83	71.6	375	81.0	445	84.3	290	86.3	1,193	82.7
DCIS	33	28.5	88	19.0	83	15.7	46	13.7	250	17.3
TNM staging										
0 (in situ)	31	29.8	67	21.4	59	16.3	32	15.8	189	19.3
I	36	34.6	152	48.6	210	58.2	125	61.9	523	53.4
II	25	24.0	79	25.2	72	19.9	39	19.3	212	21.6
III+	12	11.5	15	4.8	20	5.5	6	3.0	56	5.7
(# unknown)	(12)		(150)		(167)		(134)		(463)	
Tumour size (invasive only)										
≤ 5 mm	4	4.9	29	9.0	20	5.2	22	8.5	75	7.2
6-10 mm	16	19.8	85	26.3	119	31.2	78	30.0	298	28.5
11-15 mm	23	28.4	85	26.3	115	30.1	88	33.8	311	29.7
16-20 mm	13	16.1	61	18.9	65	17.0	38	14.6	177	16.9
21+ mm	25	30.9	63	19.5	63	16.5	34	13.1	185	17.7
(# unknown)	(2)		(52)		(63)		(30)		(147)	
Median tumour size	15	mm	14	mm	13	mm	13	mm	13	mm
Positive nodes (invasive only)										
0	49	66.2	244	73.5	306	79.3	208	84.2	807	77.7
1-3	17	23.0	62	18.7	54	14.0	30	12.2	163	15.7
4+	8	10.8	26	7.8	26	6.7	9	3.6	69	6.6
(# unknown)*	(9)		(43)		(59)		(43)		(154)	

* Includes missing values and cases in which dissection was not done.

a function of the length of time the program has been operating. Saskatchewan, with one of the longer running programs, had the lowest proportion of first screens (19.7%), while Newfoundland, whose program started in 1996, had the highest (99.6%). Abnormal recall rates varied among provinces: Alberta and Nova Scotia had the lowest abnormal recall rates; Manitoba, Ontario and Newfoundland, where screening visits include mammography and a clinical breast examination, had some of the highest. The higher abnormal recall rates found in Manitoba and Newfoundland may also reflect the fact that they were the two newest programs, starting in 1995 and 1996 respectively. Abnormal

Table 10
Screening Outcome Summary by Program, for Women 50-69 Years at Screening, 1996

Outcome	B.C.*	Alta.	Sask.	Man.**	Ont.**	N.S.***	Nfld.**	All
Number of screens	86,474	12,422	23,334	13,062	54,537	10,393	3,116	203,338
Number of first screens	17,163 (19.9%)	3,277 (26.4%)	4,607 (19.7%)	12,913 (98.9%)	20,266 (37.2%)	3,958 (38.1%)	3,103 (99.6%)	65,287 (32.1%)
Abnormal recall rate (%)								
1st screens	10.9	7.1	14.3	12.1	13.8	6.6	14.1	12.0
Rescreens	4.2	3.9	6.1	5.4	8.4	3.5		5.5
Number of cancers	316	73	116	103	320	46	17	991
Cancer detection rate per 1,000 screens								
1st screens	6.6	7.9	8.0	8.0	7.2	5.6	5.5	7.1
Rescreens	2.9	5.1	4.2		5.1	3.7		3.8
PPV of abnormal screening (%)	6.6	12.3	6.4	6.6	5.7	9.5	3.9	6.5
Benign to malignant open biopsy ratio	1.3:1	1.1:1	1.6:1	1.9:1	1.4:1	0.9:1	3.5:1	1.5:1
Benign to malignant core biopsy ratio	2.5:1	1.0:1			1.8:1	2.2:1		1.8:1

* The recall interval was annual in B.C. in 1996 and biennial in other provinces.
** Screening visit includes mammography and complete clinical breast examination.
*** Screening visit includes mammography and modified clinical breast examination by technician.

recall rates tend to decrease with each additional round of screening as a result of radiologists increased experience and the availability of previous films with which to compare current examinations.

Cancer detection rates in all provinces compare favourably with the standards used by the U.K. and Australian breast screening programs (see Table 3). Positive predictive values (PPV) were highest in Alberta and Nova Scotia, where the abnormal rates were the lowest. The biopsy yield ratios reflect the overall effectiveness of the diagnostic evaluation. Diagnostic techniques such as

mammography, ultrasound, fine needle aspiration or needle core biopsy should be used to the fullest before open biopsy is resorted to for diagnosis. With the exception of Newfoundland, provincial programs fall within the standards set by other countries (see Table 3), which indicate that the biopsy ratio of benign to malignant should be less than 2:1.

Table 11 summarizes outcomes by age group. Almost two-thirds of screens (65.5%) were within the target age group (50-69 years). As expected, the proportion of first screens was highest among women younger than 50 (39.1%) and lowest in women over 70 (21.4%). The rate of abnormal screens differed little by age group. The cancer detection rate increased with age, as did the positive predictive value of abnormal screening. Similarly, the benign to malignant biopsy ratio was high in women under 50, but improved with advancing age.

Table 11
Screening Outcome Summary by Age Group, 1996 (all programs combined)

Outcome	< 50	50-59	60-69	70+	All Ages
Number of exams	61,746	111,295	92,043	45,275	310,359
Number of first screens	24,145 (39.1%)	39,849 (35.8%)	25,438 (27.6%)	9,685 (21.4%)	99,117 (31.9%)
Abnormal recall rate (%)					
1st screens	11.0	12.4	11.4	11.5	11.7
Rescreens	5.4	5.7	5.2	5.1	5.4
Number of cancers	116	463	528	336	1,443
Cancer detection rate per 1,000 screens					
1st screens	2.7	5.9	9.0	12.3	6.6
Rescreens	1.3	3.2	4.5	6.1	3.8
PPV of abnormal screening (%)	2.5	5.2	8.3	11.6	6.3
Benign to malignant open biopsy ratio	4.9:1	1.9:1	1.1:1	0.7:1	1.5:1
Benign to malignant core biopsy ratio	3.5:1	2.3:1	1.3:1	0.9:1	1.8:1

Cancers Detected Outside of Programs

Occasionally, a participant of an organized screening program is given a diagnosis of breast cancer outside of the screening program. These cancers fall into two categories: interval and non-compliant. Interval cancers are those detected in the intervals between mammographic screening. Interval cancers can be further categorized into 1) missed cancers due to technical or observer error, 2) radiographically occult cancers, i.e. those that cannot be detected by screening or diagnostic mammography but are found by other techniques, 3) true interval cancers, for which even retrospectively no abnormalities could be detected in the most recent screen.[15] Non-compliant cancers are those detected after the program-specific recommended screening interval, when the woman does not return for a subsequent mammogram.

Provincial/territorial breast screening programs obtain information on cancers detected outside of the program through links to provincial/territorial cancer registries. Staging and pathological information is collected for these cancers, and previous mammographic films are reviewed. Radiologic and clinical audits of such cancers are important to improve the performance of breast cancer screening programs.

Complete information on cancers detected outside of screening programs is not yet available for women screened in 1996 because of the length of time needed for follow-up. For this reason, information is presented instead on women screened in 1993 (Table 12). Targets set by the U.K. Breast Screening Programme specify that not more than 12 per 10,000 women screened should present with cancer in the subsequent 24 months after screening. This target relates to women aged 50-64. Among Canadian provincial breast screening programs, 15.1 cancers per 10,000 screens among women of all ages, and 14.5 cancers per 10,000 screens among women aged 50-64 years were detected outside of programs within 24 months after screening.

Table 12
Cancers Detected Outside of Program Among Program Participants of All Ages, 1993*

Months After Screening	Interval cancers		Non-compliant cancers		
	≤ 12 months	13-24 months	25-36 months**	37-60 months**	Within 60 months**
Number of cancers detected	114	177	56	42	389
Rate per 10,000 women screened	5.9	9.2	2.9	2.2	20.2
Cumulative rate per 10,000 women screened	5.9	15.1	18.0	20.2	20.2

* Includes data from British Columbia, Alberta, Saskatchewan, and Ontario

** Cancers detected outside of program after 24 months represent non-compliant cancers, in which the woman did not return for a subsequent screen within the recommended interval.

SUMMARY AND FUTURE DIRECTIONS

This document is the first of a series of biennial reports on provincial/territorial organized breast screening programs in Canada using data from the Canadian Breast Cancer Screening Database (CBCSD). Organized screening ensures that meticulous quality assurance practices are in place and allows monitoring and evaluation of screening performance. Currently, all 10 provinces and the Yukon have organized screening programs, and the Northwest Territories is implementing an organized program.

Despite an increase in the number of women participating in breast screening programs over the past decade, participation of women in the target age group remains low, with participation rates in 1996 ranging from 10.6% to 54.2%. Participation is expected to increase in the coming years, as programs continue to expand their services and as the benefits of breast screening in organized settings are being recognized.

The 1996 results show that breast screening programs in Canada compare well with internationally established outcome indicators. Characteristics of screen-detected cancers, for example, fall within the ranges set by screening programs in other countries. Among women aged 50 to 69, 51.8% of invasive cancers were less than 15 mm in diameter, and 76.6% of invasive cancers did not have lymph node metastases. Detecting cancers when they are small and unlikely to have spread beyond the breast is necessary to achieve a reduction in breast cancer mortality.

A biennial report based on 1997/98 results is planned for the year 2000. As well, the database provides opportunities for more in-depth investigations of many aspects of organized screening, and has the potential to advance scientific knowledge in the area of breast cancer screening. Representatives from Health Canada and provincial programs are currently in the process of setting priorities for future research efforts.

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APPENDIX 1

Database Management Sub-Committee

Chair
Dr. Verna Mai
Division of Preventive Oncology
Cancer Care Ontario
620 University Avenue
Toronto, Ontario M5G 2L7

Dr. André Corriveau
Department of Health and Social Services
Government of the NWT
5022-49th Street, 6th Floor
Centre Square Tower
P.O. Box 1320
Yellowknife, Northwest Territory X1A 2L9

Dr. William Cunningham
Yukon Mammography Program
406 Lambert Street
Whitehorse, Yukon Y1A 1Z7

Dr. Ivo Olivotto
Screening Mammography Program of British Columbia
600 West 10th Avenue
Vancouver, B.C. V5Z 4E6

Dr. Heather Bryant
Alberta Cancer Board
c/o Room 382
Heritage Medical Research Building
3330 Hospital Drive N.W.
Calgary, Alberta T2N 4N1

Ms. Lois Harrison
Saskatchewan Cancer Agency
952 Albert Street
Regina, Saskatchewan S4R 2P7

Ms. Marion Harrison
Manitoba Breast Screening Program
5-25 Sherbrooke Street
Winnipeg, Manitoba R3C 2B1

Ms. Nicole Lefèbvre
Ministère de la Santé et des Services sociaux
Service de la prévention en santé
1075, chemin Ste-Foy, 3e étage
Québec, Québec G1S 2M1

Ms. Stephanie Smith
Dept. of Health and Community Services
520 King Street, 2nd Floor
Fredericton, New Brunswick E3B 5G8

Dr. Judy Caines
N.S. Breast Screening Program
5916 Emscote Drive
Halifax, Nova Scotia B3H 1B3

Dr. Kim Hender
Queen Elizabeth Hospital
Department of Diagnostic Imaging
P.O. Box 6600
Charlottetown, PEI C1A 8T5

Ms. Regina Sullivan
Breast Screening Program
Community Health
St. John s Region
P.O. Box 13122, Station A
20 Cordage Place
St John s, Newfoundland A1B 4A4

Dr. Françoise Bouchard
Cancer Control Assessment and
Surveillance Division
Cancer Bureau
Laboratory Centre for Disease Control
LCDC Building, Tunney's Pasture, PL 0602E2
Ottawa, Ontario K1A 0L2

Ms. Judy Snider
Cancer Control Assessment and
Surveillance Division
Cancer Bureau
Laboratory Centre for Disease Control
LCDC Building, Tunney's Pasture, PL 0602E2
Ottawa, Ontario K1A 0L2

Ms. Dana Paquette
Cancer Control Assessment and
Surveillance Division
Cancer Bureau
Laboratory Centre for Disease Control
LCDC Building, Tunney's Pasture, PL 0602E2
Ottawa, Ontario K1A 0L2

Technical Sub-Committee

Ms. Lona Heinzig
Department of Health and Social Services
Government of the NWT
5022-49th Street, 6th Floor
Centre Square Tower
P.O. Box 1320
Yellowknife, Northwest Territories
X1A 2L9

Ms. Laurel Baldwin
Yukon Mammography Program
406 Lambert Street
Whitehorse, Yukon Y1A 1Z7

Ms. Lisa Kan
Screening Mammography Program
of British Columbia
Suite 414, 750 West Broadway
Vancouver, British Columbia V5Z 1E2

Ms. Zeva Mah
Alberta Program for the Early Detection
of Breast Cancer
Suite 120, 1040 7th Avenue SW
Calgary, Alberta T2P 3G9

Mr. Jon Tonita
Saskatchewan Cancer Agency
4101 Dewdney Ave
Regina, Saskatchewan S4T 7T1

Ms. Kathleen Decker
Manitoba Breast Screening Program
25 Sherbrook St., Unit 5
Winnipeg, Manitoba R3C 2B1

Ms. Veronika Moravan
Ontario Breast Screening Program
Cancer Care Ontario
620 University Avenue
Toronto, Ontario M5G 2L7

Dr. Diane Major
Service provincial de dépistage
5636 des Aulnaies
Lévis, Québec G6V 5B4

Mr. Chris Heissner
Provincial Epidemiology Service
Public Health and Medical Services Div.
Dept. of Health and Community Services
520 King Street, 2nd Floor
Fredericton, New Brunswick E3B 5G8

Ms. Julie Gallant
Nova Scotia Breast Screening Program
Halifax Shopping Centre
Tower 1, Suite 103
7001 Mumford Road
Halifax, Nova Scotia B3L 4H6

Ms. Norah Smith
PEI Breast Screening Clinic
Queen Elizabeth Hospital
Department of Diagnostic Imaging
P.O. Box 6600
Charlottetown, PEI C1A 8T5

Mr. Greg Doyle
Newfoundland Breast Screening Program
20 Cordage Place. St John s, Newfoundland
A1B 4A4

Ms. Judy Snider
Cancer Control Assessment and
Surveillance Division
Cancer Bureau
Laboratory Centre for Disease Control
LCDC Building, Tunney's Pasture, PL 0602E2
Ottawa, Ontario K1A 0L2

Ms. Dana Paquette
Cancer Control Assessment and
Surveillance Division
Cancer Bureau
Laboratory Centre for Disease Control
LCDC Building, Tunney's Pasture, PL 0602E2
Ottawa, Ontario K1A 0L2

M. Alex Madramootoo
Information Management Division
Bureau of Surveillance and Field Epidemiology
Laboratory Centre for Disease Control
LCDC Building, Tunney's Pasture, PL 0602C
Ottawa, Ontario K1A 0L2